RADICAL ATOMS
and the alchemists of our time

ARS ELECTRONICA 2016
FESTIVAL FOR ART, TECHNOLOGY, AND SOCIETY

ARS ELECTRONICA

HATJE CANTZ

RADICAL ATOMS

and the alchemists of our time

Edited by Gerfried Stocker / Christine Schöpf / Hannes Leopoldseder

Cover illustration: Lunart; Drone 100—Intel in collaboration with
Ars Electronica Futurelab holds the world record in the
category Most Unmanned Aerial Vehicles (UAVs)
Airborne Simultaneously. Photo credit: Intel Corporation

Changes and typographical errors reserved.

PEFC
PEFC/06-39-27
This product is from
sustainably managed
forests and controlled sources.

printed climate-neutrally ○
CP IKS-Nr.: 53401-1508-1002

ARS ELECTRONICA

Ars Electronica 2016
Festival für Kunst, Technologie und Gesellschaft
Festival for Art, Technology and Society

Organization
Ars Electronica Linz GmbH

Managing Directors
Gerfried Stocker, Diethard Schwarzmair
Ars-Electronica-Straße 1, 4040 Linz, Austria
Tel: +4373272720
Fax: +4373272722
info@aec.at

Co-organizers

ORF Oberösterreich
Director: Kurt Rammerstorfer

LIVA—Veranstaltungsgesellschaft m.b.H.
Directors: Hans-Joachim Frey, Thomas Ziegler

OK Offenes Kulturhaus im OÖ Kulturquartier
Directors: Martin Sturm, Gabriele Daghofer

Partners
Anton Bruckner Privatuniversität
BOZAR Centre for Fine Arts Brussels
bug`n`play
c3
Campus Genius Award
Central Linz
Centre for the promotion of science
Crossing Europe
CUBUS
DIG gallery
Europe for Festivals, Festivals for Europe (EFFE)
Empowerment Informatics
Etopia
European Southern Observatory (ESO)
European Space Agency (ESA)
eutema
FAB Verein zur Förderung von Arbeit und Beschäftigung
Fachhochschule Oberösterreich – Campus Hagenberg
Filmakademie Baden-Württemberg
FMX 2016—Conference on Animation, Effects, Games and Transmedia
GameStage
Gebärdenwelt.tv
GV Art London
Interface Cultures
International Students Creative Award
Japan Media Arts Festival
Kapelica Gallery / Kersnikova
Kepler Salon Verein zur Förderung von Wissensvermittlung
Klimabündnis Österreich Gmbh – Regionalstelle Oberösterreich
Kunstuniversität Linz—Universität für künstlerische und industrielle Gestaltung
LABoral Centro de Arte y Creación Industrial
LENTOS Kunstmuseum Linz
Mariendom Linz
mb21
OTELO Linz und Vorchdorf
QUT Queensland University of Technology
Saloon 2000
Science Gallery
Stadtwerkstatt
Südwind

Tourismusverband Linz
ULF – Unabhängiges LandesFreiwilligenzentrum
V2_ Institute for the Unstable Media
VHS
Wirtschaftskammer OÖ
Wissensturm
Zaragoza City of Knowledge Foundation
ZusammenHelfen in Oberösterreich

Directors Ars Electronica: Gerfried Stocker, Christine Schöpf
Head of Festival: Martin Honzik
Technical Head: Karl Julian Schmidinger
Head of Finance & Organization: Veronika Liebl

Production Team: Joan Bairam, Christl Baur, Katharina Bienert, Klaus Birklbauer, Lisa Brandstötter, Elise Brokensha, Florina Costamoling, Roman Dachsberger, Leopold Eckl, Hannes Franks, Marion Friedl, Bettina Gahleitner, Felix Ganzer, Sandra Gaßner, Rosi Grillmair, Nathan Guo, Julius Jell, Verena Christine Jurkovic, Juliane Leitner, Kristina Maurer, Hans Christian Merten, Antonia Mittendrein, Fabian Mühlberger, Manuela Naveau, Melvin Neumann, Michaela Obermayer, Emiko Ogawa, Hideaki Ogawa, Elvis Pavic, Pablo Peula, Christina Radner, Tina Reinthaler, Vera Reinthaler, Michael Sarsteiner, Louise Roux, Tamara Schürz, Shoko Takahashi, Tobias Thaler, Jochen Tuch, Olga Vad, Joschi Viteka, Nina Wenhart, Michaela Wimplinger, Susi Windischbauer, Carla Zamora

Co-curators
Ars Electronica Animation Festival: Christine Schöpf, Jürgen Hagler
Big Concert Night: Dennis Russell Davies, Heribert Schröder
Campus Exhibition: Wang Zhigang
Expanded Animation: Jürgen Hagler, Alexander Wilhelm
Interface Cultures Exhibition: Christa Sommerer, Laurent Mignonneau, Martin Kaltenbrunner, Michaela Ortner, Marlene Brandstätter, Fabrizio Lamoncha
Music Monday: Werner Jauk
Nightline: Salon 2000
Radical Atoms: Hiroshi Ishii
Music and Media Art / Music as Media Art: Volkmar Klien, Se-Lien Chuang, Andreas Weixler

Prix Ars Electronica 2016

Co-organizers

ORF Oberösterreich
Director: Kurt Rammerstorfer

LIVA—Veranstaltungsgesellschaft m.b.H.
Directors: Hans-Joachim Frey, Thomas Ziegler

OK Offenes Kulturhaus im OÖ Kulturquartier
Directors: Martin Sturm, Gabriele Daghofer

Idea: Hannes Leopoldseder
Conception: Christine Schöpf, Gerfried Stocker
Coordination: Martin Honzik, Emiko Ogawa
Technical Management: Karl Julian Schmidinger

Production Team: Katharina Bienert, Marion Friedl, Veronika Liebl, Kristina Maurer, Hans Christian Merten, Manuela Naveau, Elvis Pavic, Johannes Poell, Christina Radner, Remo Rauscher, Tina Reinthaler, Louise Roux, Jutta Schmiederer, Joschi Viteka

ARS ELECTRONICA

Ars Electronica Linz GmbH is a company of the city of Linz.

BRUCK NER HAUS

OK im oö kulturquartier

ORF oö

LINZ UNESCO City of Media Arts

COOPERATION PARTNERS

1000 Worms
Anton Bruckner Privatuniversität
b00t Consultants
Berliner Technische Kunsthochschule (BTK)
BORG Bad Leonfelden
BOZAR Centre for Fine Arts Brussels
brotsüchtig
BTK–Hochschule für Gestaltung
bug'n'play
c3
Campus Genius Award
Center for Digital Music, Queen Mary University of London
Central Linz
Centre for the promotion of science
Crossing Europe
CUBUS
DIG gallery
DISK Berlin / CTM Festival
Donau-Universität Krems
Europe for Festivals, Festivals for Europe (EFFE)
Etopia
European Southern Observatory (ESO)
European Space Agency (ESA)
eutema
Experience Workshop Math-Art Movement
FAB Verein zur Förderung von Arbeit und Beschäftigung
Fachhochschule Oberösterreich – Campus Hagenberg
Filmakademie Baden-Württemberg
FMX 2016–Conference on Animation, Effects,
Games and Transmedia
GameStage
Gebärdenwelt.tv
GV Art London
hTh–CDN
Intel Corporation
Interface Cultures
International Students Creative Award
Japan Media Arts Festival
Johannes Kepler Universität Linz–Internationales GeoGebra Institut
Kapelica Gallery / Kersnikova

Kepler Salon–Verein zur Förderung von Wissensvermittlung
Klimabündnis Österreich Gmbh–Regionalstelle Oberösterreich
Kunstuniversität Linz–Universität für künstlerische
und industrielle Gestaltung
LABoral Centro de Arte y Creación Industrial
le lieu unique
Lehramt Bildnerische Erziehung–Kunstuniversität Linz
LENTOS Kunstmuseum Linz
Mariendom Linz
mb21
mehr demokratie!
Museo de la Universidad Nacional de Tres de Febrero
OÖ Familienbund
OTELO Linz und Vorchdorf
play:vienna
Quantum Reboot
QUT Queensland University of Technology
Resonate
Saloon 2000
Scholz & Volkmer
Science Gallery
Stadtbibliothek Linz
Stadtwerkstatt
Studiengang Raum & Design Strategien
der Kunstuniversität Linz
Südwind
Tourismusverband Linz
Trick-my-Film
ULF–Unabhängiges LandesFreiwilligenzentrum
Universidad Nacional de Tres de Febrero
Universität Salzburg
V2_ Institute for the Unstable Media
Volkshochschule Linz
Waag Society
Wanderkoch
Wirtschaftskammer OÖ
Wissensturm
youris.com
Zaragoza City of Knowledge Foundation
ZoopTEK
ZusammenHelfen in Oberösterreich

ARS ELECTRONICA RECEIVES SUPPORT FROM

Land Oberösterreich

Bundeskanzleramt

Bundesministerium für Wissenschaft,
Forschung und Wirtschaft

Creative Europe

Europäische Kommission

Bundesministerium für Europa
Integration und Äußeres

Bundesministerium für Familien und
Jugend – BuPP – Bundesstelle
Information zu digitalen Spielen

KulturKontakt Austria

Botschaft Flandern

EU-Japan Fest
Japan Commitee

Creative Industries Fund NL
(CIFNL)

SPONSORS

Intel and the Intel logo are trade-
marks of Intel Corporation in
the U.S. and/or other countries.

Linz AG

Hakuhodo

MIT Media Lab

Tangible Media Group

Mercedes-Benz

Hutchison Drei
Austria GmbH

Liwest Kabelmedien GmbH

VH Award

HYUNDAI MOTOR GROUP

Österreichische Post AG

LIVA – Linzer
Veranstaltungsgesellschaft mbH

Tsinghua University

Academy of Art & Design, Tsinghua University

Faculty for Creative New Media and Performing Art

MEIZU

Department of Information Art & Design (IAD) at Tsinghua University

Greiner Holding AG

MAXON Computer GmbH

NTT

Industriellenvereinigung OÖ

netidee

CONRAD Electronic GmbH & Co KG

NTS Retail

Rotary Club Linz-Altstadt

Ton + Bild

Sparkasse OÖ

Quanta Arts Foundation

Casinos Austria AG

University of Tsukuba

Empowerment Informatics

Trotec Laser GmbH

Österreichisches Rotes Kreuz

Cordial GmbH

Kuka Roboter CEE GmbH

Kreisel Electric GmbH

CoderDojo

Microsoft Österreich

4YOUgend - Verein OÖ Jugendarbeit

Pädagogische Hochschule OÖ

Arbeiterkammer OÖ

BRP ROTAX / POWERTRAIN

RIC GmbH

KNOWLEDGE CAPITAL

Otto Bock HealthCare Deutschland GmbH

Screenteam GmbH

Sharp Electronics GmbH

Vöslauer Mineralwasser AG

BIO AUSTRIA

Weinhaus Wakolbinger

Triple A Aqua Service GmbH

esero Austria

Baumschule Ökoplant GmbH

Smurfit Kappa Wellkart GmbH

Wissensfabrik
Unternehmen für Österreich

NTRY Ticketing OG

Team Vienna Games GmbH

Bildrecht GmbH

Oö. Landesmusikschulwerk

kraftplex
materials by franzbetz

Schäfer Shop GmbH

Baumschule Riedl

Lapp Austria GmbH

Miba AG

Plaspack Netze
GmbH

isel Austria
GmbH & Co. KG

DS AUTOMOTION
GmbH

Südsalz GmbH

Mayr Schulmöbel
GmbH

CC4 Remarketing
GmbH

FRAMED immersive projects
GmbH & Co KG

Carl Zeiss GmbH

S. Spitz GmbH

Synthesa
Chemie GmbH

Stangl Reinigungstechnik
GmbH

KÜCHER
Digitale Welt

shapeways

g.tec

Google ATAP

IST Austria

Aruba

PROJECT PARTNERS

Future Catalysts

art&science

STARTS-Prize

SPARKS-EU Horizon
2020 Project

Mini Maker
Faire

MEDIA PARTNERS

OÖ Nachrichten

Der Standard

TIPS

Ö1

Radio FM4

Radio Fro

dorf TV

Maker Media

Die Presse

Contents

RADICAL ATOMS
and the alchemists of our time

ART & SCIENCE

RADICAL ATOMS exhibition

THE ALCHEMISTS OF OUR TIME exhibition

EUROPEAN DIGITAL ART & SCIENCE NETWORK

FUTURE INNOVATORS SUMMIT

PROJECTS

EVENTS, CONCERTS & PERFORMANCES

FOCUS SOUND ART & DIGITAL MUSIC

CAMPUS

u19 – CREATE YOUR WORLD

ARS ELECTRONICA ANIMATION

ARS ELECTRONICA

Gerfried Stocker (AT)

RADICAL ATOMS
and the alchemists of our time

. . . and what comes after self-driving cars and the internet of things?

While the world still has its hands full dealing with the digital revolution and the cultural and social transformations and challenges that it has brought about, a young generation of scientists and creative engineers has set a course for new frontiers and is already at work amalgamating the disembodied world of digital data with the physical world of our bodies.

They are interconnecting bits and atoms in elementary form, fabricating new high-tech materials from natural substances. They are teaming up with artists and designers, employing the neurosciences and biotechnology, digital hardware and software, and bringing together old handicraft traditions with 3D printers and laser cutters. With their unorthodox approaches and highly inspiring projects, they are not only blazing trails for new developments; they are also opening up completely new ways of looking at the role of science in our society and the interplay of technology and nature.

In close cooperation with Prof. Hiroshi Ishii of MIT Media Lab, the 2016 Festival Ars Electronica will be focusing on this field, one that is fascinating and challenging for art, technology and society in equal measure.

With his Tangible Media Group at the MIT Media Lab, Ishii has done pioneering work on the human-machine interface and thereby made a name for himself worldwide. His first high-profile appearance at Ars Electronica was in 1997. In the meantime, he and the staff of his lab have launched *RADICAL ATOMS*, the next step in interlinking the digital and physical domains, and thus broaching a realm that goes far beyond the idea of an Internet of Things. The spectacular prototypes that have emerged from his lab are already milestones along the course of this new development.

Hiroshi Ishii, on *Radical Atoms* . . .

"*Radical Atoms* is our vision of human interaction with future dynamic materials that are computationally reconfigurable.

Radical Atoms was created to overcome the fundamental limitations of its precursor, the *Tangible Bits* vision. *Tangible Bits*—the physical embodiment of digital information and computing—was constrained by the rigidity of "atoms" in comparison with the fluidity of bits. This makes it difficult to represent fluid digital information in traditionally rigid physical objects, and inhibits dynamic tangible interfaces from being able to control or represent computing

inputs and outputs. Our vision of *Radical Atoms* is based on hypothetical, extremely malleable and reconfigurable materials that can be described by real-time digital models so that dynamic changes in digital information can be reflected by a dynamic change in physical state and vice–versa. Bidirectional synchronization is key to making *Radical Atoms* a tangible but dynamic representation and control of digital information, and enabling new forms of human–computer interaction.

With *Radical Atoms* we are developing our vision of interactions which do not exist today, but may be invented in next 100 years by atom hackers (material scientists, self–organizing nano-robot engineers, etc.), and speculating on new interaction techniques and applications which would be enabled by the *Radical Atoms*."

Who are the alchemists of our time and what can they contribute to changing our world?

But we will not only be dealing with the technological concepts, we will also be focusing on the people behind them. Who are the men and women developing our impending future? What drives them on? In what sorts of constellations and collaborative arrangements are they working? And what characterizes the locations at which their ideas and projects are taking shape?

Alchemists—the term that has historically been used to characterize them—transcended the narrow confines that were delineated by the science of their time and culture. They are emblematic of unorthodox methods and a profound interconnection of science with nature and metaphysics.

They were in search of the elixir of immortality, aimed to create artificial life, sought the universal panacea to cure all diseases, and they are said to have discovered gunpowder. The hope that their arts might be the key to transforming lead into gold made them not only sought-after and well-paid specialists but also, often, despised and persecuted social outsiders.

Nevertheless, the alchemists played a decisive role in the emergence of the modern sciences and were key protagonists in the rediscovery of the knowledge of Antiquity and the Orient and its dissemination during the European Renaissance.
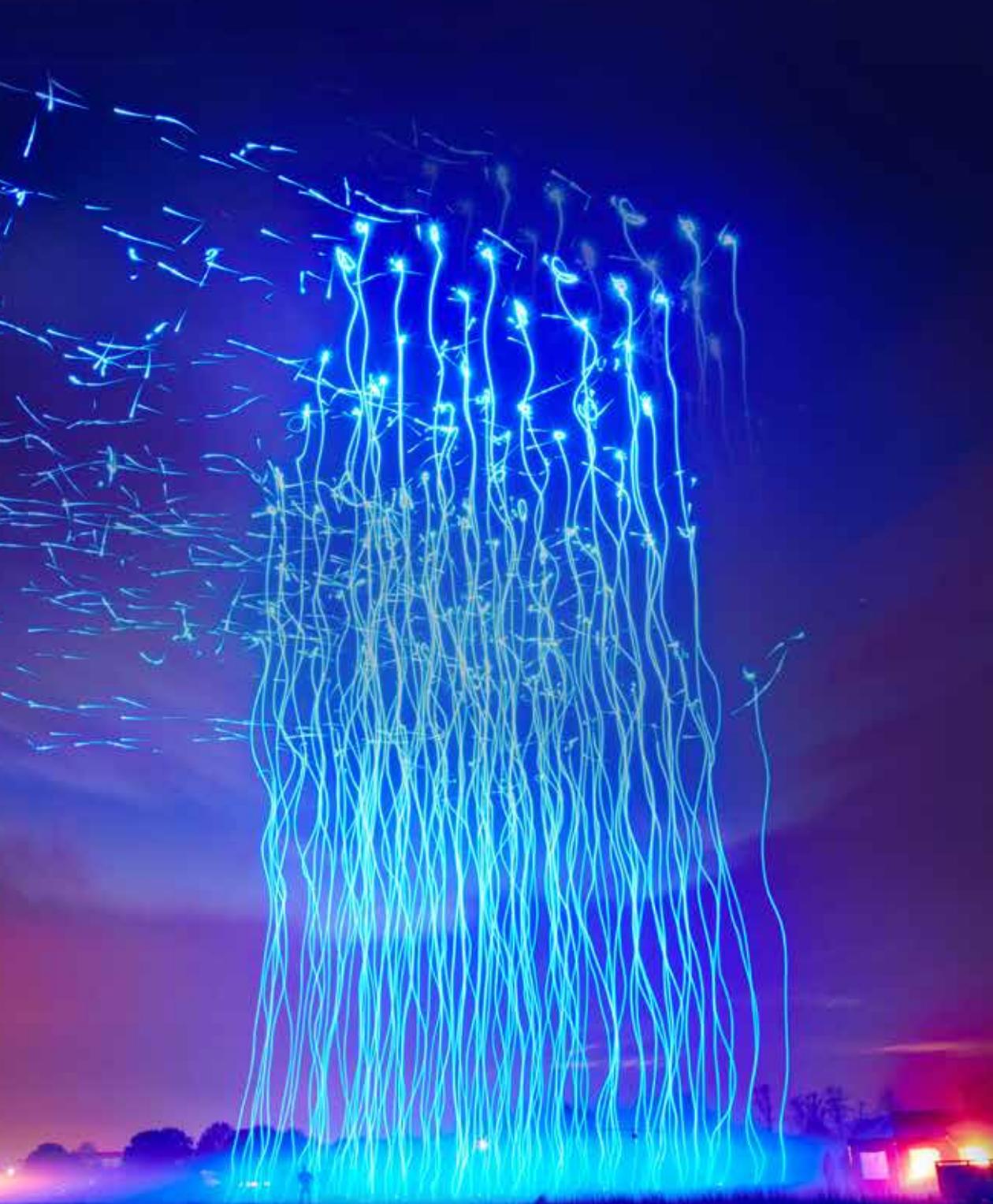
http://www.aec.at/radicalatoms

Drone 100 – Intel in collaboration with Ars Electronica Futurelab holds the world record in the category Most Unmanned Aerial Vehicles (UAVs) Airborne Simultaneously. *Photo credit: Intel Corporation*

RADICAL ATOMS

and the alchemists of our time

Hiroshi Ishii | Tangible Media Group | MIT Media Lab

Radical Atoms:
Beyond the "Pixel Empire"

Dancing Atoms

In a world of static forms we envision dancing formations as full of life as the pixels on a screen. Our dream is to let atoms dance, as pixels can do today. Physical materials are, at a human scale, seemingly shy, inert and frozen. In our eyes, these frozen atoms desire to be awoken: to dance, to leap and to levitate around us. Using the power of computation, we aim to build a new, dynamic, digital and physical medium for artistic expression, design and communication, to breathe life into static forms. This vision encapsulates the shift from static formations to dancing atoms, which would no longer be confined by their current physical constraints, thus enabling them to dance, much as pixels do.

Iceberg Rising

Information can be visualized as water flowing rapidly through the channels of the Internet, connecting billions of machines and users via the cloud. As is true for liquids, we cannot grasp and hold onto the information with our hands, as we would be able to do with wooden blocks or molding clay. We then must rely on our eyes to make sense of the pixel-based information within the screen, and with remote controllers, such as mice, keyboards, or

© LEXUS DESIGN AMAZING 2014 MILAN

touchscreens, to indirectly manipulate intangible pixels. This pixel-oriented world, more commonly referred to as a GUI (graphical user interface), allows for interactions via an indirect medium, thus limiting the tangibility and embodied interactions for the user. Given that GUIs currently dominate our interactions, we often refer to the GUI world as the "pixel empire" and our research as a battle against the far-reaching presence of the ubiquitous pixels. This discontent with the separation between representation (intangible pixels) and remote control led to the conceptualization of Tangible Bits as a pioneering medium. This idea–to partially freeze the ungraspable water to physically embody digital information–was born out of the desire for people to grasp and manipulate digital information. This next stage interface, the tangible user interface (TUI), allows for direct interaction and manipulation of information.

However, these frozen forms pose the problem of asynchrony between the ever-changing, dynamic states of the digital and the frozen physical forms– the tip of the iceberg exposed to the physical world. The physical component, which breaks through the water, is rigid and frozen, yet the digital, which is submerged below the water, is dynamic and ever-changing.

To overcome this limitation of frozen atoms in Tangible Bits, we envisioned Radical Atoms to bring atoms to life through their dynamic physical manifestation–malleable and computationally transformable. These advanced new materials composed of Radical Atoms will be the modern machines that will drive the new paradigm of material user interfaces (MUI). The name "radical" has its origins in chemistry. A radical, more precisely a "free radical"– an atom, molecule, or ion with unpaired valence electrons–makes free radicals highly chemically reactive towards other substances, or even towards themselves.
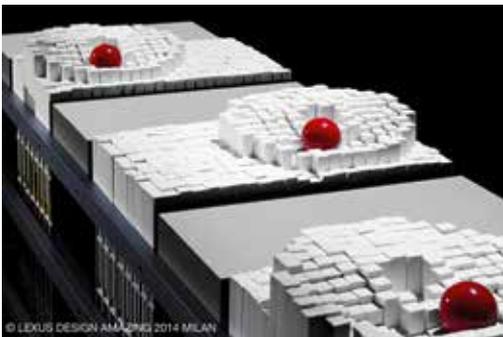
GUI PAINTED BITS   **TUI** TANGIBLE BITS   # RADICAL ATOMS

THE PHYSICAL WORLD

THE DIGITAL WORLD

a)

b)

c)
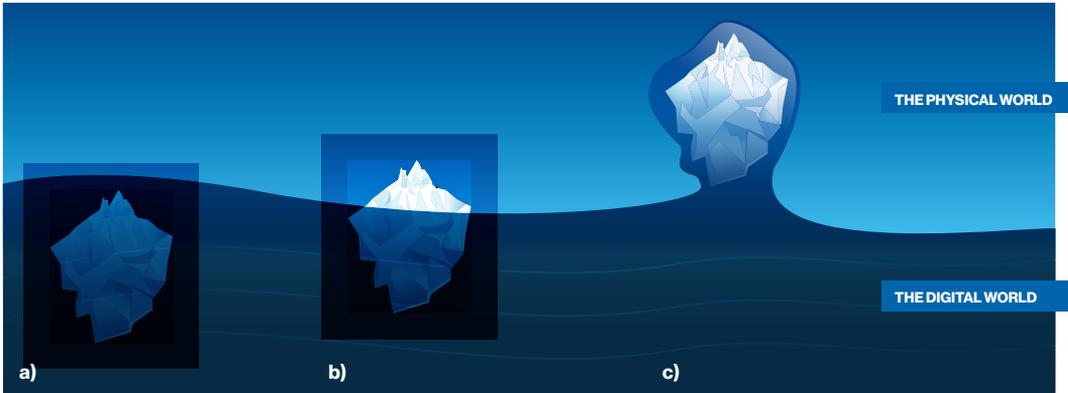
Graphical user interfaces only let users see digital information through a screen, as if looking through the surface of the water. We can interact with the forms below using remote controls such as mice, keyboards or touch screens.

A tangible user interface is like an iceberg: a portion of the digital emerges beyond the surface of the water - into the physical realm - representing the manifestations of computation, allowing us to directly interact with the 'tip of the iceburg.'

Radical Atoms symbolizes our vision for the future of interaction with hypothetical dynamic materials, in which all digital information has a physical manifestation so that we can interact directly with it - as if the iceberg had risen from the depths to reveal its sunken mass.

Materials to think with

This leads into the following key question: why care about these new materials for the representations of ideas? By using mathematical equations to represent ideas, we can apply the embedded mathematical, logical and linear operators to manipulate ideas. By using drawings on the whiteboard or on sheets of paper, we can apply spatial mental operators to manipulate the idea, by rearranging them spatially in our mind's eye.

Tangible Bits and Radical Atoms represent the combined effort to create new physical and digital representations of ideas and concepts, for the artists, designers, and communicators of the future. They personify our way to "defy the gravity of the pixel empire" by demonstrating the new possibilities of embodied and kinesthetic relationships between humans and digital information.

We are determined to invent new media to express creators' ideas, and to engage body-syntonic interactions with users. Hence, our focus on Radical Atoms—computational, physical, and dynamic materials.

Machines become Materials . . . Materials become Machines

Atoms, when arranged in a specific order, can be engineered to mimic the behavior of materials. For instance, a repetitive array of motors can be programmed to resemble water or soft foam through algorithmically defined feedback.

Conversely, when cells are arranged at the microscale, their organization can become like that of a machine, such as coordinated lines of bacteria arranged in a way so as to actuate a substrate, coordinating movement through activated biological processes.

Blurring the boundary between the machine and material is one of our dreams. Radical Atoms could represent the future of digital information and computation, and they, in turn, could provide us with a rich variety of embedded interfaces with which to manipulate them. Thus, machines become materials . . . and materials become machines.

While we might need to wait decades before atom hackers like material scientists, biologists, or self-organizing nano-robot engineers can invent the necessary enabling technologies for Radical Atoms, we strongly believe the exploration of artistic expression and interaction design can begin from today.

Joseph Paradiso (US)

Speculating across Scale, from Sensory Landscapes to Radical Subatoms

I live for those moments when I'm engaged in a project that I know has the potential to change everything, but I don't yet know exactly what it's "good for." Like the alchemists of old, my research is supported by interest in the "gold" that might be mined from my inquiries, but such practical transmutation isn't what motivates me in the end. The special times are when my team and I have created a technical "elixir" that evokes myriad exciting futures, but it's not clear which vein will reward auric ambition—when we live simultaneously in all possible universes that unfold from our work, but commercial interests haven't yet collapsed its cosmic wave function into markets.

Most of my research over the last decades has centered on sensing as opposed to mechanical actuation. Accordingly, my first forays into "radical atoms" explored smart materials as what I termed *Sensate Media*—essentially dense sensor networks realized on a smart surface. As with most Radical Atomists, my inspiration came in part from the pioneering *Smart Matter* work done at Xerox PARC in the 1980s, but I was interested in building sensate skins instead of doing distributed control, exploring a vision of dense sensor/processor "soup" that realized new kinds of smart material. My team built our first incarnations of this in the early 2000s, such as the *Trible* (a reactive sphere tiled with a sensor network), *Pushpin Computer* (a planar surface upon which hundreds of networked smart sensors can be arrayed like pushpins), and the *Z-Tiles* (sensate networked floor tiles made in collaboration with the University of Limerick in Ireland). We proceeded to smaller scale with the *S.N.A.K.E.* skin (all on flex

PCB) and the *ChainMail* (a sheet of small rigid nodes linked by flexible or stretchable interconnects). Our current work in this area is exemplified by *SensorTape*—a vision of a dense linear sensor network embodied as a conventional roll of one-inch-wide adhesive "tape" that can be spooled off, cut, and rejoined as desired, enabling any object or surface to which it is attached to attain a multisensory capability. The underlying technology is rapidly evolving, enabling sensors and electronics to be printed or applied as stickers, the substrate to become stretchable, and certain elements to be self-powered, allowing sensor tape to be applied to material and remotely interrogated for "perpetual" operation. Dr. Katia Vega, a visitor in my research team, is exploring the application of such flexible sensor/actuator arrays as interactive on-skin "smart makeup" in what she terms "Beauty Technology"—an intriguing bridge between wearable and implantable systems.

Looking at coarser scales, the vision of Radical Atoms melds with distributed robotics. Although this is a field with a legacy going back decades, recent developments in materials, miniaturization, communication and fabrication enable distributed mobile actuators to be realized on increasingly smaller scales. As nanotechnology and MEMS are driving the bottom here (often driven by extreme visions of in-vivo healthcare), there's plenty that you can do in the middle, as coin-sized mobile microrobots are now fairly easily made, and open questions abound, ranging from system applications to cooperative control, as witnessed by the worldwide abundance of research conducted with

these devices. We've taken a particular slant on this at the Media Lab, colored by our interest in wearable systems. In collaboration with Stanford colleagues, our recent *Rovables* microrobots are biomemetic constructs designed to crawl over clothing to function as dynamic user interfaces as well as performing a variety of collective tasks that span medical and aesthetic purposes.

That said, biology still humbles current microrobot capability. One of the prime deficiencies in technology here is in energy—insects and micro-organisms acquire energy from their surroundings by ingesting food and nutrients, and hence can keep functioning until they die (of course, they can self-reproduce and heal too—extreme challenges for electromechanical constructs). Existing technology for energy harvesting in microrobots is still extremely limited, as the available conversion/storage volume is very small and our electronics aren't yet able to easily tap into common nutrients or exploit digestion. In work launched a decade ago, we have explored a different approach here, adopting another inspiration from nature. It generally takes much more energy to physically move than it does to transmit information. Additionally it seems that nature lacks the vocabulary to evolve an effective radio, which is better manifest in silicon than via biology—this is one place where electronics wins. Hence we've constructed a set of devices that offload energy-consuming mobility to other agents in the environment. Termed *Parasitic Mobility*, our nodes demonstrate the idea of hitching "rides" on passing vehicles, people, etc., attaching and detaching at their convenience. This is modeled after the common natural

process of "phoresis"—e.g., insects and micro-organisms using larger animals for transportation. Devices can also transport themselves symbiotically by being attractive to people to carry and afterwards discard when they are no longer useful, ready to be picked up by somebody else. Pens and pencils have long held this niche (bringing along parasitic advertising), and we start to see mobile electronics follow this pattern as well—again hinting at a fascinating near-future where our physical electronics use us to stochastically move them where they desire.

The basic constituents of matter don't stop at atoms. For over a century we've known about electrons and the atomic nucleus, which consists of protons and neutrons. And since the 1960s, we've known that these nucleons are each built from three quarks in a "sea" of field-carrying gluons. Hence, although the energy scales involved here are far beyond that of material science and chemistry, it's fun to consider thinking past Radical "Atoms" into Radical "Subatoms." The Chinese science fiction author Cixin Liu engaged in wonderful speculation here in his award-winning 2006 novel *The Three-Body Problem*, where he envisioned a proton existing in nine dimensions being unfolded into in 3D (where it occupied a planetary scale) by malevolent alien scientists, who then lithographed a planetary-scale supercomputer onto it, folded it back into compact 9D space, then sent it to Earth to unleash considerable mayhem (it was capable of actuation by "borrowing" energy to be paid back towards the end of the universe). Although theories of grand unification tend to require fundamental particles (which the proton is not, as it is made of quarks)

to extend into compacted extra dimensions, Liu is taking massive artistic license with the science of his so-called *Sophons* here at several levels—but nonetheless, the vision he articulates entertainingly pushes the fanciful limits of what one could consider Radical Subatoms.

The subatomic realm has held a huge resonance for me, as I've spent many years working as a high-energy physicist, and have recently launched a collaboration with the ATLAS (one of the two main detectors at the Large Hadron Collider) to bridge experimental subatomic physics and music. Termed *Quantizer*, my student Juliana Cherston and our CERN collaborators have built a framework for composers to author generative music atop real-time ATLAS detector data. At the project website, you can "tune in" to ATLAS data as it arrives, interpreted by several different composers who have built mappings via our framework, with more to come.

More generally, I've been fascinated with the use of large data sources (e.g., as above with the LHC detectors) as artistic canvases. Although this has been explored somewhat via prior sound art and visualization, the quantity and richness of data sources available today are exploding as the Internet of Things unfolds and tools to extract structure from it are increasingly developed. For the last decade, my research team has been engaged in a

Artem Dementyev

Rovables
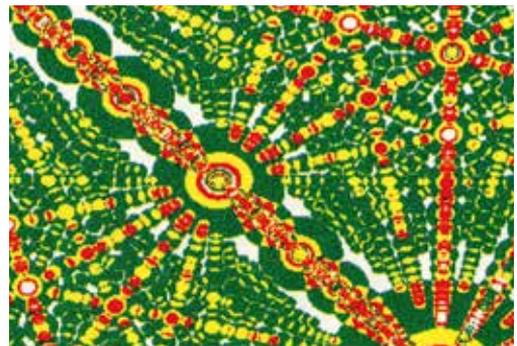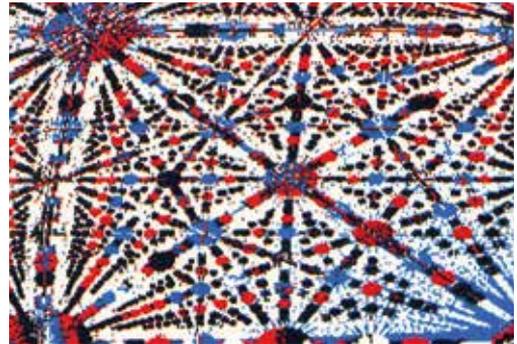
Donald Derek Haddad, Gershon Dublon

DoppleMarsh

Joseph Paradiso
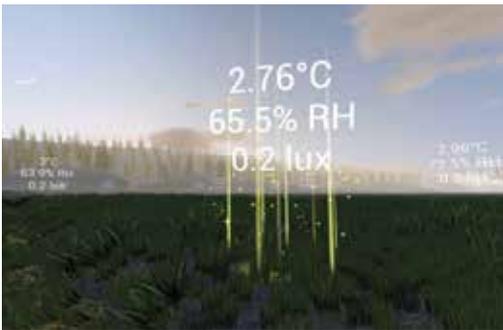
ReflectingCubeChaos

series of projects aimed at mapping human perception onto rich sensor network data under what we call *Cross Reality*–where ubiquitous sensor/actuator networks are "wormholes" tunneling real-world information to and from virtual environments that enable users to experience a "resynthesized" reality incarnated via a game-engine browser–an environment where the sense of presence is extended via manifestations from densely-deployed sensors. Freed from physical constraint, you can see and hear information streaming at scale from the physical world as interpreted into your own sensorium by artists and composers. One of our earlier installations, *DoppelLab*, was shown at Ars Electronica in 2011. *DoppelLab* enabled virtual visitors to experience spatialized sensor information and hear obfuscated audio from distributed microphones as they drifted through a virtual 3D model of our Media Lab building across both space and time.

Our recent work has focused on a retired cranberry bog in southern Massachusetts called *Tidmarsh* that's being restored to a natural wetland. We've deployed hundreds of low-power sensors across this beautiful natural landscape to capture the environment's response to this restoration. In addition to storing this multimodal data for ecological analysis, we are manifesting it (including spatialized sound from over 30 distributed microphones and hydrophones) in a virtual world as a networked sensory landscape, so online visitors can experience this space in both an informative and aesthetic way. The distributed sensors and microphones in our *Tidmarsh* environment drive a music engine that produces a spatial sound stream that reflects real-time conditions and events in the marsh as interpreted via four different composers, who have employed our generic musical mapping framework. Conditions at *Tidmarsh* "play" musical pieces that are always unfolding and evolving and reflect the present physical character of the actual place.

Through such networked sensory landscapes, we have re-synthesized the world of real atoms into a virtual experience interpreted via aesthetic mappings. Returning to our free-wheeling exploration of Radical Subatoms and associated particles, Ed Fredkin and Tom Toffoli showed that simple classical contact interaction (ignoring scattering dynamics) between elastically colliding particles are capable of universal computation in their *Billiard Ball Computer* model devised at MIT in 1982. In the mid-80s, I became fascinated by the kinematics of such particle trajectories in a perfectly reflecting cube, where a single particle, launched from the center of one face of the cube, classically and losslessly reflects off of each face, essentially iterating a recursive map at each reflection.

Due to strong nonlinearities near the edges of the cube, when the particle trajectory approaches the sides of a face, it becomes very sensitive to small changes in state, evoking chaotic behavior and fractal characteristics. If one plots the distance traveled by the particle before it comes within a finite radius of where it started (or the number of bounces it encountered before returning, etc.) as a function of the angles at which the initial particle was launched, fascinating graphics can be generated that exhibit the symmetry of the cube along with very complex fractal-like regions–indeed, playing with this system occupied much of my spare time during the heyday of Mandelbrot Set graphics.

As we've traversed immense scale, from networked sensory landscapes to Radical Subatoms and particle scattering, I'll close this essay with the key phrase remembered from Richard Feynman's classic 1959 talk that launched nanotechnology–"There's Plenty of Room at the Bottom"–and abundant creative inspiration all the way down!

http://resenv.media.mit.edu

David Benjamin (US)

Living

Buildings and cities are living, breathing organisms. They have metabolisms and they live in complex ecosystems with interconnected loops of ideas, technologies, culture, politics, humans, non-humans, and the natural environment. Each loop relates to the other loops. For example, technology without culture does not make sense. Environment without justice does not make sense. Humans without non-humans does not make sense, Each project—and our collective projects—only make sense through the interconnections.

In this context, over the past few years we have been exploring prototypes of new metabolisms through a variety of digital technologies. We have created glass that breathes in response to people—combining sensors and information for a project called Living City in New York City, commissioned by the Van Alen Institute and Eyebeam Center for Art and Technology. We have created a facade that glows and blinks in response to air quality and human interest in the environment—combining environment and public space for a project called Living Light in Seoul, commissioned by the City of Seoul. We have created a wall that displays real-time social media graffiti—combining robotics and public debate for a project called Social Robot in San Francisco, commissioned by the Quantified Self group. And we have even created soup bowls that reveal secret messages in street food stalls—combining street culture and critical discourse for a project called Street Life in Shenzhen, commissioned by the Shenzhen-Hong Kong Biennale for Urbanism and Architecture.

More recently, we have been designing with actual living systems. For example, we designed an air-filtering facade with a self-sustaining ecosystem of marine plants and animals—combining building systems and aesthetics for a project called Amphibious Envelope in Chicago, commissioned by the School of the Art Institute of Chicago and associated with the Chicago Architecture Biennial. And in a more general sense, much of our recent work involves combining architecture, biology, and computation. Of course, architects and designers have been drawing on biology for hundreds of years. But I believe that biology of today is different than biology of 100 years ago. It is now possible to grow cells on a glass chip isolated from other cells instead of in a living organism. It is now possible to visualize complex biological processes such as the neurons firing inside of a living tadpole in real time. It is even possible to cut and paste DNA and bring to life organisms that never before existed in nature, such as yeast that spits out biofuel. In addition, it is possible to apply the latest techniques of computation—such as computer vision and machine learning—to functions such as biological growth. Biology is very complex, but if you can encapsulate it in something like a computer model then it becomes a more actionable part of the design ecosystem. This has sparked our recent thinking, and led us to focus on three different approaches to biology, computation and design that we believe are very promising.

First, bio-computation involves using living organisms as tiny processors that can help solve human problems. One example involves studying the way that slime mold grows into a complex network that is both efficient and redundant. It is efficient because it connects a given set of dots (food) with a minimal number of lines. And it is redundant because each dot touches at least two lines—so if any line is removed, the dots remain connected in the network. For a project called *Bionic Partition*—in collaboration with Airbus, Autodesk Research, and APWorks—we developed an algorithm that uses the "biological algorithm" of slime mold to link critical connection points in an airplane partition (the dividing wall between the seating area and the galley of a plane). Then we ran a process of bio-computation that generates, evaluates, and evolves tens of thousands of design options. This allowed us to create a partition that is almost 50 percent lighter than current designs, and it is also stronger. This weight

saving translates to fuel savings and carbon reductions—ultimately this design approach could save up to one million metric tons of carbon emissions per year. More generally, by combining our custom techniques of data science and bio-computation, we can derive results that are both high-performing and unexpected. We can discover ultra-high-performance results beyond typical engineering rules of thumb. The process is not about achieving cold-blooded efficiency. Rather it is about expanding our creativity.

Second, bio-sensing involves using living organisms to detect the conditions of their environment and respond accordingly. This can be seen with live mussels, which open their shells to "breathe" dissolved oxygen. It turns out that the rate and the amount that mussels open their shells is an incredibly sensitive and sophisticated detector of water pollution. In fact, a mussel is better at detecting water pollution than our best digital sensor. For a project called the *Pier 35 EcoPark*—developed in collaboration with the artist Natalie Jeremijenko—we are attaching an inexpensive Hall-effect sensor to one side of a mussel's shell and a magnet to the other side, and this allows us to harness the natural breathing process of mussels as a bio sensor. We are using the signal from the mussel to provide a public interface to water quality via floating lights in New York City's East River. Blue lights mean water quality is improving and red lights mean it is getting worse. More broadly, this approach combines "artificial intelligence" and "natural intelligence"—integrating the best computational techniques of the past few decades with the complex processing that has evolved in living systems over millions of years—and points to an incredibly rich hybrid design palette for future projects.

Third, bio-fabrication involves using living organisms as tiny factories to manufacture building materials in a new way. Here, the root-like structure of mushrooms—called the mycelium—is a powerful model. Drawing on the natural process of growth and decay in the forest, mycelia can be combined with agricultural waste, placed in a mold of any shape, and used to "grow" solid objects. This process does not use the high-value part of agriculture (corn kernels); it uses the low-value part (corn stover). And it makes objects with almost no waste, no embodied energy, and no carbon emissions.

For a project called *Hy-Fi*—developed in collaboration with Ecovative, Arup, and the Columbia University Strength of Materials Lab—we used mycelium to develop a new architectural brick that was both robust and compostable. The idea was to create a building from nothing but earth and then return the building to nothing but earth. To test this idea, we manufactured 10,000 bricks, constructed a 13-meter-high tower, hosted cultural events for three months, then deconstructed the tower and composted the building. Among other things, this approach suggests that we might start growing building materials and we might start "designing to disappear."

These three approaches are at once familiar and completely new. They are biological and digital, ancient and cutting-edge, approximate and precise. And perhaps these dualities define life and point to our future.

Courtesy of The Living

Siegfried Zielinski (DE)

Expanded Materiology

"The science is lost if the purity of heart is lost"
Nicholas Valois[1]

"From building to growing" are the terms in which Hiroshi Ishii of the Massachusetts Institute of Technology's Media Lab describes the paradigm shift that's currently taking place in the design of worlds that can be experienced via the senses. The fluid underworlds of data streams are being merged into liquefied materials of the supraterranean—that is, what exists on Earth. The outcome is a hybrid reality woven out of the finest heterogeneous biological and technological components. The logic and materiality of the technical are being projected into the biological. On this side of the metaphor, what's transpiring as a result of this abstraction (applied informational knowledge in the world of data) is a new concretization, the consequences of which we do not yet know in detail but we'll have to practice getting used to, as Vilém Flusser might put it. And that man is a native of Prague, the Central European city that is still keeping alive at least the memory of a lane in which its alchemists once lived.

If we give some thought to the essential components that should characterize this paradigm shift—that which is built, the mechanical-constructive on one hand; that which grows, the living-becoming on the other—then we find ourselves amidst a "pluri-verse," the development of which went through a deep time of several thousand years. Its events have played out and its protagonists performed their investigations along a narrow ridge between the physical and the metaphysical, the precise mathematical equation and fuzzy magic, extended things (*res extensae*) and thinking things (*res cogitans*).

European Modernism has taught us to strictly segregate the heterogeneous realities of the material on one hand and the intellectual on the other, and that despite the fact that several of its foremost exponents spent much time perusing the magicians'

tracts and sojourning in the laboratories of the sorcerers' apprentices, quacks and early genetic engineers. So let's not repeat the mistake of separating that which can only be conceived of together. Instead, let's encounter the new hybrid realities at the nexus of the calculable controls and nervously sensitive material with expanded hermeneutics.

Let's accept the challenge and interpret the current trends in design as updates of archaic experiments in the creation of experiences between the particle form and wave form of the physical world. And keep in mind that when I refer to physics here, then it's to the understanding of Johann Wilhelm Ritter, for whom something like dead material simply couldn't exist. As a chemo-physicist and early theoretician of electricity, he accepted only different states of oscillation of material entities that are very much alive. 2,500 years ago, the coterie of natural philosophers who thought in terms of this and other such ideas was called the atomists.

In Greece of Antiquity, *chymeia* referred to the mixing of liquefied materials—metallurgy, to put it in technological terms. Europeans had acquired the method of producing pure, shiny gold from the high culture of Ancient Egypt, where it had been in use since before 2,000 BC. *Chymeia* was essentially a matter of transforming a material into an intermediate state by subjecting it to extreme heat and thereby imparting a more noble form to it, and, following its passage through liquefaction, hardening it into a solid again.

Metallurgical skills were then joined by dyeing techniques. *Chymeia* also taught and practiced ways of immersing the surfaces of material such as woven fabrics into various coloring agents and thereby making them more aesthetically pleasing. And this, in turn, fostered advances in pharmacology,

Ouroboros, the serpent that bites its own tail, as a magical symbol of the endless process of transformation, is pictured here in the *Synosius*, a tract that was transcribed by Theodoros Palecanos in the 15th century. (Zielinski Archive)
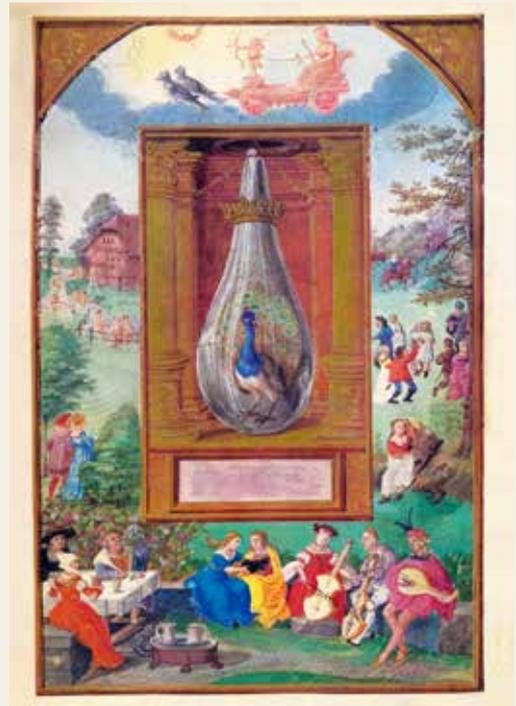
Regimen Veneris, The Regime of Venus; miniature from *Splendor Solis*, the magnificently illustrated 1582 tract by Salomon Trismosin (pseudonym), which was discussed, among others, by Maurizio Calvesi in *Arte e alchimia* (Florence, Milan 1986:7). Attraction and love engender harmonies in the acoustic and visual realms and in everyday life. The peacock in the distilling vessel, with the colorful splendor of its tail feathers (*cauda pavonis*), on one hand, stands for transmutation per se; on the other hand, it's emblematic of the transmutation phase immediately prior to the projection of *lapis philosophorum*.

the science of producing medicinal substances and cosmetics—thus media to promote the healing and beautification of the human body by means of extracts derived from the bodies of plants.

Certain alchemical concepts and practices go all the way back to the earliest ages of high culture in China, Egypt, Byzantium, India and Persia, to European Antiquity, and to *l'age d'or* of Arabic-Islamic knowledge formation between the 8th and 13th centuries AD. The alchemical arts went though one of their strongest periods in 4th-century Europe, where Christianity waged a merciless struggle against all that was un-Christian. The arcane, subversive vocabulary of the alchemists' tracts like those of Zosimos of Panopolis had their brutal origins here. Alchemy was the art of the fallen angel who strove to equal or even surpass God, to trump Him with a show of magnificence. An ideal world of media.

The strongest movements of the first centuries AD were taken up again in the 8th and 9th centuries and reformulated by Arabic-Islamic scholars. *Al-kimyá* was the name used in the House of Wisdom in Bagdad to refer to the experiments in this field and the writings about them, idiosyncratic treatises that these learned men compiled themselves or translated from other languages.

During the Middle Ages in Europe, lore passed down from the Hermetic tradition of natural philosophy made its way to Spain, where it established itself as a program entitled *alchimia*. In this period of renewed flowering in Christianized Europe, alchemy was pervaded by the Catholic faith in God that those people held. Processes of chemical transformation were said to be analogous to the conversion process in which infidels or skeptics underwent purification. Alchemical knowledge and the experimental procedures of its adepts became increasingly diversified and pervaded more and more realms of life—for example, medicine, agriculture and various crafts and trades. The upshot was the popularization of the alchemists' tracts and communiqués as how-to manuals containing useful formulae.

With the emergence of the avant-garde in the public sphere, alchemy became a more generalized conceptual model at the nexus of the natural sciences, technology, art and magic, an endeavor to visualize nature's internal workings and the complexities of its interrelationship with the world of ideas. The coupling of the world's complexity and an obsession with interrelationships became the defining characteristics of a long epoch, the medial fulfillment of which we are experiencing at present. The chain that connects everything to everything else is, at this point, no longer an imaginary phenomenon; it exists as an omnipresent telematic network.

The path from physical (sensory) experience to metaphysical show climaxing in the mystical unification of the genders as well as the antipodes of matter and spirit was, at the point of convergence, intimately connected with the idea of projection. The "immense array of things that neither are nor can be, but can be conceived and believed"[2] could achieve an unheard-of proliferation in conjunction with this wild, wonderful world of the power of the imagination and of natural experimentation, possibly its final flowering before modern civilization brings its pitiless project of standardization and universalization to fruition.

Nature turned back upon itself undergoes metamorphosis. This is how the basic principle of alchemy was frequently enunciated. This is represented by Ouroboros, the serpent that eats its own tail. *Physika kai Mystika*[3], an ancient tract only fragments of which have been handed down to us and whose authorship is ascribed in the alchemists' literature to Pseudo-Demokritos, deconstructs this in these terms: Nature rejoices in nature / Nature dominates nature / Nature defeats nature. At the end of the alchemical process is the surmounting of nature once the radical passage through it has been completed.

In contemporary design that experiments with data, algorithms, cells, molecules and atoms, the process proceeds in reverse. The natural material is first

In Christoph Scheiner's *Fundamentum Opticum* (1619), the spectrum of colors of the peacock's tail fans out amidst a series of basal optical devices, including the helioscope, the reverse telescope that Scheiner claimed to have invented to observe sunspots.

Mathematician John Dee's most famous book—aside from his English translation of Euclid's Geometry—is dedicated to hieroglyphic monads. The complex of hieroglyphs is made up of a few entities. The point is the point of departure; line and circle complement it to make up an endless meshwork of interrelationships. (Dee, *Monas Hieroglyphica*, 1564)

analyzed and then informed. The data and/or algorithms are projected into the elaborate construction that is thereby sensitized for both external and internal control. The body frees itself, so to speak, through its porous skin out into the world. This brings forth an ideal interface, like what Austrian author and artist Oswald Wiener described in an addendum to the experimental novel *Die Verbesserung von Mitteleuropa* (The Improvement of Central Europe) he published in the 1960s and thus almost ten years before the first Festival Ars Electronica.[4] The technological "happiness suit" that Wiener designed via Bio-Adapter had a dual functional direction corresponding to the bias of any and all communication and of every medium. It makes the world beyond the artificially generated boundary enjoyable for the individual imprisoned inside it; at the same time, it changes the one so restrained to achieve greater compatibility with the reality outside. These are constellations that we're familiar

with as facts and circumstances prevailing at inter-sections—in a psychological, technological and aes-thetic sense. The two stages that Wiener differ-entiates in the process of adjustment that takes place between the adapter and that which is to be adapted can also be interpreted from this point of view. In the first stage, there's still something like a dramatic of difference. Since "glitches and unavoidable mishaps" (p. CLXXIX) occur occasion-ally, the individual becomes aware of the fact that he's being carried by a machine suit. In the second adaption phase, the control over the individual's physical and mental functions has become com-plete, the cybernetic cycle has been closed, so that the individual "bio-modules" can enter into a learn-ing relationship with each other.

The individual body designs itself into the world that, in turn, opens up a place to accommodate it in order for the two to merge together as an indis-soluble hybrid reality. That's the world of tomorrow in which individuals feel well and can see/hear in endless loops of the visual and the acousmatic.

Alchemy wasn't invented to hone terminology. The dazzling diversity of the significance of its semantic fragments is one of its characteristics. Alchemy was a specific form of exertion, of profligate expendi-ture. It was a process of working out the nature of the particular, the individual, and the same applies to the texts it generated. There are still alchemis-tic tracts that have been read and understood by only a handful of adepts and later exegetes. In this sense, alchemy is an elitist theory and practice. It "is a dream to which one can only hearken, and, when one tries to tell what one dreamed, one can only stammer. When people were no longer able to sit by their hearths and dream and, in the narratives they told, listen in on themselves, this was when the dream of alchemy receded back into the night."[5] The highest level of transformation of base material into the dazzlingly beautiful shine of the coveted

noble stuff is explicitly referred to in several tracts as *proiectio*. Depending on the predefined architec-ture of the particular alchemist's model, it's the seventh or the twelfth level of the transforma-tion process. In an experimental-practical sense, *proiectio* means projecting in the sense of throwing. A precisely specified quantity of powdered *lapis philosophorum* (philosopher's stone) is coated with hot wax and projected onto the simmering base metal. If the *lapis* actually does possess the transformational power ascribed to it, then, in the final amalgamation, the desired transformation should occur.

Lapis was, of course, a promise, just as the digital today is a pledge made with the highest level of solemnity and assurance. "The digital is the ana-log correspondence of the alchemists' formula for gold" is how I translated a text by J.-P. Fargier on an early book by Nam June Paik about Allan Kaprow and Allen Ginsberg. It entirely depends on which substances are used for the transformational work, and what quality goes into the hypermaterial that's supposed to be the catalytic agent of change.

In a Late Medieval tract translated into convoluted German in 1608, Roger Bacon stated that it was essential that the material being projected—i.e. *lapis philosophorum*—itself consist of noble substances. In order to succeed in achieving the most beautiful brilliance of the Moon (silver) and the Sun (gold)—to both of which are ascribed genders (female Moon/ male Sun) that are the opposite of those used in German—the philosopher's stone must contain that which is to be attained. "Thus if *proiection* into the white or red range is what we seek, then a starting point in gold is what we must take . . ."[6]

In the Early Modern period, alchemical theory and practice served the purpose of (self) comprehension and communication on the part of an unsettled, wavering, rather empirical and, possibly, on the way to becoming a thoroughly provisional subject that

strove to position itself in contradistinction to the Other, that which is not (yet) understood, and thus to nature too. The cosmos emitted exhilarating signals, and listening in on them was perceived as intoxicating. It projected itself acoustically into the souls of the adepts, who had decided in favor of taking part in the world and not just observing it. As a new model for experiencing the world and processing it, alchemy understood in these terms did not refer back to a magical past; rather, it pointed the way forward into a potential future. There emerged an esoteric form of education, like that which can be found today in the scenes of expanded and aesthetically applied computer science–a matter of something that one learns before one understands it.

Several natural philosophers who conducted research in optics, acoustics and other mediation techniques–Roger Bacon and Giovanni Battista della Porta, for instance–were also practicing alchemists and possessed intimate knowledge of the highly speculative theoretical literature. Even some of Isaac Newton's experiments were undertaken in response to alchemical stimuli.[7] His famous *Experimentum crucis* to split sunlight into the colors of the spectrum that could be broken down no further was experimentally structured as a sort of *camera obscura*, except that here sunlight was not used as a source for the projection of objects situated outside the darkened chamber but, instead, was itself the object of refraction by means of the prismatic glasses within the *camera*. Only one writing and reading variant of the alchemists' transformational practice is the one on the generation of substantial color qualities. Wonderful opportunities to study adaptations are presented by the paintings of Mark Rothko as well as by works of Yves Klein and Sigmar Polke.[8]

"Materiology is the study of the interrelationship between Heaven and Earth," Will Grohmann wrote to Jean Dubuffet in the context of *Matériologies*, his magnificent exhibition in spring 1961 at Galerie Daniel Cordier in Frankfurt.[9] Expanded Materiologies could be considered a concept in which the boundaries between extensive things and conceptualized matters are being constantly and radically transgressed.

1   Quoted by Kurt Seligmann, *Das Weltreich der Magie: 5000 Jahre Geheime Kunst* (Stuttgart 1958), p.110
2   Charles Mackey, *Aus den Annalen des Wahns* (Frankfurt 1992), p.8
3   Florian Ebeling, *Das Geheimnis des Hermes Trismegistos: Geschichte des Hermetismus* (Munich 2005), p. 47f.
4   This text, first published in 1965-66, was written during the years after 1963 when Wiener was employed as a manager in Olivetti's EDP department.
5   H. E. Fierz-David, *Die Entwicklungsgeschichte der Chemie*, p. 132.
6   Roger Bacon, *Vom Stein der Weisen / und von den vornembsten Tinkturen des Goldes* (Leipzig M.DC. VIII), quote p. 57. I found this bizarre document in 1992 in the University of Salzburg Library bound together with a version of *Monas Hieroglyphe*, the famous work by English mathematician, physician, cartographer and alchemist John Dee (1527-1608).
7   On this subject, also see the fascinating biography by White (1998) that goes into detail on Newton's controversial dealings with alchemy.
8   See the final chapter of Michel Butor's *Die Alchemie und ihre Sprache* (Frankfurt/Main 1990): "New York's Mosques or the Art of Mark Rothko." On the subject of Klein and Polke in this context, see the detailed study by Ulli Seegers, *Alchemie des Sehens* (Cologne 2003), which refers to the philosopher's stone as the powder of projection (p. 51).
9   See the exhibition's catalog, *Matériologies de Jean Dubuffet* (Frankfurt/Main 1961), o.P.

Verena Kuni (DE)

Consonants

Or: The Alchemy of Our Time (Delirium 2.1)

Our turn now. The story of more than one of our insanities.

For a long time we boasted that we were masters of all possible landscapes, life-forms, universes and we thought the great figures of art and poetry were laughable.

What we liked were: absurd paintings, animated gifs, WYSWYG (because we never got what that really meant), images without imagination everywhere, stage sets, carnival backdrops, billboards, brightly colored prints; cars, planes, drones, and everything mobile; old-fashioned literature, Church Latin, spam poetry, dating apps, erotic books full of misspellings and online porn, the kind of novels our grandmothers read, fairytales, little children's books, old operas, talk shows on TV, silly old songs as well as ridiculous new ones, the naive rhythms of country rhymes and the lullaby of the stock exchange.

We dreamed of crusades, voyages of discovery, republics without histories except for those we'd write for them, religious wars, populations stamped out, revolutions in morals, movements and migrations of whole continents (of course under the premise of our control): all in the name of endless growth. We used to believe in every kind of magic, and afterwards in science and in technology—which in the end turned out to amount to the same.

We invented colors for the vowels! A red, E orange, I yellow, O green, U blue. Then we continued to do so for the money. And then we invented data capitalism. So all we'd need after that was black and white and gray. The vowels and the colors were sold to the companies for their trademarks. As were the images, as were the words. As were the genes. We made rules for the form and movement of every consonant, and we boasted of inventing, with rhythms from within us, a kind of poetry that all the senses, sooner or later, would have to recognize. And we alone would be its translators. We who made the rules.

We began it as an investigation. And then we simply couldn't stop. We turned words into silences and days into glitzy nightmares. We made the whirling world stand still.

B   is for billions, for biotechnology, and for blood.
C   is for carbon, and for corrosion.
D   is for doom, and for dust.
F   is for fake.
G   is for then we saw gold, and wept, but could not drink.
H   is for home sweet homeland security.
J   is for jackasses (now all happy there is loads of smart stuff to buy).
K   is for kerosene.
L   is for lead, and for lethargy.
M   is for matter, for media, and for memory (long-term, random access and loss).
N   is for nevermore.
P   is for particles, for power, and for pollution.
Q   is for the question that has never been asked.
R   is for rare earths, and for radical atoms.
S   used to be for substance. But now it is for same, same (no difference available).
T   is for terror, and for threat.
V   is for virtue, for vice, and for all that has vanished.

W   is for warranty, for worries, and for waste.
X   is for xenobiotics (an extra we never expected, but finally got everywhere).
Y   is for you.
Z   is for zero–as in zero gravity?–as in zero tolerance? Unfortunately we forgot we once had the choice.

Finally we got used to elementary hallucination: we could very precisely see a mosque instead of a factory, a drum corps of angels, drones on the highways of the sky, a drawing room at the bottom of a lake, data in the clouds; monsters and mysteries everywhere.
We had expanded our magical sophistries by turning words into visions into reality!

We said farewell to the world.

And in desolate, moss-grown isles
They raise their precious panels
Where the city
Will paint a hollow sky

Joe Davis (US)

ASTROBIOLOGICAL HORTICULTURE

An unusually broad set of experiments is devoted to discovery and modification of terrestrial extremophiles with traits that can extend survivability of an organism intended for future introduction into extraterrestrial environments. These investigations include isolation and enhancement of radiation resistant organisms, revivals of cryptobiotic species, and the search for microorganisms with psychrotrophic phenotypes and oxygen-producing perchlorate metabolism.

Astronaut Scott Kelly grew zinnia flowers and harvested lettuce in space this year during his 340-day mission on the ISS (2015-2016).[1] These were the first fresh vegetables and flowers to be grown in space. The gardens I have in mind are not at all like Kelly's garden, or any of the gardens we are generally familiar with. I am not inspired to recreate tropical paradise or an idyllic Eden. Rather, I imagine hot, forbidding cornucopias subject to cataclysmic bombardments where cooling continental crusts have just begun to coalesce; harsh, and trackless landscapes, blanketed with poisonous atmospheres or else frozen nurseries of ice with dark, subsurface liquid oceans of water, ammonia and salt.

The Garden

This kind of garden first appeared on Earth about 4.5 billion years ago. It was in such a landscape, early in the Archean eon—roughly 3.5 billion years ago—that life left its first detectable impressions. The oldest known bacteria microfossils date from about 3.5 billion years ago, when Earth's crust had cooled just enough to begin the formation of rocks and continental plates. For most of the history of life, the garden had a very different atmosphere than the one we know now. Like Mars, there was no oxygen, rather it consisted of CO_2, CH_4, NH_4, SO_2, H_2, N_2, and would be toxic to air breathers on our planet today. The "Ur" organism is thought to have evolved

in such a reducing atmosphere.[2] Recent studies suggest that late Archean Earth atmospheric pressure was only 0.5 bar, more like conditions on Mars at the time.[3] 3.7 billion years ago, Mars was a wet planet with much thicker atmosphere. Current Martian atmospheric pressure is about 0.07 bar, but if Mars did not have a stable, multi-bar atmosphere at the time that its rivers were flowing, the warm-wet CO_2 greenhouse would be ruled out and long-term average temperatures would have been below freezing. Atmospheric pressure on Mars is thought to have been 0.5-2 bar prior to the late heavy bombardment (4 to 3.8 billion years ago).

The garden was anoxic. Organisms that evolved in this envelope of poisonous gases are thought to have changed it into an oxygenated atmosphere billions of years later. These events in the evolution of Earth's biosphere would have far-reaching biogeochemical consequences for the related evolution of Earth's hydrosphere and lithosphere, but abundant O2 in atmosphere appeared only in recent geological history. Free oxygen was first produced by prokaryotic and later, by eukaryotic organisms carrying out oxygenic photosynthesis producing oxygen as a waste product.[4] Oxygen-producing organisms are thought to have first appeared 3.5 billion years ago, perhaps even earlier, but oxygen's first tiny appearance in Earth atmosphere, known as the Great Oxygenation Event or GOE, was around 2.3 billion years ago. Cyanobacteria are considered to have significantly contributed to the GOE but do not seem to have appeared until about 200 million years beforehand. Major environmental change started around 2.3 billion years ago, but until roughly 0.85 billion years ago, oxygen was probably only 1% to 2% of its current level. We would have suffocated. The spike to current O2 levels coincided with a global glaciation event, but even 1–2% oxygenation was enough to precipitate perhaps the greatest biologi-

cal disaster ever to unfold—and it wasn't just the ice age. Free oxygen is toxic to obligate anaerobes and would have wiped out the vast majority of anaerobic organisms. Earth probably lost most of its primordial biome at this time.

Atmospheric O2 peaked at ~35% in the Cretaceous, only to reach its current level (~21%) after the Cretaceous-Tertiary (KT) extinction event 65 million years ago.

Lost Worlds

Amateur paleontology has become one of my most consuming avocations. I think fossils are teleporters for the imagination with special qualities that can transport the beholder into the presence of whole lost kingdoms of life. Perhaps just for this reason there is something terribly plaintive and poignant about the fossil record: great bottlenecks that marked the passage of large, genetically diverse initial populations into much smaller, genetically simplified subsequent populations. At the end of the Ordovician (~438 million years ago), when life on Earth had reached the greatest extent of biological diversity, only 12% of all species survived. Then, ~100 million years later, at the end of the Devonian, three-quarters of all surviving species went extinct. Another 100 million years passed by and in an episode now referred to as "The Great Dying," 96% of species vanished from the face of the Earth at the Permian Triassic boundary. Only 4% survived. Then, after another 185 million years, just as species diversity finally began to recover from the Ordovician disaster, 75% of species disappeared at the end of the Cretaceous.

Scholars lament great lost libraries of books and fanatic interdictions of art, science and philosophy, that have marked the passage of history. But all of these losses pale by comparison with the unspeakable *biological* tragedy of mass extinction. More than 99% of all species, amounting to over five billion species that ever lived on Earth, are now estimated to be extinct. There are simply no numbers to describe the lost libraries of genes and proteins held in uncountable disappeared species. We can only imagine what synthetic biology could accomplish with these lost genes if even a tiny percentage of them were ever recovered.

The Halophiles

Today most organisms on Earth live in saline environments in oceans and inland seas, both on continental shelves and in the benthic deeps, in deep ocean vents and hypersaline anoxic basins, in marine solar salterns, terminal hypersaline environments of evaporating seawater; in natural brines at hot springs and in perennial salt and alkaline soda lakes. The Dead Sea and Great Salt Lake are only two examples. Others include Lakes Natron and Rukwa in Tanzania, Kara Bogaz in Turkmenistan, Lakes Bogoria and Elmenteita in Kenya, Lake Eyre in Australia, Mono Lake in California, Lake Urmia in Iran, Lake Uvs in Mongolia and Lake Van in Turkey. Salt and Soda lakes are actually ubiquitous features in the global landscape. Human beings and other air-breathing, freshwater-dependent organisms are latecomers and taken in context, are the true *extremophiles*. Salt-loving organisms called halophiles are extremely robust and diverse. They can resist routine exposure to ionizing radiation (high UV). Halophilic *xerophytes* persist in environments characterized by extreme aridity. Halophilic *thermophiles* inhabit extremely hot environments. Halophilic *psychrophiles* thrive in circumstances of extreme cold. Halophiles have been found in "Deep Lake,"[5] a hypersaline lake in the Vestfold Hills, of Antarctica.[6] Deep Lake's temperatures range from +11.5° C to –20° C; due to its to extreme salinity it never freezes.

Halophiles can resist extremes of the space environment too. Some species have been found to survive high vacuum, extreme temperatures and hard radiation in space. Experiments demonstrating this were installed onboard NASA's *Long Duration Exposure Facility* (April 1984-January 1990) and *Expose-E* (2008-9); ESA experiments included Biopan, installed on the external surface of Russian Foton descent capsules (six flights: 1992-2007) and the European *Technology Exposure Facility* (EUTEF), attached to the *Columbus* module of the ISS for seven months (February 2008- September 2009).

My preoccupations with the apparatus of space exploration first brought me to molecular biology 30 years ago. I organized *Poetica Vaginal* (1986) and *Rubisco Stars* (2009) interstellar transmissions for communication with extraterrestrial intelligence (and ourselves). My earliest "bioart" projects were created with these same objectives in mind. Accordingly, my interest in "biological spacecraft" emerged with *Microvenus* and other models for bacterial extraterrestrial message carriers in the 1980s.

One evening in 1986, at *The Plough and Stars* (a bar in Cambridge, Mass.) I sat pondering "bacterial spacecraft" over several pints of Guinness with friend and collaborator Dana Boyd, a geneticist at Harvard Medical School. We decided that if there are roughly 500 million (0.5 billion) stars in the galaxy and there are 112 bacteria or spores per ml of bacterial or spore paste, and there are 52 ml per "pint" of Guinness (a metric "pint"), then about 514 spores would fit into a glass of Guinness. That's only 1,000,000 spores per solar system, but it's something to start with: the humble beginnings of *Microvenus, Riddle of Life*, and the *Milky Way DNA* projects in bioart. These led to the development of *DNA Supercode, Silent Code, DNA Manifolds* and other "DNA-programming languages" that attempt to produce biologically and biochemically friendly DNA sequences that can keep parity with input data

in the form of human intellectual information. Ongoing efforts to contain a highly compressed version of Wikipedia in the genome of the progenitor apple represent the latest developments of these ideas.

The Norton Rings

Fishing in the Norton Rings (1997) was a project noting extensive discharges of human sanitary waste in space since the 1960s. The US Space Administration has only recently acknowledged International Space Station (ISS) and Space Shuttle wastewater dumps in space, which are readily visible to observers on the ground.[7] Moreover, multi-million dollar space toilets notoriously break down. Projects *Gemini*, *Apollo* (in Earth and Lunar orbits and on Lunar surface), *Sky-Lab*, Space Shuttle and the ISS have all discharged wastewater into space. Russians *Salyut*, *Soyuz*, and *Mir* were more environmentally sensitive by either treating and storing wastes for Earth-return, or by loading them onto empty *Progress* resupply vehicles which were allowed to burn up on reentry into atmosphere.

Shuttle wastewater dumps usually weighed 165 lbs., which was the tank capacity for all wastewater tanks. As of February 1994, estimated Shuttle dumps from 15 missions totaled 5,385 kilograms discharged into low-Earth orbit. Seven additional missions were flown (1996-2011) including the longest Shuttle flights. Thus total discharges from the Space Shuttle probably equaled ~10,000 kilograms of human waste.

I obtained space-returned samples from the *Solar Max* satellite's[8] outer metal shell from a repository for such samples at the Johnson Space Flight Center in Houston. Dana Boyd and I later recovered living organisms from impacts on these samples. We estimated more than a million impacts per square meter on exposed surfaces of *Solar Max* ranging from 1 mm to 1 micron in diameter.

Liquid water discharged into the 10-5 torr vacuum of

the near-Earth space environment literally explodes, expanding at supersonic speeds. This expansion rapidly cools discharged liquids causing them to freeze into macroscopic and microscopic particles that, according to NASA's own studies, occupy every conceivable orbit within a period of 33 months. These ices vaporize on impact, leaving "freeze-dried" specks of solid materials from which Dana Boyd and I revived organisms. We could not revive organisms from surfaces that were not impacted with debris. We suspect that random motion alone might account for interplanetary transport of these materials over periods of geologic time, even without the assistance of spacecraft or passing comets, asteroids and meteors. Our project was called *Fishing in the Norton Rings*, after Ed Norton (Art Carney), a 1950s character in the classic Jackie Gleason television series, *The Honeymooners*. Norton's character was that of a sewer worker.

Icarus Worms

On the first of February 2003, Space Shuttle *Columbia* tragically disintegrated on reentry at ~mach 20 at an altitude of 39.7 miles. One of the experiments on board involved experimental growth media for the nematode, *Caenorhabditis elegans*, a popular organism for biological studies. These organisms were growing in Petri dishes stacked into five thermos-sized cylindrical aluminum canisters. The experiment's complement of five canisters were all recovered intact after impact.[9] Only one Petri dish in one of the recovered canisters was not viable. Principal investigator Catharine Conley, PhD (now NASA's Planetary Protection Officer) did not access worms until ~two months after the *Columbia* disaster.

Radiation

Interstellar radiation from mysterious galactic sources and fierce radiation from the Sun are big problems for any space traveler. One insidious result of radiation exposure is called "molecular cross-linking." Radiation energizes an atom enough to break a chemical bond and then form abnormal bonds with other atoms. Such "free radicals" have been implicated in a range of cancers and genetic mutations. Furthermore, distinct forms of physical damage to DNA have been observed to result from respective exposures to either ionizing or particle radiation.

Synthetic biology is likely to be an essential resource to support planetary exploration. Biosynthesis of materials in space, including pharmaceuticals, fuel and industrial chemicals is a much more desirable option than expending energy to lift supplies from planetary gravity wells. Biological organisms are storable (dormancy with little or no energy input), can carry on precise mineral extraction and deposition and can produce atomic scale precision assemblies. But these "space factories" will need genes for radiation resistance.

Without radiation-resistant plants, greenhouses on Mars will have to be heavily shielded and so require substantial structures and energy-intensive artificial lighting. Away from the protection of planetary magnetic fields, any biological entity will have to endure sleeting radiation and require resistance in the form cellular repair mechanisms that can cope with inevitable radiation damage.

MIT Nuclear Reactor Laboratory

In January 1994, I collaborated with Stefan Wölfl (then a colleague in the Alexander Rich Laboratory at MIT) to isolate radiation-resistant organisms from primary coolant exposed to the MIT reactor core. Our experiment consisted of a microbiological assay in which we prepared assorted nutrient media and inoculated them with samples drawn directly from the reactor core. These were incubated for a week or more at 47° C. Active colonies appeared in media ordinarily prepared for *Micrococcus* (TCNZ) and a nutrient preparation commonly used for the

culture of yeast (PYC). Yet neither *Micrococcus* nor yeast were identified in colonies of organisms obtained from the reactor and cultured in these media. Dr. Micheal Shia, then at Boston University Hospital Clinical Microbiology Laboratories, identified organisms growing in one of the culture types: a species of *Ochromobactrum* (*Ochromobacter anthropi*) predominated together with numerous bacillus species.[10]

In 1994, it was possible to find organisms that could be cultured in growth media. No non-cultured organisms could be identified. In the decades since 1994, however, the appearance of an emerging technology called "metagenomics" has enabled scientists to identify a broad spectrum of organisms that cannot be cultured in the laboratory.

Revisiting Reactor Experiments with New Tools

The *ribosome* is part of cellular machinery that converts genetic instructions in genes into all of the structures that make up the biological world. Genes that code for the ribosome itself are highly conserved across all kingdoms of life.

Ribosomes consist of two RNA subunits. The smaller subunit is called 16S and the genomic diversity of many microbial communities can now be detailed by analyzing genes for 16S ribosomal RNA (rRNA) in metagenomics data sets. With Harvard colleagues, Conor Camplisson, Emma Kowal and others, in 2016 we revisited the MIT reactor with tools to carry out 16S analysis of the reactor coolant microbiome. Over several months, we sampled reactor input and output fixtures and the coolant itself, both before and after exposure to the reactor core. We worked together with MIT Nuclear Reactor Laboratory personnel Tom Bork and Bill McCarthy to pilot several iterations of a 0.22 μm vacuum filter system (1-2 ml/sec) to satisfy requirements for both radiation safety and sterility. We have now filtered more than five liters of reactor primary coolant and,

as I write this, are in the process of 16S PCR analysis and MiSeq "shotgun" DNA sequencing. Exposures of selected organisms to reactor neutron beam ports (109 neutrons/cm2/sec) and direct exposure to the reactor core (1013 neutrons/cm²/sec) are also planned. We will test microorganisms known to exhibit radiation resistance (including several halophilic organisms) and will attempt to enhance levels of resistance in others. Since gamma ray output at the reactor is not quantifiable, a set of parallel experiments have been organized with cobalt and cesium gamma ray sources elsewhere at MIT.

In order to identify proteins involved in tissue repair, additional reactor experiments in regenerative biology and *transcriptomics* (RNA sequencing) are underway in collaboration with James Monaghan Laboratory at Northeastern University and the laboratory of Ashley Seifert at the University of Kentucky. 16S PCR and metagenomics can contribute to "biological spacecraft' in other ways too.

Salt of the Earth

Until recently, the record for DNA recovered intact was ~0.7 million years (from a horse ancestor preserved in permafrost). In personal correspondence about this DNA, George Church remarks, "it is pretty beaten up: <100 bp fragments." DNA fragments were not expected to be recovered from extremely ancient remains. Many environmental factors contribute to DNA degradation. George Church has suggested that spontaneous chemical processes– notably, depurination and cytidine deamination– are comparable to cosmic rays in terms of DNA damage.[11] Yet, an exception lies hidden in ordinary crystals of salt.

Fluid Inclusion Microthermometry

Salt crystals expand and contract with temperature at a different rate than surrounding brines. As crystals grow, small pockets of brine are trapped

within the salt crystal structure and as the rate of crystal growth increases, the quantity of fluid inclusions also increases. Quantities of inclusions are greatest in the center of a given salt crystal.[12]

Fluid inclusions in halite crystals have long been employed in a classical analytical technique in geology called, "fluid inclusion microthermometry." Halite crystals with fluid inclusions are placed on a special, refrigerated microscope stage and cooled. Vapor bubbles form within cooling fluid inclusions because at low temperatures liquid brines in the inclusions contract faster than the surrounding salt. Crystals are then slowly heated to "homogenization temperature," when the vapor bubbles entirely disappear. This is the temperature at which crystals initially formed. Fluid inclusion microthermometry is therefore a useful technique in studies to estimate relationships of water temperature, air temperature and climate in the distant past.

De-Extinctions

Until relatively recently, micropaleontological studies of fluid inclusions in halites have been largely overlooked. The first cultivations of halophilic micro-organisms from Permian salt sediments (about 250 million years old) were reported in the 1960s.[13, 14]

These studies predated many now familiar tools of molecular biology and contamination issues were suspected. The survival of viable micro-organisms over extended periods of geologic time was difficult to imagine. But since the late 1990s that picture has changed . . .

Later findings (16S PCR) found that prokaryotes cultured from ancient halites (Permian Salado salts from New Mexico) were, in fact, halophilc archaea and a halotolerant bacterium, *Vergibacillus sp.*[15] In 2016, revivals of organisms were reported from Atacama desert salt deposits of up to Permian age and collected at burial depths of up to 2000 meters.[16]

In several other studies of halite-buried microbes, archaea belonging to *Halobaceterium* and *Halococcus* commonly appear, whereas bacteria are rare. Ribosomal 16S sequencing data have revealed many bacteria and unknown archaea in sediments. Halophilic archaea forming miniaturized spore-like cells have been found inside these halites.

Haloarchaea from the Permian-Triassic boundary (252-300 million years ago) have been found in salts in England, Germany and Austria (salts from marine brines that once covered western Europe). One of these, *Halococcus salifodinae*, was isolated from geographically separate areas. In addition, *Haloterrigena*, *Natromonas* and *Halorubrum* have been found among Death Valley halophilic archaea recovered from ~97,000-year-old salt.[17]

Halophilic archaea from 5 of 881 crystals harvested from Death Valley core suggests rarity of microbial survival in fluid inclusions. However, several important points have helped to convince scientists that organisms recovered from ancient salts were not the result of contamination:

1) well-preserved primary halite fluid inclusions
2) in situ microscopy
3) intra-laboratory reproducibility
4) DNA sequences exhibiting expected variance with contemporary halophiles indicated by mutation rates associated with age.

Park et al. (2010)[18] sequenced haloarchaeal DNA related to modern genera *Haloarcula*, *Halorubrum* and *Halobacterium* from 23, 121, and ~419 million year old halites. Organisms have been recovered from inclusions in other evaporites too, including gypsum, selenite, and calcite. Panieri et al (2010) extracted and amplified the oldest known *Cyanobacterium* DNA trapped within solid portions of gypsum evaporite found in Miocene (Messinian: 7.2-5.3 million-year-old) formations from the northern Apennines in Italy. Bacteria, archaea and algae (*Dunaliella*) have also been found in ancient

primary fluid inclusions in halite and gypsum/calcite evaporates.

Published Protocols for Decontamination of Halites and Culture of Cryptobiotics

1) Decontamination with NaOH, HCL solutions[19]
2) Halite crystals dissolved in high salt media w/ (pick and choose)
      –Yeast extract
      –Casein-derived amino acids
      –Pyruvate
      –Glycerol

or, 3) Micro-drill to breach inclusions with precision micro-drilling instrumentation. Mechanical drilling or polishing involves a high risk of contamination of the sample and some researchers have suggested alternative laser ablation techniques for optical drilling and extracting micro-size material.[20]

Laser sectioning of samples also presents problems, requiring matching laser output wavelengths with absorption coefficients of targeted matrix (salts) while at the same time avoiding subjecting microbial inclusions to phototoxicity, unwanted photo--activated cross-linking, excessive thermal and acoustic shock, and absorption of laser light by the microbes themselves.

Mary, Mary . . . Where Does Your Garden Grow?

Astronomers routinely peer at events that have occurred hundreds of thousands of years in the past, but observed objects are just as many light years away. Now there is another way to look just as deeply into the past, but unlike astronomical objects, the subjects of these observations are much closer at hand. Salt formations in North America range in age from Silurian (438-419.2 million years) to the Miocene (23-5 million years). My collaborators and I have cataloged over 50 commercial salt mining operations in North America with a view to obtaining primary salt crystals for analysis. In the US, common table salt (e.g., Morton salt) found in kitchens and restaurants is likely to have been mined from Permian salt formations. In 1940, Detroit became the first major city to use rock salt (from Silurian deposits) for snow and ice control. Other cities followed. Human beings have therefore been carrying out wholesale re-inoculations of the environment with ancient organisms for over 75 years. The implications of these actions remain unresolved.

Based on *Astrobiological Horticulture* results to date, we are preparing for a global *Great Paleozoic Evaporite Expedition* to collect primary halites from formations spanning all geological periods. Cambrian (541-485 million years) salt-bearing basins are prominent features of older strata in Asia, for instance.[21] The only confirmed Precambrian (4.6 billion to 541 million years) salt formations are located in remote Central Australia, west of Alice Springs. Recovered organisms from these deposits could shed light on genetic and evolutionary responses to the range of "Earth-like" conditions that have unfolded over geologic time.

My initial interest in microbial contents of salts stemmed from collections of microorganisms I carried out to support *L'Art Biotech*, a 2003 bioart exhibition in Nantes, France. At *L'Art Biotech*, I had installed an audio-synthesizing version of my audiomicroscope apparatus for which I collected microbial samples from local ponds, lakes and rivers. Towards the end of that installation, a French video production team[22] decided to introduce me to famous, medieval salterns still in operation on the Guérande Peninsula on the Atlantic coast of Brittany. I found abundant organisms in Guérande brines and wondered what would happen to them when brines in these saltpans were completely desiccated. I considered the possibility that Guérande halophiles would somehow become trapped in salts and perhaps contribute to the delicate flavor of

harvested salts. Moreover, I thought that by inoculating sterile, filtered ocean water with selected organisms, I might artificially create salts with flavors matching those of corresponding "artisan" salts.

I found two papers about artisan salts in 2013. One, by Harvard food-science researchers, was concerned with contamination of cheeses treated with non-sterile sea salts. The authors pointed to the possibility that pathogenic bacteria might "hitch hike" in artisan salts.[23] The other paper reported 16S rDNA "fingerprinting" of specialty sea salts from geographically separate locations.[24] Neither study distinguished surface contaminants from organisms that may have been embedded within the salts.

My early experiments in 2016 were carried out with externally sterilized commercially available "artisan" salts, including examples of "Himalayan" salts mined from 250-million-year-old formations in Pakistan. I prepared two versions of sterile hypersaline growth media with Harvard laboratory bench mate Jeff Nivala and worked with Wyss Institute researchers Brian Turczyk and Allie Martin to establish new protocols using ethylene oxide gas for sterilizing only external surfaces of salt crystals. I then directly inoculated hypersaline media with surface-sterilized salt crystals[25] and incubated at 45° C in a shaking incubator for five to six days noting growth in several samples. No attempt was made to penetrate or isolate fluid inclusions from surrounding salt matrix.

In subsequent experiments, my Church Lab bench mates Jeff Nivala and Seth Shipman helped me to integrate several strict experimental controls. 50% of our samples are routinely autoclaved, for instance, as well as surface sterilized, and these samples do not exhibit growth. We established cultures in liquid media, on agar plates and stored cells suspended in glycerol and frozen at −80° C.

I am fortunate to have access to high-power microscopy at Harvard and continue to document revived halophiles with still microphotography and movies. With help from Ute W. Gottschall, curator of the Historical Collection and Salt Mine ("Kuratorin historische Sammlung und Salzkammer") at Schweizer Salinen AG in Pratteln, Switzerland, we have obtained mineral salt samples from salt deposits in Heilbronn, SE Germany (235 million years old), associated with "muschelkalk" limestone formations from the Permian-Triassic boundary; Schweizerhalle and Riburg in NW Switzerland (235 million years old); Bex in Canton Vaud or "Waadt" in SE Switzerland (225 million years old) and from 5-20-million-year-old Miocene salt deposits in Armenia.

Our oldest revived organisms to date have been grown from 438-419.2-million-year-old Silurian primary salt crystals salts obtained from the Cargill Cayuga salt mine in Lansing, NY. The Cayuga salt mine is the deepest in North America at 2,300 ft. Collaborating Cornell University physicist, Robert Hovden carried out analysis of our samples with a scanning electron microscope (SEM) showing abundant pore networks and inclusions in Cayuga salts. Elana Lockshin, Seth Shipman and I first isolated DNA from revived organisms (including those from Silurian and Permian salts) with 16S PCR in July of this year and are currently carrying out MiSeq "shotgun" sequencing of those results. We plan whole genome "long-read" sequencing of revived organisms with Pacific Biosciences (PacBio).

Since we may now be able to track evolution of genes and phenotypes across very large periods of time, these data may have strong implications for evolutionary biology. There are obvious implications for synthetic biology too, as genes and molecular mechanisms otherwise lost may now be investigated. Both of these scenarios may entail years of work, but the sources of these revelations are now sitting on my laboratory bench and in incubators

Robert Hovden
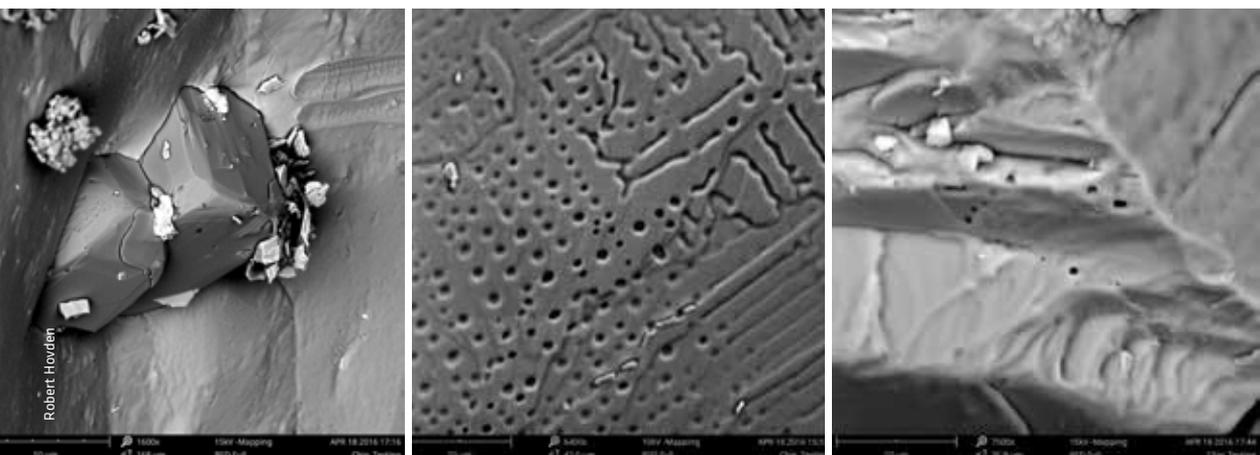
and freezers elsewhere in lab. We will test these organisms for radiation resistance as a part of our MIT Nuclear Reactor Laboratory experiments and search for genes responsible for perchlorate metabolism and other traits needed for applications in *Astrobiological Horticulture.*

Exophiles

In 2002, a gamma ray spectrometer aboard the *Mars Odyssey* orbiter mapped distribution of water on the Martian surface. These results were confirmed In May 2008, when suspected ice was uncovered by the landing thrusters as the *Phoenix* lander settled into its landing site in the Martian "northern lowlands." Onboard cameras imaged what were thought to be droplets of volatilizing liquid brines on the struts of the Phoenix lander. In 2012, the *Curiosity* rover also found direct evidence for past water flows on Mars. In 2015, NASA's Mars Reconnaissance Orbiter imaged contemporary liquid seeps and resulting salt deposits in recurring Martian slope lineae. Antediluvian terrestrial salts can provide useful information about temperature and chemistry of oceans on ancient Earth. They are also useful as a guide for conditions used for culturing organisms found embedded in salts. Likewise, Mars salt spectroscopic data obtained by these spacecraft can be used to model ocean chemistry for the 3.8-billion-

year-old *Oceanus Borealis* that once spread across large areas on Mars and now, as a blueprint for creating hypersaline growth media for culture of model Martian organisms.

I plan to create thousands of ocean models that range from terrestrial contemporary and paleocean formulae to hypothetical formulae for Martian brines and *Oceanus Borealis*. We will attempt to establish at which point terrestrial halophiles fail to survive gradients in titrations approaching "Mars normal." Our cryptobiotic ancient halophiles are expected to have important roles in these experiments since terrestrial paleocean and paleoatmosphere formulae may have had characteristics closer to corresponding Martian models than the Earth's atmosphere and oceans do today. Furthermore, we want to determine how terrestrial halophiles may be modified to enhance survivability in simulated Martian environments. There may also be some very good reasons to extend these investigations to extraterrestrial environments well beyond the planet Mars.

Beyond Mars

At approximately 6:30 pm on March 22, 1998, a meteorite now known as the "Monahans meteorite" fell in Monahans, Texas. Later that same year, the "Zag meteorite" fell on either August 4 or 5 in

Morocco's Sahara desert. Fossil hunters witnessed its fall, and found it shortly afterwards. The meteorite was apparently acquired by a dealer shortly afterwards and seems to have been available for sale by several meteorite dealers. Samples have been obtained by museums, and notably, by Michael Zolensky (Cosmic Dust, Microparticle Impacts, and Stardust Curator at the NASA Johnson Space Center in Houston). Meteoritic salts (xenolithic halites) with fluid inclusions with liquid water were discovered in both of these meteorites.

Zolensky and a team of scientists from Johnson Space Center and Virginia Tech (Blacksburg, Virginia) dissolved small samples of these salts and extracted rare isotopes for age dating. They concluded that the age of the xenolithic salts in both meteorites was approximately 4.56 billion years, exceeding the age of the Earth.[26, 27, 28]

When we say that we have learned how to reach into the past and pull back life that may have remained desiccated and dormant for hundreds of millions of years, periods of time as large as this are difficult to reconcile with the 200,000-year scope and context of human experience. One way to think about this is to consider that since our oldest revived organisms were first imprisoned in their crystals of salt, the Sun has traveled nearly twice around the galactic core.[29]

No biological studies have yet been undertaken with the Zag and Monahans meteoritic salts. It is likely that xenolithic salts may be found in other carbonaceous chondrites, the family of stony meteorites that includes Zag and Monahans. In the past, water normally used in the preparation of meteorite sample for analyses would have dissolved any salts they contained. My colleagues and I hope to obtain untreated samples of xenolithic halites for paleomicrobiological analysis and so to search for evidence of biological activity in the planetary nebula from which Earth and other planets formed.

1 Kelly's garden, developed by Orbital Technologies Corp. in Madison, Wisconsin, was made with plastic "pillows" containing calcined clay and controlled-release fertilizer. These were strapped into a structure called "Veggie" and artificially illuminated (red, blue and green LED lights).

2 There is evidence that the atmosphere of early Earth may also have contained oxygen long before biological photosynthesis is known to have appeared. A 2011 article in *Nature* found that cerium oxidation in zircon—which comprises the oldest rocks on Earth at roughly 4.4 billion years of age—was comparable to that of present-day lava. This observation implies that Hadean atmospheric oxygen levels were similar to those today. Note that these results do not, however, contradict existing theories about life's journey from anaerobic to aerobic organisms. (See: "The Oxidation State of Hadean Magmas and Implications for Early Earth's Atmosphere," Dustin Trail, E. Bruce Watson, Nicholas D. Tallby, *Nature* 480, 79–82 (01 December 2011)]

3 "Earth's Air Pressure 2.7 Years Ago Constrained to Less Than Half of Modern Levels," Sanjoy M. Som, Roger Buick, James W. Hagadorn, Tim S. Blake, John M. Perreault, Jelte P. Harnmeijer, David C. Catling, *Nature Geoscience* 9, 448-451 (2016). † O_2 Buildup in Earth's Atmosphere: Stage 1 (3.85–2.45 billion years ago): practically no O_2 in the atmosphere. Stage 2 (2.45–1.85 billion years ago): O_2 produced, but absorbed in oceans and seabed. Stage 3 (1.85–0.85 billion years ago): oceans outgas, O_2 that is absorbed by land surfaces. Stages 4 and 5 (0.85 billion years ago–present): O_2 sinks filled and the gas accumulates

4 It is interesting to note that ongoing climate change due to a spike in concentrations of atmospheric CO_2, the biological waste product of our own era, may actually constitute a kind of reversal, bringing Earth's atmosphere closer to its primordial form.

5 Note that Deep Lake is about 10 km from Davis Station, Antarctica, an Australian research station on the Antarctic coast of the Davis Sea.

6 An expedition to Antarctica is currently planned in collaboration with Boston University Prof. Jennifer Bender. An Antarctic passage is tentatively planned aboard the *Ocean Watch*, a 64-foot yacht displacing 44 tons with a draft of eight feet and a beam of just over 16 feet. Built of quarter-inch steel plate, the center-cockpit sailboat's keel configuration is a deep fin with a skeg-hung rudder. The double-headsail cutter rig consists of a high-clewed yankee jib, a staysail, a powerful mainsail with three deep reefs, and an asymmetric spinnaker for off-wind sailing. Sailors know latitudes from 40 to 70 degrees south as the "roaring forties," furious fifties" and "shrieking sixties" due to high winds and large

waves that form as winds blow around the entire globe unimpeded by any land-mass. Apart from having some of the strongest winds on the planet, cyclonic storms are frequent in the great Southern Ocean due to the varying temperatures and large open waters. Icebergs, especially from May to October, make the area even more dangerous. They can occur at any time of year throughout the ocean. Some may have drafts up to several hundred meters; smaller icebergs, iceberg fragments and sea-ice (generally 0.5 to 1 m thick) also pose problems for ships. The remoteness of the region makes sources of search and rescue scarce. I might opt to fly

7 "Astronaut Urine Spotted in Skies above North America," *The Daily Telegraph*, September 18, 2009 http://www.telegraph.co.uk/news/science/space/6206742/Astronaut-urine-spotted-in-skies-above-North-America.html

8 The Solar Maximum Mission satellite was designed to investigate Solar phenomena. Parts of Solar Max and several other satellites were retrieved by Space Shuttle and returned to Earth.

9 "*Caenorhabditis elegans* Survives Atmospheric Breakup of STS-107, Space Shuttle Columbia," Nathaniel J. Szewczyk, Rocco L. Mancinelli, William McLamb, David Reed, Baruch S. Blumberg, and Catharine A. Conley, *Astrobiology*, December 2005, Vol. 5, No. 6: 690-705.

10 These results were reported in the *Suddeutsche Zeitung*, January 24, 1994.

11 Personal correspondence with George M. Church.

12 Deposition of Evaporites and Red Beds of the Nippewalla Group, Permian, Western Kansas," by Katrine A. Holdoway. http://www.kgs.ku.edu/Publications/Bulletins/215/ : Kansas Geological Survey, Bulletin 215, originally published in 1978.

13 "Investigation of the Viability of Osmophile Bacteria of Great Geological Age," Reiser, R., Tasch, P., trans. *Kans. Acad. Sci.*, 1960, 63, 31–34.

14 "Bacteria from Paleozoic Salt Deposits," Dombrowski, H, *Ann. N. Y. Acad. Sci.*, 1963, 108, 453–460.

15 https://geoweb.princeton.edu/research/geomicrobio/halite.html : Six Bacteria-shaped Particles in Primary Fluid Inclusion from 97 kyr old Salt in Badwater Salt Core (85 meter depth).

16 "Buried Alive: Microbes from Ancient Halite, Jaakkola," Salla, T. et al., *Trends in Microbiology*, Vol. 24 , Issue 2, p. 148–160 (February 2016).

17 "Halophilic *Archaea* Cultured from *Ancient Halite, Death Valley, California*, Schubert, B.A., Lowenstein, T.K., Timofeeff, M.N., and Parker, M.A., *Environmental Microbiology* 2010, Vol. 12, No. 2, p. 440–454.

18 "Haloarchaeal Diversity in 23, 121 and 419 MYA Salts," Park, J.S.; Vreeland, R.H., Cho, B.C., Lowenstein, T.K., Timofeeff, M.N., Rosenzweig, W.D., *Geobiology* 2009, 7, 515–523.

19 "Ribosomal RNA Gene Fragments from Fossilized Cyanobacteria Identified in Primary Gypsum from the Late Miocene, Italy," G. Panieri, S. Lugli, V. Manzi, M. Roveri, B. C. Schreiber and K.A. Palinska, *Geobiology* 2010, 8, 101-11.

20 "High-Precision Drilling and Extraction of Micro-sized Material in Geologic Samples: Implications for Astrobiology," M. Ivarsson, M. Swillo, A. Neubeck, N.G. Holm, C. Broman, G. Björk, 42nd Lunar and Planetary Science Conference (2011).

21 "Distribution of Cambrian Salt-Bearing Basins in China and its Significance for Halite and Potash Finding," Shuli Wang, Mianping Zheng, Xifang Liu, Xinsheng Niu, Wenxi Chen, Kui Su, *Journal of Earth Science* Vol. 24 No. 2, 212-233 (2013).

22 French filmmaker Catherine Tissier and her production team.

23 "Chefology: There Might Be Bacteria in Your Artisan Sea Salt", Scott Jones, Benjamin Wolfe, *Boston Magazine*, December 23, 2013.

24 "Determination of Specialty Food Salt Origin by Using 16S rDNA Fingerprinting of Bacterial Communities by PCR−DGGE: An Application on Marine Salts Produced in Solar Salterns from the French Atlantic Ocean," Laurent Dufosse, Clara Donadio, Alain Valla, Jean-Christophe Meile, Didier Montet, *Food Control* 32 (2013) 644-649, Elsevier.

25 Halophiles are naturally saturated to balance cell-membrane transfer activity with surrounding hypersaline media. As a result, many halophilic organisms will simply explode when suspended pure water.

26 "Asteroidal Water within Fluid-Inclusion-Bearing Halite in an H5 Chondrite, Monahans," Zolensky, Michael E., Bodnar, Robert J., Gibson, Everett K., Nyquist, Laurence E., Reese, Young, Shih, Chi-Yu, and Wiesmann, Henry, 1999, (1998), *Science*, Vol. 285, p. 1377-1379.

27 "Asteroidal Water within Fluid-Inclusion-Bearing Halite in Ordinary Chondrites" (abstract), Zolensky, Michael E., Bodnar, Robert J., and Rubin, A. E., *Meteoritics and Planetary Science* 1999, Vol. 34, p. A124.

28 "Extinct 129I in Halites from a Primitive Meteorite: Evidence for Evaporite Formation in the Early Solar System" James Whitby, Ray Burgess, Grenville Turner, Jamie Gilmore, John Bridges (2000), *Science*, Vol. 288: 1819-1821.

29 In accord with the "proper motion" of stars, the Sun travels in a nearly circular orbit around the galactic core. The Solar System is traveling at an average speed of 828,000 km/h (230 km/s) or 514,000 mph (143 mi/s) within its trajectory around the center of the Milky Way. One galactic year, the time it takes the Sun to complete one orbit around the center of the galaxy, equals about 225 million years. Modern humans appeared about 0.001 galactic years ago, or about 1/1000th of a single orbit of the Sun around the galactic core. In the future, around four galactic years from now, carbon dioxide levels in the Earth's atmosphere are expected to drop to levels at which C4 photosynthesis becomes impossible and multicellular life on our planet dies out.

Carlo Ratti (IT), Daniele Belleri (IT)

Living in a New Babylon

Beauty and Urban Utopias in the Age of Networks

The least known of the urban revolutions of the 20th century began exactly 60 years ago, by chance, in the least likely place of all: a gypsy camp on the outskirts of Alba, in the Langhe region of Italy.

This is where Constant Nieuwenhuis, the Dutch artist known as Constant, went walking on a piece of land owned by his friend, the Piedmontese painter Giuseppe Pinot-Gallizio. Then and there, Constant had an insight that would change our way of looking at cities, at their workings and at their beauty. During those weeks, in that territory on the edges of the Tanaro River, a group of Sinti had set up camp. Approaching the community, observing their rhythms, Constant saw the possibility of a completely new architecture, an architecture with which one could imagine an existence conducted in perpetual motion.

In other words, on that day in in Alba in December 1956, the first seed of *New Babylon* had been planted. This was the urban and human utopia on which Constant would continue to work for almost two decades. In documents accumulated over time— drawings, models, and blueprints now largely preserved in the Gemeentemuseum in The Hague—*New Babylon* is presented as an indefinitely extended settlement, in the form of a huge network of raised platforms that cross the whole of Europe. In this "camp for nomads on the planetary scale," human lives would take place within enclosed, remodelable spaces. Each individual could lead a fluid existence, free to reconfigure their place of residence, their domestic space, and their attitude toward work. *New Babylon* would be inhabited by a new type of human—which, taking inspiration from the historian Johan Huizinga, Constant dubbed *Homo ludens*— whose flexible lives would break down every distinction between work and art.

Beyond the political message, which is an expression of the mid-20th-century climate, we read in Constant's work an extraordinary anticipation of some of the paradigms that define the 21st-century experience, such as low-cost mobility and the hybridization of working time and leisure time. Finally, in a fundamental way, we arrive at the idea that the city can be represented as a network of fluxes (which brings us to a key phrase that Constant could not have known, and which we will discuss later: big data). In short, from the starting point of *New Babylon*, beauty in architecture also becomes beauty in movement: to say "dynamic architecture" is no longer an oxymoron.

The idea of studying and representing fluxes in the spaces in which we live is not new; it even accompanied the birth of the modern West. In 1869, the French engineer Charles Joseph Minard created an illustrated map that reconstructed the disastrous Russian campaign of Napoleon's troops in 1812-13. Along with the geographical representation, the key to the map also included such information as the passing of the weeks, the degrees below zero, and the troop numbers—represented in thinner and thinner fluxes, as the French soldiers succumbed to the blows of "General Winter". Minard thus became one of the fathers of modern infographics (ironically, it is Napoleon to whom the phrase "a good sketch is better than a long speech" is often attributed). Then, at the beginning of the 20th century, the works of the Futurists gave us images of "The City That Rises," expressions of amazement about the first car races through European cities. Later, but still contemporaneous with Constant, Harold Edgerton, the father of high-speed photography and inventor of the electronic flash, for the first time showed exactly how a bullet pierces an object, and how the

athletic prowess of a tennis player or a ballerina can be frozen into a sequence of fascinating static gestures. However, it is *New Babylon* that brought about a turning point: fluxes are no longer merely an aesthetic phenomenon, but they are an ideal as well—the true paradigm of the urban future.

In the digital age, fluxes surround us. In 1957, when the French sociologist Chombart de Lauwe created a map of a Parisian student's movements over the course of an entire year, there was disappointment and even disdain in the discovery that the girl's life had been spent in three bourgeois locations: home, university, and piano lessons. Today, thanks to GPS, each of us could potentially be mapped in the same way. Sooner or later, writers or psychologists will certainly coin a term for that particular sense of postponed disorientation that comes upon us when we look at our individual "Google Location History," and are confronted by a place we simply don't remember, when we ask ourselves, "But was I really ever *there*?" The fluxes fascinate us because they are mysterious as well as revelatory. Although Constant's metropolis-world was never realized, his vision continues to inspire us. After all, don't intercontinental airports resemble the crucial nodes of the network of *New Babylon*, traversed by an elite group of global travelers—the first capitalist *Homines ludentes*?

With fluxes, we are not limited merely to observing the urban environment; in fact, we can also analyze it in order to figure out how to achieve a better design. Fluxes are one of the most important subjects of investigation for the future of architecture. They are the focus of many projects we have worked on in recent years, both at MIT in Boston, as well at the architectural firm of Carlo Ratti Associati in Turin. Our goal is to understand how to redesign the city, beginning with the data trails that our everyday life leaves behind in ever greater measure. Data from mobile phones and sensors, when interpreted, may become an additional tool to approach more closely the mystery of the city—that "poem I have failed to fix in words," as Jorge Luis Borges described it in the early decades of the 20th century, expressing his affection for Buenos Aires. In pondering a name for this new city, we came up with the term "Senseable City": the city that senses the data, and which, at the same time, is also a sensitive city, close to the people and to their need for beauty.

With our 2006 project, *Real Time Rome*, we used the data from the Roman cellular networks to interpret local mobility. One evening that summer, we watched with amazement as the entire city started to move synchronously. It was the night of the Soccer World Cup Final in Germany, and, almost as if they were one body, millions of people began to pulsate and party together. It was the first time that this type of information—big data on the urban scale—had been used for reading the city. The drawing of the illuminated metropolis, bordered on one side by the sea and, on the other, by hilly hinterland, seemed to create the shape of a beating heart—recalling that idea, again Borges', that the streets of the city "are the core of my soul."

Still on the subject of traffic, but on the other side of the ocean, we analyzed the movements of the taxis and the rate of sharing in the daily mobility of New York City. Wouldn't life in the sensitive city be ever more based on a sharing economy? Developing this project—which was the beginning of a collaboration with Uber—other images resurfaced in our minds. That is, images from *Koyaanisqatsi*, an experimental documentary from the early 80s, whose plot consisted of an uninterrupted sequence

of accelerated filming, including night sequences of the super-crowded, raised highways of American cities. If today we support the sharing economy, in the hope of having fewer and fewer cars around us, perhaps it is also because those hypnotic and vorticist visions—rivers of cars in a maze of skyscrapers—have never ceased to unsettle us. Sometimes, the beauty of the city of flux can be frightening and irresistible at the same time.

Returning to Europe, and speaking of other experiences worth sharing, we entered the Louvre in Paris to investigate the movement of visitors inside this city within a city. We found that everyone, even those who have very little time to spend in the galleries, attempts to reproduce similar paths, in a common search for gratification. The link between aesthetics and ethics is ever more inextricable: in 2009, via GPS tags, we had begun to trace the movement of waste across the United States, to reveal the irrationality of disposal cycles that sometimes cover thousands of kilometers. Haunted by visions of Coca-Cola cans that journey from California to Florida, some citizens of Seattle have confessed to us that they have spontaneously decided to change their habits—for example, they have given up buying water in plastic bottles. To have attracted the attention of these people would have been difficult without fluxes that are able to tell these impassioning stories. Building on this success, a few months ago, we launched the second part of the project, in which we were able to identify the smuggling routes of electronic waste, from North America to Southeast Asia.

Constant dreamed of New Babylon as a dynamic space, in which every room of *Homo Iudens* could be remodulated—using a range of light, color, sound insulation, ventilation systems, temperature, as well as moveable walls, ramps and stairs. This too is a field of research for us, and it always stems from the flux of data to achieve a tangible form. The idea that architecture can become like a third skin, reflecting our lives in movement, inspired us to create workplace projects such as the one in the Agnelli Foundation in Turin while with the Digital Water Pavilion for the Zaragoza Expo, we constructed a digital water architecture that draws the contours of dynamic buildings.

In short, this is our vision of the Senseable City inspired by *New Babylon*: an open environment, given to sharing, in which everyone is free to move about and decide where to live. An architecture that is not only beautiful in its appearance, but that also shows fluid harmony in its functioning. Like the New Babylon envisioned by Constant, it is a city that knows how to become the platform on which we can interweave our respective lives with grace and tolerance—the beauty of life in all of its dynamic variety.

In the age of networks, we are ever more strongly witnessing the rise of a new generation—of artists, programmers, graphic designers, makers, writers—who call themselves digital nomads. These young people, perhaps without being aware of it, are giving new lifeblood to Constant's ideas. Working and at the same time enjoying themselves—a week of co-working on a beach in Thailand, a day at a cafe in Mexico City, a month in an Airbnb room in a Norwegian village. They are trying, in short, to realize the hopes of *Homo Iudens*, and to give birth to new visions, not only in the great cities, but also in the remote outskirts of the world—a bit like what happened on the outskirts of Alba that day in December 60 years ago.
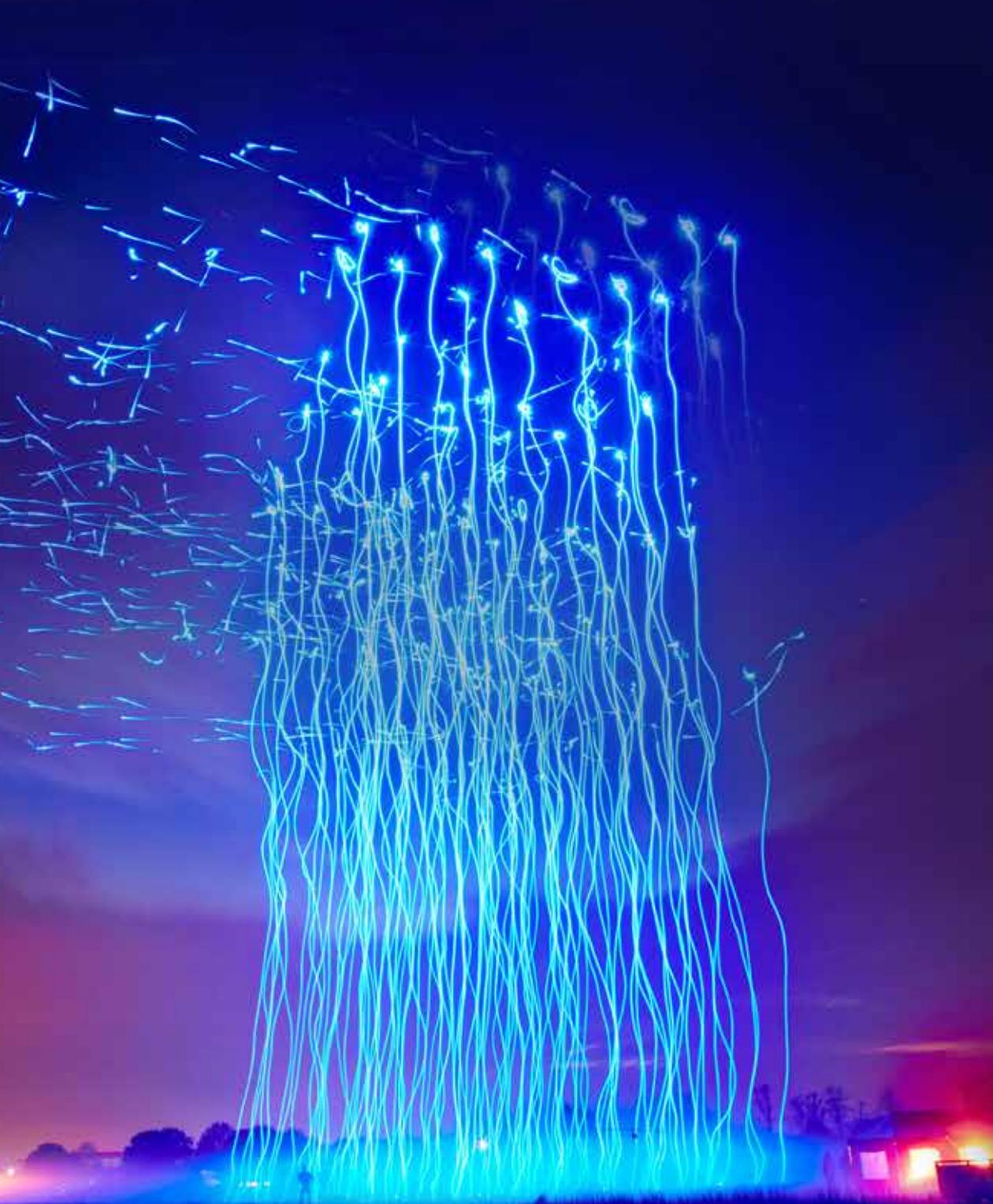
Drone 100 – Intel in collaboration with Ars Electronica Futurelab holds the world record in the category Most Unmanned Aerial Vehicles (UAVs) Airborne Simultaneously. *Photo credit: Intel Corporation*

ART & SCIENCE

Digital Art and Science Program at the 2016 Ars Electronica Festival

The huge current interest in forms of interdisciplinary collaboration shines what or many people is a long-overdue spotlight on the multifarious possibilities that can emerge from exchange and cooperation among, on one hand, art and creativity, and, on the other hand, science and technology. Moreover, an increasing number of observers are applauding the fact that, above all, there is finally widespread realization of a paradigm shift having occurred in a world that is now globalized not only geographically and economically but intellectually as well.

Driven by correspondingly wide-ranging motivations, more and more artists are lighting out to explore these territories. They are in search of new sources of inspiration, and they also want their artistic work to make an impact beyond the confines of the art world. In going about this, they often pursue trails that were blazed long ago, and sometimes without knowing too much about that back story. After all, the history of media art, and especially its roots in adventuresome collaboration among artists and scientists, is still a subject on which far too little research has been performed and published. Accordingly, it is particularly gratifying that Jassia Reichard, the curator of the legendary Cybernetic Serendipity exhibition, is the 2016 recipient of the Prix Ars Electronica's Golden Nica award for a Visionary Pioneer of Media Art.

What is striking is the greatly increased readiness on the part of both individual scientists and a growing number of institutions to make a commitment to these liaisons. Such prestigious research institutions as CERN—European Organization for Nuclear Research, the European Southern Observatory and the European Space Agency now host artist-in-residence programs under the aegis of the European Digital Art and Science Network subsidized by the EU.

By means of a network linking Ars Electronica to many other cultural facilities throughout Europe

and abroad, the experiences and insights, the experiments and prototypes that are emerging from these residencies are being presented to the general public, and thereby not only contribute to broader awareness and understanding of new scientific findings but also provide prototypical scenarios for reflection on the process of social and cultural change.

The private sector too is progressively seeking new ways and means, and has come to regard artistic creativity as an important resource that can lead to competitive innovations. Of course, such efforts to maximize art's practical benefits have to be approached very cautiously to avoid being one-sided, and the expectations associated with them need practiced moderation. This is one of the essential challenges facing Ars Electronica, an institution whose staff have decades of experience dealing with interdisciplinary working methods and their unique nature. In this connection, Ars Electronica,

with its prominent role in the European Digital Art and Science Network's programs, is increasingly regarded by representatives of the private sector as an international point of reference for creative innovations, and the Festival Ars Electronica has become a dynamic meeting place for a broad spectrum of stakeholders who have noticed that interesting things are happening here.

The Digital Art and Science program at this year's Festival Ars Electronica includes a series of projects and events that, together, will yield a comprehensive and enlightening picture of the latest developments and trends.

• Radical Atoms—Exhibition and Symposia
• Alchemists of our Time—Exhibition and Symposium
• New Paradigms for Art & Technology Labs— Symposium
• Prix Forum Art & Science
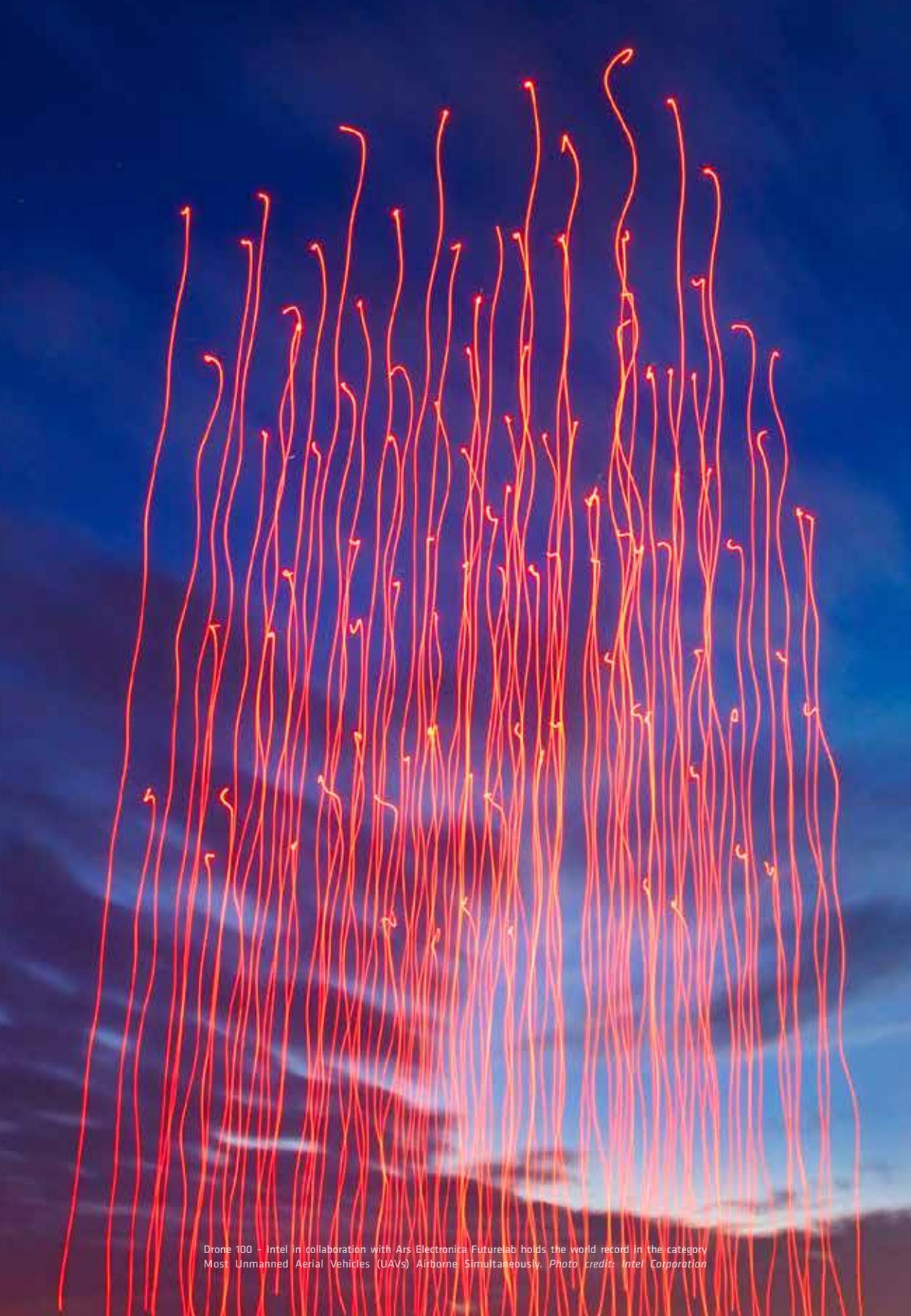
Drone 100 – Intel in collaboration with Ars Electronica Futurelab holds the world record in the category Most Unmanned Aerial Vehicles (UAVs) Airborne Simultaneously. *Photo credit: Intel Corporation*

RADICAL ATOMS exhibition

Arranged on a thematic and chronological axis, this exhibition takes the theories and works of Hiroshi Ishii, a professor at the MIT Media Lab and one of the pioneers in artistically inspired technological development, as its point of departure. Examples from the early years of the *Tangible Bits* Group demonstrate how ideas derived from art led to the development of trailblazing and fundamentally new technological concepts. First and foremost among them are *musicBottles*, a 1999 work by Hiroshi Ishii (US/JP). The subsequent thematically structured sections elaborate on current R&D work. The impact isn't so much the result of the technically remarkable functional efficiency of the exhibits on display, but rather the result of what these prototypes are still incapable of—but nevertheless immediately enable us to infer and extrapolate. Each of these projects is an inspiration incubator in its own right.

Supplementing this exhibition are works by Carlo Ratti (US), Joachim Sauter (DE) and the Ars Electronica Futurelab, which will remain on display after the festival at the Ars Electronica Center.

Hiroshi Ishii | Tangible Media Group | MIT Media Lab

Radical Atoms Exhibition at the Ars Electronica Center

In 1997, Tangible Media Group presented our *Tangible Bits* vision of the physical embodiment of digital information & computation, at the CHI '97 conference. During 2001 to 2003, a dozen *Tangible Bits* projects were presented at the "Get in Touch" exhibition at Ars Electronica Center. Since then, Tangible Media Group has been working to evolve our *Tangible Bits* vision to the next level, resulting in

our current vision of *Radical Atoms*; dynamic physical & computational material. As illustrated below, we have developed various streams of *Radical Atoms* projects, such as actuated tabletop tangibles, kinetic materials, dynamic shape displays, and programmable materials. In this exhibition, we present the evolution from our classic *Tangible Bits* projects such as *musicBottles* and *SandScape* to

EVOLUTION
From Tangible Bits to Radical Atoms

STATIC / PASSIVE

DEFORMABLE TANGIBLES

Illuminating Clay	**SandScape**
CHI '02	ARS Electronica '02

DYNAMIC SHAPE DISPLAYS

Relief	**Recompose**	**SUBLIMATE**	
TEI '09, UIST '11	UIST '11	CHI '13	UI

PROGRAMMABLE MATERIALS

Jamming UI	**PneUI**	**jamSheets**
UIST '12	UIST '13	TEI '14

TABLE TOP TANGIBLES

metaDesk	**Urp**
CHI '97 UIST '97	CHI '99 SIGRAPH '98

Sensetable
CHI '01

ACTUATED TABLE TOP TANGIBLES

PSyBench	**Actuated Workbench**	**PICO**
CSCW '98	UIST '02	CHI '07

musicBottles
CHI '01

KINETIC MATERIALS

TELESYNCED   **RECORD + PLAY**

inTouch	**curlyBot**	**Topobo**
CSCW '98	CHI '00	Chi '04, '06, '08

Radical Atoms projects, such as *Topobo*, *inFORM*, *LineFORM*, *PneUI*, *jamSheets*, and *bioLogic*. In addition to the projects from the Tangible Media Group, we are also exhibiting a number of projects from other labs across MIT and the world, such as *Lift-Bit*, *Infinite Cube*, *Spaxels*, *Rovables*, and *Active Wood Products*.

Through a combination of projects crossing altitudes and domains, we present our vision of *Radical Atoms*, where atoms dance across scale and axes, and the static becomes alive and active.

The projects to be exhibited in the framework of Radical Atoms exhibition are:

TMG Classics: *musicBottles* (Tangible Media Group |

MIT Media Lab), *SandScape* (Tangible Media Group | MIT Media Lab), *Topobo* (Tangible Media Group | MIT Media Lab).

Shape-Changing Materials: *inFORM* (Tangible Media Group | MIT Media Lab), *LineFORM* (Tangible Media Group | MIT Media Lab), *Lift-Bit* (Carlo Ratti Associati and OpenDot team), *Infinite Cube* (ART+COM), and *Spaxels* (Ars Electronica Futurelab).

Programmable Materials: *PneUI* & *jamSheets* (Tangible Media Group | MIT Media Lab), *bioLogic* (Tangible Media Group | MIT Media Lab), *Rovables* (Responsive Environments Group | MIT Media Lab), *Active Wood Products* (Self-Assembly Lab | MIT School of Architecture & Planning).

ACTIVE / KINETIC

RADICAL

inFORM	TRANSFORM	Cooper Hewitt inFORM	Kinetic Blocks	Materiable
UIST '13, UIST '14	Milano Design Week '14 CHI '15	Cooper Hewitt Museum '15	UIST '15	CHI '16

OptiElastic	bioLogic	uniMorph	bioLogic	Cillia
UIST '14	UIST '14, CHI '15	UIST '15	Media Lab Exhibit '15	CHI '16

LEVITATING MATERIALS

ZeroN
UIST '11

MOTION DESIGN TOOLKITS

Kinetic Sketchup	Bosu
DIS '10	DIS '10

SELF RECONFIGURABLE

LineFORM	ChainFORM
UIST '15	UIST '16

The Future of Radical Atoms

PHASE SHIFT

PROGRAMMABLE MATERIALITY

BIOLOGICAL SYMBIOSIS

LEVITATION

SELF ASSEMBLY

musicBottles

musicBottles is an installation to interact with sound waves encapsulated in transparent glass bottles. The bottles are used as containers for trapping audio memories; escaping the bottle and vaporizing into sound at the opening of a lid. In 1999, *musicBottles* was first introduced as a tangible interface for handling digital information. The bottles "contained" the sounds of the violin, the cello and the piano in Edouard Lalo's *Piano Trio in C Minor, Op. 7*. Opening a bottle by removing its stopper made the corresponding instrument audible. In addition to the sounds played, a pattern of colored light was projected onto the table's translucent surface to reflect changes in pitch and volume. Originally, *musicBottles* used custom-designed electromagnetic tags embedded in the bottle and the stopper, allowing wireless identification of the containers. This 1st generation *musicBottles* was exhibited in Ars Electronica Center in 2001–2003. The modern version now works using weight sensor and custom algorithms that detect discrepancies in the subtle changes to the bottles when opening.

Exhibition: Udayan Umapathi, Penny Webb, Mitchell D Hwang, Patrick Shin and Hiroshi Ishii
Research: Rich Fletcher, Ali Mazalek, Jay Lee, Seungho Choo, Joanna Berzowska, Craig Wisneski, Charlie Cano, Andres Hernandez, Colin Bulthaupand, Joe Paradiso and Hiroshi Ishii

SandScape

SandScape is a tangible interface for designing and analyzing landscapes through a direct form-giving with hands using sand and computational simulations that are projected on the surface of a sand model that represents the terrain. The users can choose from a variety of different simulations that highlight either the height, slope, contours, shadows, drainage or aspect of the landscape model. *SandScape* exemplifies the *Tangible Bits* vision that blends physicality and digitality into sand, which is directly manipulatable with tactile feedback. The first generation of *SandScape* was exhibited at Ars Electronica Center between 2002 to 2003.

Exhibition: Daniel John Fitzgerald, Luke Vink, Ken Nakagaki, Nikolaos Vlavianos, and Hiroshi Ishii
Research: Yao Wang, Assaf Biderman, Ben Piper, Carlo Ratti and Hiroshi Ishii
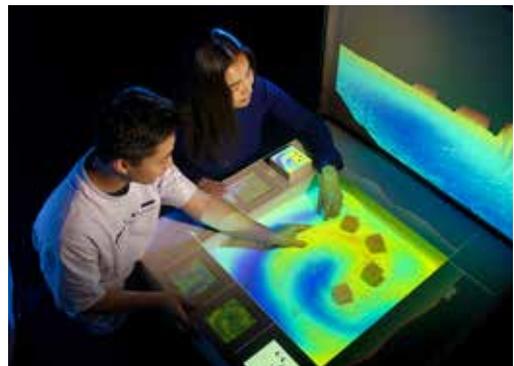
Topobo

Topobo allows us to sculpt with motion. *Topobo* is a construction toy with a kinetic memory, able to record and playback physical motion. Snap together passive (static) and active (robotic) pieces into a creation, and with a press of a button and a flick of the wrist, you can teach your creation how to dance or walk. The same way you can learn how buildings stand by stacking up blocks, you can discover how animals walk by playing with *Topobo*. *Topobo* received an Honorary Mention in 2004's Prix Ars Electronica in the category Interactive Art.
Kinetic and reconfigurable materiality of *Topobo* lead us to the vision of *Radical Atoms* later.

Exhibition: Penny Webb and Hiroshi Ishii
Research : Hayes Raffle, Amanda Parkes, Laura Yip and Hiroshi Ishii

inFORM

Imagine being able to reach out and grasp a digital model right in front of you, or to handle physical objects thousands of miles away! This vision has inspired *inFORM*, a shape display that gives physical form to digital information. Motorized pins act like physical pixels that extend from a tabletop to form a dynamic, computer-controlled sculpture that users can view, touch and deform. Besides rendering information, *inFORM* can interact with the world around it by accurately moving and manipulating objects placed on its surface. We have utilized *inFORM* as a platform to explore how programmable materials transform how we work, play, and make art. The system installed at Ars Electronica demonstrates a scenario for collaborating over a distance. Remote participants in a video-conference can be rendered physically, allowing for a strong sense of presence and the ability to manipulate distant objects.

Exhibition: Daniel Leithinger, Ken Nakagaki and Hiroshi Ishii
Research: Daniel Leithinger, Sean Follmer, Alex Olwal, Philipp Schoessler, Jared Counts, Ken Nakagaki, David Doan, Basheer Tome, Akimitsu Hogge, and Hiroshi Ishii
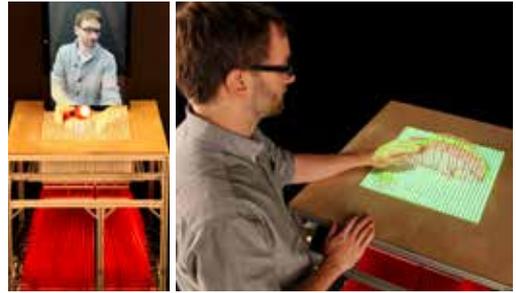
Sean Follmer

LineFORM

LineFORM is a shape-changing interface in the form of a "line". Physical lines have several interesting characteristics from the perspective of interaction design: they have a variety of inherent affordances; they can easily represent abstract data; and they can act as constraints, boundaries, or borderlines. By utilizing such aspects of lines and curves, together with the added capability of shape-changing, new possibilities for display, interaction and body constraint are available. We investigated such interaction possibilities using our hardware prototype based on snake robotics technology. *LineFORM* presents a wide range of applications such as shape-changing cords, mobiles, body constraints and data manipulation tools. *LineFORM*

Ken Nakagaki

envisions a future in which shape-changing strings will be woven into our everyday life.

Exhibition: Ken Nakagaki, Nikolaos Vlavianos and Hiroshi Ishii
Research: Ken Nakagaki, Sean Follmer, and Hiroshi Ishii

Carlo Ratti (US)
Lift-Bit

Lift-Bit is a modular, digitally reconfigurable furniture system that allows a sofa to seamlessly turn into a chair, a chaise longue, a bed, a complete lounge and a myriad of other configurations. The system is composed of a series of individual, upholstered stools. Each element is motorized using a linear actuator, enabling it to be raised or lowered. It can double (or halve) in height in just a few seconds. *Lift-Bit* can be controlled in person, via a simple gesture (just by hovering your hand over the seat), or from a distance by a mobile app. The app includes both a series of predetermined three-dimensional shapes and a tool to create dynamic new combinations. Paying homage to radical British architect Cedric Price's 1970s *Generator Project*, the *Lift-Bit* system can even become "bored": if it is not used for a long time it will start shape-shifting on its own to engage users.

Exhibition: Lift-Bit is a project by Carlo Ratti Associati, developed with the support of Vitra; Engineering and interaction design: Opendot; Originally realized in spring 2016 for the ROOMS: Novel Living Concepts exhibition organized by Salone del Mobile.Milano as part of the XXI Triennale; Carlo Ratti Associati team: Carlo Ratti, Giovanni de Niederhausern, Andrea Cassi (project leader), Ina Sefgjini, Damiano Gui, Antonio Atripaldi, Emanuele Protti, Gary Di Silvio, Daniele Belleri; OpenDot team: Alessandro Masserdotti, Fabrizio Pignoloni, Vittorio Cuculo.

Mybosswas

ART+COM Studios (DE)
Infinite Cube, 2006/2010/2013

Infinite Cube is a spatially concentrated but at the same time expansive kinetic installation. The spheres follow a computational narrative that molds them into a fluid succession of abstract shapes. An optical illusion extends the apparently clear spatial confines of the installation into infinity. Viewers are also reflected in the installation, and their presence adds an additional layer to the interplay of real and reflected space. Combined with the specially composed music by Ólafur Arnalds, a poetical correlation of the three elements of reflection, sound and movement is obtained.

Credit: ART+COM Studios
Sound: Ólafur Arnalds

Nils Krüger

Kunsten Museum Aalborg

PneUI

Energy or substance, air is one the most abundant resources on earth. In many mythologies across cultures, air brings life to animated static substance. By adding computational ability to air, inert materials can be activated and transformed. This work presents a design, simulation and fabrication strategy for making various transforming materials by inflation. We introduce a bending mechanism that creates multiple, programmable shape-changing behaviors with non-extensible materials, including paper, plastics and fabrics; a software tool that generates these bending mechanism for a given geometry, simulates its transformation. With these tools, new materials are created to design robots that are soft, furniture that is adaptive, clothing that is intelligent and artworks that breathe.

jifei

jamSheets

jamSheets represent a new generation of sheet material for design. In the process of design and architectural design, sheet materials have frequently been used to transform flat surfaces into three-dimensional objects by cuts and folds. In this project, rather than looking at how to use sheet materials to create form, we explored how to dynamically control their stiffness. We invented a thin, lightweight material composite that can be tuned between rigid and soft states seamlessly. Shifting the focus from designing form to designing stiffness would enable a new type of human-material interaction. When the material is soft, one can form it as desired, then switch it to rigid and let it perform. By switching it back to soft, one can reshape the material again. The prototype of *jamSheets* shows a formal and functional adaptive furniture: from a carpet to a table to a chair and back. The idea of programmable stiffness-changing materials could be scaled up beyond furniture design, such as medical devices, wearables, even for aircraft design.

bioLogic

bioLogic provides a platform involving living actuators that are grown rather than made. It is a bio-hybrid "second skin" that is functional, interactive, and intelligent. This work exists in the era where 'bio' can be considered as a new interface between environment and our body. *bioLogic* seeks this harmonious perspective, where biological and engineering approaches are in sync. These animated bacterial cells are harvested in a bio lab, assembled by a micron-resolution printing system, and transformed into responsive fashion, a "second skin" The synthetic transformable bioskin reacts to body heat and sweat, causing flaps around heat zones to open, enabling sweat to evaporate and cool the body through an organic material flux. In collaboration with New Balance, bioLogic is bringing what once may have lived in the realm of fantasies into the world of sportswear.

Exhibition: Lining Yao, Jifei Ou, Wen Wang, Hiroshi Ishii
Research : Lining Yao, Wen Wang, Guanyun Wang, Helene Steiner, Chin Yi Cheng, Jifei Ou, Oksana Anilionyte, and Hiroshi Ishii

Linign Yao
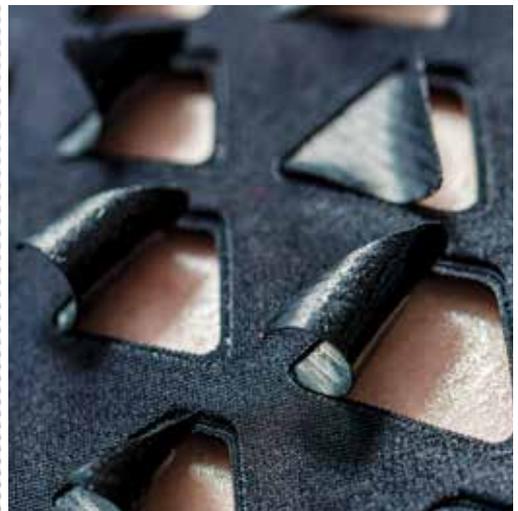
Rob Chron

Rovables

In the future we imagine swarms of fingernail-sized robots moving autonomously around clothing. Such robots will adapt to the user's style and preferences, and appear and disappear seamlessly to do a variety of tasks. For example, they can form a wristwatch when you look at your wrist, and otherwise disperse to sense your health all over the body, or turn into jewelry. To realize this concept of dynamic wearables we developed *Rovables*, miniature robots that can move freely on unmodified clothing. The robots are held in place by neodymium magnet wheels gripping between fabric. They are autonomous, with on-board power, computation and wireless communications. We also developed algorithms and sensors to track and control the position of each robot, allowing some autonomous operations. We explore a range of application scenarios for *Rovables* such as tactile feedback, body-motion sensing, mobile jewelry, and wearable displays.

Exhibition: Artem Dementyev and Joe Paradiso
Research: Artem Dementyev, Hsin-Liu (Cindy) Kao, Inrak Choi, Deborah Ajilo, Maggie Xu, Joe Paradiso, Chris Schmandt, Sean Follmer

Artem
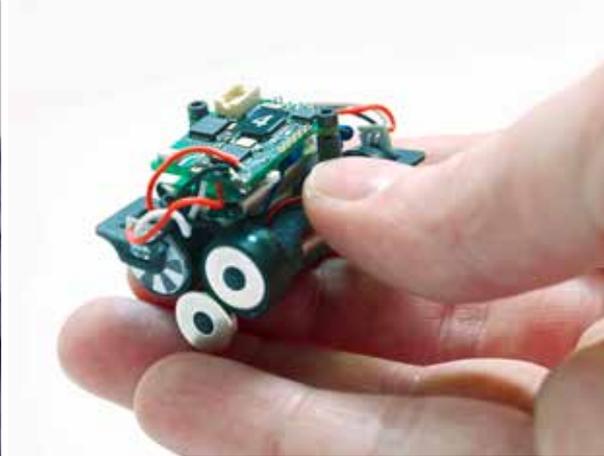
Christophe Guberan (CH) and the Self-Assembly Lab | MIT (US)

Active Wood Products

Traditional wood-bending techniques require complex steaming equipment, labor-intensive forming processes and a high degree of expertise. In addition, the natural pattern of wood grain and its physical properties make it difficult to curve into complex shapes. Novel printing and composite material technologies can now overcome previous limitations on wood forming. Flat sheets of custom-printed wood composite can be designed to self-transform in controlled and unique ways. We have developed a series of two-dimensional patterns, wood-printing techniques and processes for moisture-activation that promote precise transformation from a flat sheet to curved, twisted or folded three-dimensional forms. *Active Wood Products* are produced with a printed wood filament and carefully designed flat patterns that when subject to moisture can self-transform into the final shape of the product. We imagine a variety of products from tableware to jewelry and even furniture that can be designed and printed, then shipped flat in a moisture pack and self-transform at home.
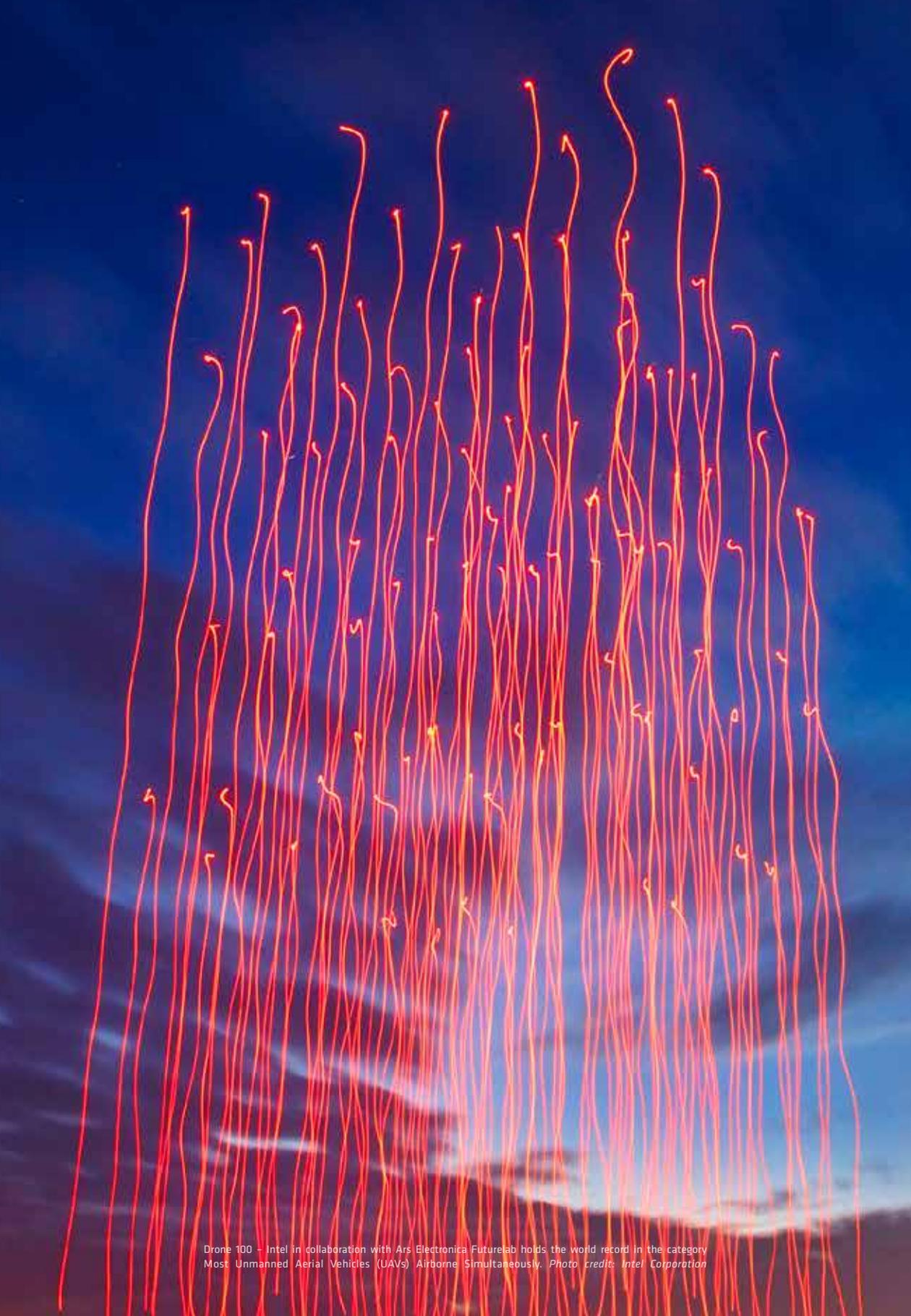
Drone 100 – Intel in collaboration with Ars Electronica Futurelab holds the world record in the category Most Unmanned Aerial Vehicles (UAVs) Airborne Simultaneously. *Photo credit: Intel Corporation*

THE ALCHEMISTS OF OUR TIME
exhibition

When you scrutinize the area of interplay at the nexus of art and science, you quickly recognize the key role of creative protagonists and their hybrid methods. However, in point of fact, interest is often focused more on the process itself than on the projects and physical results that emerge from them. This is why the Festival Ars Electronica has taken "Radical Atoms and the Alchemists of our Time" as its theme, a leitmotiv coined by Hiroshi Ishii that shifts attention to the human beings behind these works and developments.

An extensive exhibition will spotlight positions and approaches from both directions—science and art—in which concepts such as art-thinking and creative prototyping and the idea of artistic work as catalyst play major roles.

"Artists' Laboratories" will focus on the workplaces of artists and interdisciplinary teams, and thus shed light on the extraordinary ecosystem of art and science collaboration. These exhibits feature jointly produced works that offer deep insights into the concepts and practices of art and science collaborations.

This exhibition will also feature projects that are the outcome of current artist-in-residence programs. This year, an artists' collective called Quadrature spent time at the European Southern Observatory's research facilities in Chile and Germany.

Hideaki Ogawa (AT/JP)

the alchemists of our time

"Alchemy is a kind of philosophy: a kind of thinking that
leads to a way of understanding." Marcel Duchamp

The digital revolution has reconfigured our world in binary code and made it easier to integrate different elements beyond the boundaries of conventional concepts. Robotic cars, the Internet of Things, these are just two visible examples of radical changes we are going to experience. Digital computing is about to reach the quantum world, and from genetic engineering to synthetic biology, technologies are enhancing our ability to manipulate the fundamental laws of nature. Delusion, desires, dreams, or the hopes of humankind—now people have the means to experiment even with speculative ideas, and can create extraordinary moments that we have never experienced before. If we follow Duchamp's definition, it is alchemy, a philosophy that leads to a way of understanding, that is most called for in this era. Alchemy used to be a practice derived from a mixture of art and science. The practical alchemists, where are they now?

In Ars Electronica 2016 we will set up a lab in the POSTCITY to introduce what contemporary alchemists are actually doing. Artists, designers, scientists, engineers, activists and entrepreneurs, we will showcase their works and try to reveal their empirical approaches to developing our future through unique and unorthodox methods.

How do we confront the new concept of life in the era of genetic engineering? How is AI going to be externalized in our physical world? When we think of the advance of robotics and biotechnology, how can we redefine the notion of the Homunculus, the creation of artificial life? What kind of rituals and spiritualities do we need to prepare ourselves for the transition? How will biological information alter forms of communication? What happens if science enables us to perceive with a sixth sense by augmenting body's sensory awareness? What does immortality mean to us in the 21st century, and what if we already have the technologies that could become the elixir? Are we going to merge our physical existence with artificial technologies such as cybernetics? What is the future of food as human sustenance?

The emergence of 3D printers has extended our ability to fabricate things. How far will that allow our creativity to flourish? What will the new objects or furniture look like? How do creators explore their own technique in the process, and how will their

unique ideas bring us a magical experience? How will the new means of fabrication revolutionize the fashion industry? When smart textiles give us interactive clothing, how will it change the role of fashion? How do we treat them as our second skin? And what kinds of collaboration are going on in this field of art and industry?

The basic infrastructure to sustain daily lives in the new generation will have to be fundamentally remodeled. What is a better energy system in the future? How can we satisfy both sustainability and resilience? What will the role of public space be? How will technologies change the definition of architecture when it comes to be programmable, sensible, and even transformable buildings? What is the style of community in a world of pervasive connectivity? What should be governed and controlled in that society, and what should not be? And, when all of these remarkable technologies are readily available, what will it eventually mean for the whole society?

Humans developed various forms of "codes" when they created artifacts. "Coding" is an activity to create a medium that can convey ideas and functionalities. Long before the invention of computers, humans crafted analog code, such as "modeling" out of clay, "carving" out of wood, or "building" architecture. The emergence of computers introduced us a new code for computers: digital coding. And code is now expanding its limits to coding for matter: coding for "growing" biological cells, "catalyzing" specific chemical reactions, or "animating" living organisms.

In 2003, our theme for the Festival Ars Electronica was CODE—The Language of Our Time, which now gives us very insightful contrast to this year's theme: RADICAL ATOMS and the alchemists of our time. We can see a semantic transition from "language" to "alchemy", which suggests that in 2016 code is not just a language to control something behind black screens, but a series of dynamic transitional activities to be undertaken by artists and innovators. These are the living alchemists, who keep seeking artistic/scientific discoveries in an unknown world, forging creative relationships across the various disciplines, and trying to hammer out a better future. Along with the accelerated development of technology, humans must undertake certain risks and uncertainties. The work of the living alchemists will blaze a pathway to understanding the future.

Artist Lab
Quayola (IT)

Quayola is a visual artist based in London. He investigates dialogs and the unpredictable collisions, tensions and equilibriums between the real and artificial, the figurative and abstract, the old and new. His work explores photography, geometry, time-based digital sculptures and immersive audiovisual installations and performances.

KUKA

DAR|LAB
DIGITAL ARCHITECTURE ROBOTICS

QD The robotics solution

AUTODESK

Delcam

Sculpture Factory

Sculpture Factory is the latest iteration of Quayola's ongoing research on classical sculpture.

Inspired by Michelangelo's technique of "non-finito" (unfinished), the installation explores the tensions between form and matter, real and artificial, old and new. A large industrial robot live-sculpts endless variations of the Ancient Greek masterpiece *Laocoon and His Sons*. While never completing the full figure, each attempt discovers new articulations of matter. The result is a hybrid vision—a slow process of discovery not focused on the original figure but on the infinite possibilities of how to reach it. Guided by sequences of algorithms, the robot finds its way through matter using unfamiliar strategies and patterns. The original artist's hand and unique craftsmanship are eclipsed by the truly disinterested intelligence of the machine, and a surplus of viable possibilities.

Sculpture Factory is an ongoing project developed with the technical support of DARLab from London Southbank University, QD-Robotics, Kuka and Autodesk Delcam.

Nelo Akamatsu (JP)
CHOZUMAKI

CHOZUMAKI consists of a glass vessel filled with water. A small winged magnet rotating at the bottom of the vessel produces a vortex. The tiny bubbles cause curious sounds when they are swallowed into the vortex. Viewers will hear these sounds through a spiral pipe shaped like a cochlear duct.

Countless vortexes exist in the universe, including the enormous revolution of the galaxy and also the minimal spin of electrons. They all have a fractal structure that seems to be one of the fundamental elements of the universe. Water has another important role in this work. In numerous cultures is associated with purification.

The sight and sound of the water vortex that is constantly changing shape will remind viewers of crossing the boundary between the physical world and the psychological world, and will extend their perception of vital organs.

The 19th Japan Media Arts Festival

Ai Hasegawa (JP)

(Im)possible Baby, Case 01: Asako & Moriga

The 19th Japan Media Arts Festival Art Division Excellence Award

After taking genetic information from a same-sex couple to generate DNA data for the children they might have together, the results were used to produce "family photographs." Though a same-sex couple cannot conceive a child using current technology, based on the genetic information it is possible to predict what kind of baby they would have. After obtaining the couple's DNA data from a genetic analysis service called "23andMe" and uploading it to the *(Im)possible Baby* Simulator, the program randomly generated genetic profiles for their children. With advances in stem-cell research, having children may no longer be a fantasy for same-sex couples. Even if it becomes technically possible, there are ethical issues that must be addressed before the procedure can actually be used. Who is qualified to decide whether such a procedure is right or wrong? The work explores how art can provide people with an opportunity to participate in decision-making processes that are related to scientific technology.

Credit: © Ai Hasegawa
Supported by MIT Media Lab Design Fiction Group

Artist Lab
Iris van Herpen (NL)

Iris van Herpen, born in 1984, is a fashion designer. She studied fashion design at ArtEZ Institute of the Arts Arnhem and was an intern at Alexander McQueen in London and Claudy Jongstra in Amsterdam. Van Herpen immediately caught the eye with notable shows. In 2007 she started her own fashion label. Iris van Herpen creates women's-wear collections. Her designs always require a unique treatment of material or the creation of complete new materials. For this reason, van Herpen prefers interdisciplinary research and collaborations with artists from various disciplines, often on a recurring basis. Since July 2011, she has been a guest member of the prestigious Parisian Chambre Syndicale de la Haute Couture, which is part of the Fédération Française de la Couture. She participates in many international exhibitions and creates two collections a year. Her work has been recognized through awards, exhibitions, publications and the above-mentioned guest membership.

http://www.irisvanherpen.com

Magnetic Motion

Iris van Herpen explores the interplay of magnetic forces. By thoroughly examining the representation of dynamic forces of attraction and repulsion, the designer fuses nature and technology. Earlier this year, van Herpen's visit to CERN's Large Hadron Collider, whose magnetic field is 20,000 times bigger than the Earth's, provided inspiration for *Magnetic Motion*. "I find beauty in the continual shaping of chaos, which clearly embodies the primordial power of nature's performance," says van Herpen describing the essence of the collection. Van Herpen stayed true to her spirit of bridging fashion and other disciplines by collaborating with the Canadian architect Philip Beesley and the Dutch artist Jolan van der Wiel. Beesley is a pioneer in responsive "living" sculpture, whose poetic works combine advanced computation, synthetic biology and mechatronics engineering. Van der Wiel is an artist and craftsman whose work with magnetic tension has resulted in dynamic sculptures and installations that bring to mind the power of volcanic eruptions. Both artists strive to erase the boundaries between nature and technology in their work, which coincides with the direction of van Herpen's creative aim.

The designer has worked with techniques like injection molding and laser cutting on maze-like structures, 3D printing and intricate architectural handwork on dresses, jackets, trousers, skirts and

blouses, giving them dynamic shapes and surfaces that echo the body's movement. The three-dimensional nature and the layering of the garments give them volume.

Emphasizing light and shadow play, micro webs of lace both veil and reveal the luminescent glow of crystal forms, while triacetate feathers punctuate the soft drapes and volumes. The controlled structure of the clothes is offset by the chaotic structure of the accessories, where, due to the nature of magnetic growth, no two items are alike. The shoes, belts, necklaces and clutches were "grown" using magnetic fields.

The *Magnetic Motion Collection* was realized in collaboration with the following artists:
Philip Beesley, Niccolo Casas, Jolan van der Wiel

Morgan O'Donovan

ioulex

Yannis Vlamos

Artist Lab
Marjan Colletti (IT/AT/UK)

Dr. Marjan Colletti, born 1972 in Bolzano/Bozen (Italy), is an architect, an architectural educator, researcher, and co-principal of marcosandmarjan design limited in London. He is a professor at the University of Innsbruck (Austria) and head of the Institute for Experimental Architecture.
His own work, his students' work and that of his studio marcosandmarjan has been widely published and exhibited. He has exhibited in approx. 60 exhibitions worldwide and is a regular guest critic and lecturer internationally.

REX|LAB

The Institute for Experimental Architecture/Hochbau is part of the Faculty of Architecture at Innsbruck University and headed by Prof. Marjan Colletti. Since the establishment of the Robotic Experimentation Laboratory—*REX|LAB* in 2012, robotic fabrication methodologies have been a pivotal research trajectory for the institute. This engagement, at the increasingly fuzzy borders of the physical and the digital, allowed for a wide range of experiments that emphasize the relation between the material and design world.

Since the establishment of the *REX|LAB*, many international researchers and artists have collaborated with the institute. Currently, in cooperation with the industry, the Institute of Experimental Architecture/Hochbau is developing 3D concrete-printing processes—finally 3D printing should become relevant for large-scale building elements. This research cooperation is the continuation of previous activities at the institute, which have already shown reasonable success in a construction methodology that offers some obvious benefits compared to contemporary solutions to building concrete structures. While small-scale 3D printing has meanwhile become an easy-to-access technology, we aim to use industrial robots in combination with concrete to engage with architecture beyond printing mock-ups. Large-scale concrete printing has to challenge the influence of gravity caused by its own weight at a high level, since the material needs to provide initial stability as well as low cure times. The material itself, the extruder, the robotic choreography and the path planning, greatly depend on each other and therefore demand precise control of all aspects. As this research on large-scale printing with concrete continues we are confident we can actively shape this technology for commercial applications in the future and consequently allow architecture itself to be part of this development and embed all its creative potential in it.

Behnaz Farahi (IR)

Caress of the Gaze

What if our outfits could recognize and respond to the gazes of others? *Caress of the Gaze* is an interactive 3D-printed garment which can detect other people's gazes and respond accordingly with life-like behavior. It explores how our clothing could behave as an artificial skin capable of changing its shape and operating as an interface with the world, defining social issues such as intimacy, gender and personal identities. The project offers a vision of the future by exploring the possibility of second skin fabricated using multi-material 3D printing.

Ying Gao (CA/CN)

Incertitudes

The project was built around the idea of uncertainty. Both garments are activated by the spectator's voice. Through the motion of the pins, the garments engage the spectator on a conversational level, which is filled with misunderstanding(s) and uncertainty.

The beholder's voice initiates the mercurial movement of the dresses—call and response—creating an undulating conversation. And perhaps *incertitude* also stands as a metaphor for the unpredictability of human relations, whose only predictable constant is change and flux.

The singular character of this work is that it models incertitude or indeterminacy as an unstipulation, whereby an object or perception can transmute in various ways and become something else; the indefinite is not necessarily measurable but nor is it random.

Mathieu Fortin

Dr. Ivan Poupyrev (RU/US)

Project Jacquard

Dr. Ivan Poupyrev (RU/US) is an award-winning scientist, inventor and designer working at the cutting edge of interaction design and technologies blending the digital and physical realities. Ivan is currently a technical program lead at the Google's Advanced Technology and Projects (ATAP) division, where he directs efforts focused on interaction technologies and design for a future digital lifestyle.

Project Jacquard makes it possible to weave interactive touch and gesture into any textile using standard, industrial looms. Everyday objects such as clothes and furniture can be transformed into interactive surfaces. This is possible thanks to new conductive yarns, created in collaboration with our industrial partners. Jacquard yarn structures combine thin, metallic alloys with natural and synthetic yarns like cotton, polyester or silk, making the yarn strong enough to be woven on any industrial loom. Connected clothes offer new possibilities for interacting with services, devices and environments. These interactions can be reconfigured at any time. Jacquard is a blank canvas for apparel-makers. Designers can use it as they would any fabric, adding new layers of functionality to their designs, without having to learn about electronics. Developers will be able to connect existing apps and services to Jacquard-enabled clothes and create new features specifically for the platform.

http://www.projectjacquard.com
https://atap.google.com/jacquard

Google **ATAP**

NEFFA

Aniela Hoitink / NEFFA (NL)

MycoTEX

The purpose of *MycoTEX* was to create a textile out of living material and to develop a real garment out of it. Aniela started by combining mycelia with textiles, in order to create flexible composite products. But during the research process she developed a method for retaining flexibility without using traditional textile materials, but only pure mycelia. Building the textile out of modules provided a number of relevant benefits. Repair and replacement of the garment are easy and do not interfere with the look of the fabric. The garment can be built three-dimensionally and shaped while being made, to suit the wearer's wishes. Thus it is possible to adjust its length or to add elements. This allows growth of just the right amount of material needed, eliminating any potential waste during the production process. Once the garment is no longer in use it can easily be composted, making it possible to completely rethink future possibilities for fashion items.

Artist Lab
Jussi Ängeslevä (FI)

Professor Jussi Ängeslevä teaches at the University of the Arts Berlin and the Royal College of Arts alongside leading the creative efforts at ART+COM studios as a Vice-Creative Director. Throughout his career his focus has always been intentionally in between fields: combining understanding of visual, physical and interaction design with algorithmic, electronic and mechatronic knowledge to create innovative and elegant experiences.

Beyond Prototyping

Beyond Prototyping is a research project looking at the dynamics between the designer, manufacturing process and the consumer in creating everyday products in the age of digital fabrication. The "meaning" of an artifact transcends its physical utility and technical characteristics and is increasingly a personal narrative. The three case studies, *Ciphering*, *Locatable* and *Highlight* illustrate different strategies of how the experts and the target audience can together create meaningful, unique artifacts, based on an algorithmic design idea and through an online platform for intuitive interaction. The designs play with a distinct functional definition of a product and distinct aesthetics, which are expressed through the end user's encoded input of meaning, resulting in well-designed and robust but individual products that go beyond prototype status.
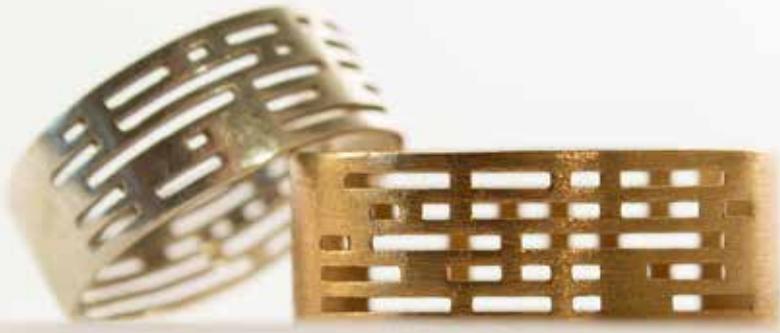
Michael Burk

Jussi Ängeslevä

Michael Burk

Artist Lab
Institute IRNAS (SI)

Luka Mustafa (SI) is a founder of the IRNAS institute, a Shuttleworth Foundation Fellow and full-time *KORUZA* developer, as well as a PhD candidate at University College London. He is actively involved in wlan-Slovenija, the deployment and management of national and international wireless backbones. He actively pursues the development of new and efficient systems by re-purposing mass-produced components.

Boštjan Vihar (SI) is a biomimeticist with a PhD in biology from RWTH Aachen University. He is interested in the structure and properties of living things and how to transfer the underlying principles to new technologies. At IRNAS, he is building an open laboratory for biological and biomedical research, using low-cost and DIY equipment, optimized for research but still widely available.

http://www.irnas.eu

KORUZA and fab&sciencelab

At the IRNAS institute, young people from various backgrounds have found each other with the common goal applying the advances in science and technology to everyday reality and creating efficient, affordable systems, available to everyone. They currently focus on three areas of interest: fabrication devices for rapid prototyping, which in turn are used for research and development of optical communication systems and open/DIY bioscience. Everything they do is completely open source and made from parts which are either available anywhere in the world or can be cut or 3D printed.

At Ars Electronica 2016, their work will be presented in two parts: an ad hoc mini *fab&sciencelab* will be set up, where visitors can test and play with the machines, produce their own models, DIY research equipment or do simple experiments. Also an interactive installment of *KORUZA*—the wireless optical communication system will be presented, where visitors will be able to witness first hand how optical communication works, its advantages and potentials for future networking.

IRNAS: Luka Mustafa, Boštjan Vihar
Tkalka: co-working space in Maribor, where IRNAS is based, *http://www.tkalka.si*
Kreatorlab: Fablab, close partners of IRNAS, also based at Tkalka, *http://www.kreatorlab.si*

Jure Zagoranski

Amit Zoran (IL)

Hybrid Basketry

Contemporary 3D printing and traditional crafts rarely meet in the same creation. They tend to live in different worlds. *Hybrid Basketry* is a medium where 3D-printed structures are shaped to allow the growth and development of hand-woven patterns. While the 3D-printed plastic elements contribute the aesthetics of the digital curvatures and manifolds, the hand-woven reed, jute, and canvas fibers infuse the baskets with a unique organic appeal.

The Living (US)

Hy-Fi: Reinventing the brick for a low-carbon, compostable structure

Hy-Fi offers a captivating physical environment and a new paradigm for sustainable architecture. In this project we tested and refined a new low-energy building material, manufactured 10,000 compostable bricks, constructed a 13-meter-high tower, hosted public cultural events for three months, dismantled the structure, composted the bricks, and returned the resulting soil to local community gardens. We designed a new type of "grown" brick through an innovative combination of corn stalk waste and living mushrooms with a root-like growth. The bricks are lightweight, low cost, and extremely sustainable. The manufacturing process engages bio-technology, agriculture, and industrial manufacturing. The composting process engages the municipal solid-waste stream. In contrast to typical short-sighted architecture, our project is designed to disappear as much as it is designed to appear.

Client: Museum of Modern Art and MoMA PS1
Architect: The Living, David Benjamin (Principal), John Locke (project lead), Danil Nagy (project lead), Damon Lau, Ray Wang, Jim Stoddart, Dale Zhao, Lorenzo Villaggi

Iwan Baan

Barkow Photo

Charles RousseII

Barkow Photo

Winner of the STARTS—Grand prize of the European
Commission honoring Innovation in Technology,
Industry and Society stimulated by the Arts 2016.

Artist Lab
Artificial Skins
and Bones (DE)

The Artificial Skins and Bones Group is an interdisciplinary group of young designers from Weißensee Kunsthochschule Berlin. Their expertise ranges from textile, surface and product design to fashion and visual communications. In the *Artificial Skins and Bones* project the group freely explored the design of and interaction with artificial bodies and body parts. The projects presented illustrate a great variety of possible starting points, prototyping techniques, and application scenarios. We hope that the outcome will be a valuable contribution to the future exploration of artificial bodies and prosthetic designs.

http://www.skinsandbones.de

About the projects

Nature's patterns, structures, and functions are an endless source of inspiration. We started our project by looking into our body's design and examining elements that may be applied to the design process of artificial bodies. The idea for this topic developed through our collaboration with Ottobock, the world market leader in prosthetics. Through workshops with their technicians and physiotherapists, interviews with amputees and a visit to Ottobock's research and production hub in Duderstadt, we added additional topics to our agenda: the language of sensation, interaction with artificial body parts, and the aesthetics of artificial bodies and their relationship to the aesthetics of natural bodies.

Active

Active looks into the rehabilitation process of lower-limb amputees and proposes a service design concept as well as a hardware solution for gathering movement data.

Credit: Hans Illiger Active

Visible Strength

Visible Strength proposes a flexible, creature-like textile surface that, like an octopus, changes its color and pattern in various ways through muscle stimuli.

Credit: Lisa Stohn and Jhu-Ting Yang

Active, Bernardo Aviles-Busch

Visible Strength, Bernardo Aviles-Busch

Tactile Sensation, Bernardo Aviles-Busch

Trans.fur, Bernardo Aviles-Busch

Tactile Sensation

Tactile Sensation explores two possibilities of displaying information through tactile feedback: *Sens_mat* allows passive tactile recognition of materials when direct contact is not possible. *Sens_dia* simplifies descriptions in pain diagnostics and offers a non-verbal and body specific communication.

Credit: Nina Rossow

Trans.fur

Trans.fur is the development of intelligent textiles, capable of altering moisture permeability by adjusting their surface structures. The inspiration for this project was the most versatile organ in the human body: skin.

Credit: Karina Wirth and Natalie Peter

Shortcut

Shortcut is a customizable human interface device (HID) for upper-limb amputees. The bracelet detects sensory muscular impulses in the phantom hand, translating them into contactless and intuitive computer controlling.

Credit: David Kaltenbach, Maximilian Mahal and Lucas Rex

Audio Gait

Audio Gait sonifies movements to aid the understanding of body balance while walking. The portable system is an easy learning aid for shin prosthetics training, which translates walking movements into auditory feedback.

Credit: Agnes Rosengren and Bernardo Aviles-Busch

The Aesthetics of the Uncanny

One of the most heated discussions during the ideation period was about the concept of Uncanny Valley. *The Aesthetics of the Uncanny* explores the delicate balance between familiar prosthesis design standards and uncanniness. The team researched how targeted material conception can help to understand and control this phenomenon and can be taken into conscious consideration during the design process.

Credit: Carmina Blank and Sandra Stark

Course instructors: Prof. Wolf Jeschonnek, Prof. Mika Satomi
Participating students: Bernardo Aviles-Busch, Carmina Blank, Hans Illiger, David Kaltenbach, Maximilian Mahal, Stephanie Nattrass, Natalie Peter, Lucas Rex, Agnes Rosengren, Nina Rossow, Sandra Stark, Lisa Stohn, Babette Wiezorek, Karina Wirth, Jhuting Yang
Main project partners: Weißensee Kunsthochschule Berlin, Fab Lab Berlin, Ottobock Healthcare GmbH, Makea Industries GmbH

Shortcut, Bernardo Aviles-Busch

Audio Gait Bernardo Aviles-Busch

The Aesthetics of the Uncanny, Bernardo Aviles-Busch

Dragan Ilić (RS/US)

Roboaction(s) A1 K1

Roboaction(s) A1 K1 is a post-media art practice that combines drawing, movement, sound and video. In his project, Dragan Ilić executes a ten-minute performance/gestural action with an advanced robot, Kuka K210+DI, which allows his body to rotate at a speed of up to two to three meters per second. He achieves dramatic expression and numerous movements along a vertical and horizontal axis. Using a specially created tool made up of pencils or brushes, he executes his dynamic, monumental drawings on paper (or canvas). This in turn enables audio and video recordings of his art actions, which represent the means of his artistic post-production. The idea behind the performance is based on a futuristic quest to achieve interaction between the body and the machine, the creation of multi-functional mobility and the realization of a hybrid body or android. This particular art action is based on his decades-long interest in the movement of elementary particles and their mechanical and magnetic rotations.

Courtesy of the artist and GV Art London

Tomotaka Takahashi (JP)

RoBoHoN
Heart moving phone

RoBoHoN was developed through collaboration between SHARP Corporation and Tomotaka Takahashi, a world-famous robot creator, CEO of robot development company Robo Garage, and Project Associate Professor at the University of Tokyo Research Center for Advanced Science and Technology.

Tomotaka Takahashi has led the *RoBoHoN* project as an industrial designer, concept designer and motion developer, and as a result of two years' project development effort, *RoBoHoN* launched in Japan in May 2016 as the world's first mobile robotic phone.

To realize *RoBoHoN's* "Heart moving phone" concept, *RoBoHoN* not only has the basic functions of a mobile phone but is also equipped with a camera,

projector and robotics functions, including the voice communication system. These are all embedded in a compact humanoid robot body, 19.5 cm high and weighing only approx. 390 g, small enough to be carried anywhere.

In addition, the technology highlights of *RoBoHoN* are the newly developed servomotors, one of the smallest in the world, allowing this humanoid robot to walk on two legs in spite of its small body, and the newly developed built-in micro laser projector with focus-free operation, which allows users to project photos, videos, and maps onto a screen or a wall. Users can also download dedicated apps to give *RoBoHoN* new functions and services over Wi-Fi or mobile networks.

https://robohon.com

Yasushi Kato

Hiroshi Sugihara (JP)

Ready to Crawl

Machines are usually completed by assembling parts which are manufactured in different ways and from different materials.

In additive manufacturing (AM) it is possible to make several parts in an assembled state as one machine.

In this project I tried to make robots which were born in completed state like creatures by making all parts, excluding a DC motor, assembled by AM as one machine. After they were born in AM, you just needed to remove the extra nylon powder adhering to them and insert a DC motor for them to start moving. I developed the original transmission mechanism, called the 3Dimensional Cam, so that robots made by AM could move more smoothly.

I made various walking robots which used the 3Dimensional Cam and AM, a unique, flexible structure seeking motions which impress people with their biolikeness.

Designer: Hiroshi Sugihara
Project director: Shunji Yamanaka
Based on the AM structure research by Keisuke Tanigawa

Simon Hauser (CH), Mehmet Mutlu (TR)

Roombots

This project explores the design and control of modular robots, called *Roombots*, to be used as building blocks for furniture that moves, self-assembles, and self-reconfigures. Modular robots are made of multiple simple robotic modules that can attach and detach. Connectors between units allow the creation of arbitrary and changing structures depending on the task to be solved. They offer higher versatility and robustness, as well as the possibility of self-reconfiguration. The type of scenario that we envision is a group of *Roombots* that autonomously connect to each other to form different types of furniture,

e.g. stools, chairs, sofas and tables, depending on user requirements. This furniture will change shape over time as well as using actuated joints to move to different locations depending on the users needs. When not needed, the group of modules can create a static structure such as a wall or a box.

http://biorob.epfl.ch

Biorobotics Laboratory
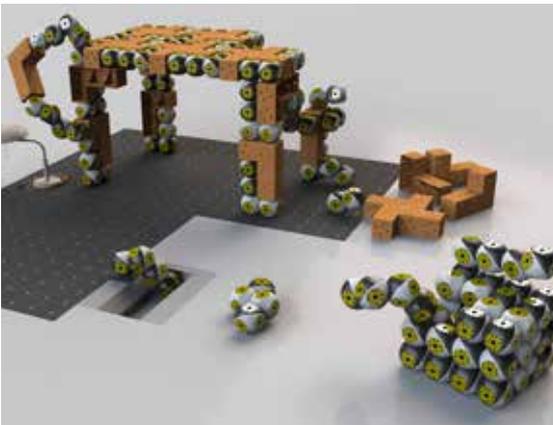
Artist Lab
Yoichi Ochiai (JP)

Yoichi Ochiai (JP), born in 1987, is a media artist, an assistant professor at the University of Tsukuba and head of its Digital Nature Group. He has a PhD in applied computer science from the University of Tokyo. He is working on new inventions and research through a mixture of applied physics, computer science and art. He has received the Innovative Technologies Prize from METI Japan, the World Technology Award from WTN, and many more.

Digital Nature

To present the vision of a post-pixel multimedia ecosystem after the ubiquitous society, we have conducted the research towards our vision called *Digital Nature*, an alternative perspective of nature and humanity. We believe the ecosystem in *Digital Nature* will be described as the interdisciplinary computational projects on multimedia systems, graphics, HCI research, fabrication, robotics, art, architecture, materials science and biology. Here we exhibits mixtures of our artwork and research achievements on the *Digital Nature* projects.

Digital Nature Group: Yoichi Ochiai, Atushi Shinoda, Mao Morita, Kotaro Ohmomo, Yui Kikuchi, Amy Koike, Kazuki Takazawa, Keita Kanai, Satoshi Hashizume, Akira Ishii, Ayaka Ebisu, Daitetsu Sato, Hiroyuki Osone, Ippei Suzuki, Kazuki Oshima, Kazuyoshi Kubokawa, Keisuke Kawahara, Kenta Suzuki, Miyu Iwafune, Mose Sakashita, Nobutaka Ito, Riku Iwasaki, Shinji Sakamoto, Shuntarou Yoshimitsu, Takatoshi Yoshida, Tetsuya Minagawa, Yuki Kubo, Yuzu Saijo

Coded Skeleton

We propose a novel design method to fabricate user interfaces with a mechanical metamaterial called *Coded Skeleton*. The *Coded Skeleton* is combination of shape memory alloys (SMA) and 3D-printed bodies, and it has a computationally designed structure that is flexible in one deformation mode but is stiff in the other modes. This property helps to realize materials that are automatically deformed by a small, lightweight actuator such as an SMA. Also the *Coded Skeleton* enables to sense user inputs with the resistance value of SMA.

Authors: Miyu Iwafune, Taisuke Ooshima, Yoichi Ochiai

Gushed Light Field
Design Method for an Aerosol-Based Fog Display

We present a new method of aerial imaging by aerosol-based fog screens. Conventional fog screens are easily affected by the air flow and their systems take up a lot of space. In this study, we propose to add new tradeoffs between limited display time and payloads. We use an off-the-shelf aerosol spray as a fog screen that can resist the wind and is extremely portable. The results showed that the minimum weight of whole system is around 600 g (including projection system), screen-raising time is approximately 0.5 s, disappearance time is approximately 0.4 s, and the maximum wind speed under which we can project images is approximately 10 m/s. We conducted user studies on a wearable application, aerial imaging with a drone or radio-controlled model car, and a display embodied in the environment. We believe that the results of this study contribute to the exploration of new application areas for fog displays and expand expressions of entertainment and interactivity.

Authors: Ippei Suzuki, Shuntarou Yoshimitsu, Keisuke Kawahara, Nobutaka Ito, Atsushi Shinoda, Akira Ishii, Takatoshi Yoshida, Yoichi Ochiai / Affiliation: University of Tsukuba, Waseda University, The University of Tokyo
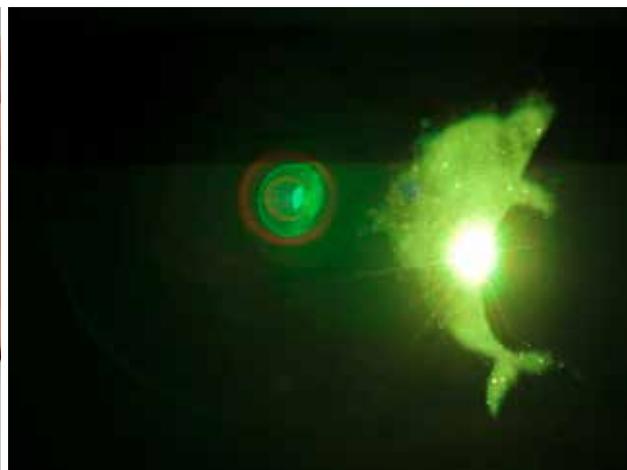
Human Coded Orchestra

Human Coded Orchestra is a new approach to enable a group of individuals to sing in harmony by using computed directional speakers. You will witness how computers can play humans just like a musical instrument.

Authors: Yuzu Saijo, Kenta Suzuki, Yoichi Ochiai
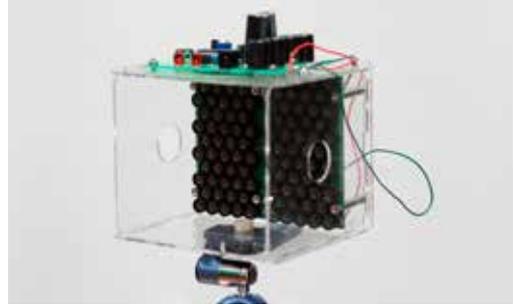
Optical Marionette

We present a novel method of manipulating people's walking direction by visual processing on head-mounted displays. Existing navigation systems require their users to recognize information and then to follow directions as two separate, conscious processes. This paper proposes a novel method that enables pedestrians to be guided without paying attention to the information provided by a navigation system.

This system enables users to be graphically manipulated by controllers. Users perceive the real world by means of dual images provided by a stereo camera and a stereo head-mounted display. In detail, when they walk, the navigation system provides users with real-time feedback to their sight by processing the images they have just perceived. The system gives visual cues to users and thus controls their walking direction. This study examined three methods of image processing, namely, a see-through image without processing, a moving stripe pattern method, and a changing focal region method. Based on the result, the changing focal region method worked most effectively in guiding pedestrians, changing their walking path by about 200 mm/m on average.

Authors: Akira Ishii, Ippei Suzuki, Shinji Sakamoto, Keita Kanai, Kazuki Takazawa, Hiraku Doi, Yoichi Ochiai
Affiliation: University of Tsukuba

Solar Projector

This is a new projector that utilizes solar energy directly. The *Solar Projector* can produce visible displays even in bright conditions, without having to use an electric power source. It uses a parabolic mirror and components of a digital light processing (DLP) projector. The element of the *Solar Projector* responsible for collecting focused solar energy replaces the lamp.

The *Solar Projector* has wide range of applications other than projection display. There are two major examples. The first scenario is lines on a court for various sports. If tape is used to mark the court, the field will be permanently designated for a specific sport. However, by using solar projection technology, a field can have different lines projected at different times, allowing different sports to be played

on the same field. The second example is growth of vegetation in specific shapes. Solar projection can determine which vegetation receives more sunlight, which causes faster growth. It means the projector makes it possible to draw with grass.

Authors: Kotaro Omomo, Atsushi Shinoda, Daitetsu Sato, Yoichi Ochiai

Thermal Tactile Display

Study of tactile presentation often focuses on vibro-tactile stimuli, but the thermal tactile sensation is
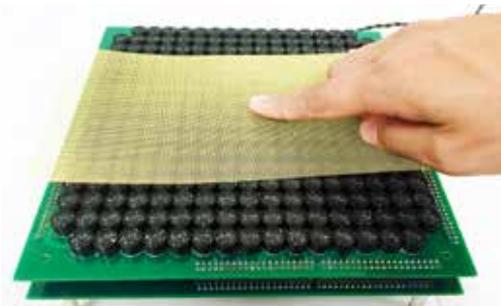
also an important factor. In conventional research, hot and cold sensations has been using a Peltier device and hot and cold water. In this study, we propose a display to present the warmth by utilizing the heat generated by the thermo-acoustic phenomenon that occurs when propagating focused ultrasound in a narrow space.

A metal plate with spaced out fine holes is used as a display, with heat generated in it by irradiating with an ultrasonic wave. In this study, we investigated the impact on the human temperature perceived by this display.

Authors: Mao Morita, Yoichi Ochiai

Leaked Light Field

We propose a method to convert a non-conductive material into a display that turns light into space. We can use not only glass but any material to display the information. We drill a small hole of about 100 μ in any plate-like material. A computer calculates the leakage of the ray from the backlight. This provides a stereoscopic display, which can be leather, wood, stone or a reflective surface. We believe our method has the potential to expand the design.

Authors: Kazuki Takazawa, Kenta Suzuki, Yoichi Ochiai

Projects on the Materialization of Holography

We present a method of rendering aerial and volumetric graphics using femtosecond lasers. A high-intensity laser excites physical matter to emit light at an arbitrary 3D position. Popular applications can then be explored especially since plasma induced by a femtosecond laser is safer than that generated by a nanosecond laser.

There are two methods of rendering graphics with a femtosecond laser in air: producing holograms using spatial light modulation technology, and scanning a laser beam using a galvano mirror. The holograms and workspace of the system proposed here occupy a volume of up to one cubic centimeter; however, this size is scalable depending on the optical devices and their setup.

Author: Yoichi Ochiai

Cross-Field Haptics

We present a new method of rendering haptic textures using electrostatic fields and magnetic fields. In conventional research, a single physical quantity is used to render haptic textures. In contrast, our method combines multiple fields (electrostatic and magnetic) simultaneously. While these fields do not directly interfere, combining them provides benefits such as multi-resolution haptic images and synergistic effects on haptic perception. We investigated the increase in the variation of texture by comparing the individual field methods.

Authors: Satoshi Hashizume, Kazuki Takazawa, Amy Koike, Yoichi Ochiai

Transformed Human-Presence System for Puppet Play

We propose a system that transmits a performer's body and facial movements to a puppet and provides visual and audible feedback to the performer. The system consists of a head-mounted display to show the performer videos from cameras in a puppet, a microphone to capture voices and photo-reflectors to detect mouth movements. This puppetry system allows performers to manipulate puppets without practicing, since they are manipulated in accordance with the movements of the performer's body and face. In addition, the system gives performers a new experience and gives more lifelike characteristics to the puppet.

Authors: Mose Sakashita, Keisuke Kawahara, Yoichi Ochiai

Holographic Whisper

Individual auditory feedback is one of the essentials to consider the sound experience towards *Digital Nature*. We propose a novel method of three-dimensional spatial audio rendering by expanding the ultrasonic phased-array technique. We employ an ultrasonic phased array as a holographic acoustic generator to focus ultrasound on arbitrary three-dimensional points. The sound pressure at the ultrasonic focal points is high enough to radiate audible sound, based on the self-demodulation effect in air. Consequently, the ultrasonic focal points act as audible sound sources. This sound-point method enables us to control aerial audio broadcasts more flexibly and more precisely compared to conventional superdirectional (sound-beam) loudspeakers. This method can generate and disappear the sound sources freely in air. These point-sound sources can deliver private messages or music to individuals.

Authors: Yoichi Ochiai, Takayuki Hoshi

Kotatsu Conference

Knowledge Capital is a centre for intellectual creation through interaction and collaboration, and a core facility at Grand Front Osaka, the multi-purpose complex established by 12 private companies in spring 2013. It is located in the center of Osaka, where every day 2.5 million people pass through this largest terminal in western Japan. The complex is fully equipped, with various-sized offices, a salon, labs, showrooms, a theater, event spaces and a convention centre, serving as a hub for interpersonal interactions and a gateway to the world.

Business people, researchers, creators, ordinary citizens and a wide variety of other people come together there to pool their knowledge and create something new and valuable. We believe that collaborative activity creates an innovative culture, ideas, goods and services. At *Knowledge Capital* places and opportunities are offered to unique and creative individuals to bring up new ideas that will spread to the rest of the world. We hope you feel the heartbeat of what is happening over there and participate in the activities of *Knowledge Capital*.

Takuya Nomura, General Producer

What is Kotatsu?

Kotatsu is a traditional Japanese heating appliance. It is a square table placed on the floor with a heat source inside, and the outside covered with a quilt, to warm the people sitting round it. It has been used in Japan for approximately 700 years, and in modern times it is common for Japanese families to gather round a *Kotatsu* in winter, eating mandarins and watching television. Since olden times the *Kotatsu* has been a place of communication for the family. It is seen less and less lately, however, but even now is considered a traditional part of Japanese culture.

What is the Kotatsu Conference?

The *Kotatsu Conference* is a unique program of the *Knowledge Capital* and a new form of round-table discussion, where four speakers are seated at a *Kotatsu* and converse openly. A facilitator, the *Kotatsu Conference Host*, and the various guest speakers, such as a university professor, a cartoonist, a pop idol, a performer or an artist, discuss the theme of *Omosiroi*. In the 2016 Ars Electronica Festival, Japanese special guests, such as a media artist and a Buddhist priest, explore the idea of *Omosiroi*. Come and enjoy the *Kotatsu Conference*, the special *Knowledge Capital* event and a new platform of communication.

Omosiroi

Omosiroi is a Japanese word, which has various meanings such as as "interesting," "funny," "amusing" and "convivial." However, as a core value of *Knowledge Capital*, *Omosiroi* signifies knowledge innovation, and that is to say, the most fundamental human sensibility, originating in a heart-moving experience with unexpected discoveries and inspiring encounters. It is the driving force to accelerate pleasure and curiosity regardless of nationality, gender or age. At present, when society has reached a transition period, what is required is not the existing standard of values, but a novel point of view and new criteria. Now that values are more diverse, *Knowledge Capital* is aiming to create a future full of creativity through *Omosiroi* as the most fundamental human sensibility.

Knowledge Capital Association

Artist Lab
ASSISIbf

Thomas Schmickl, project coordinator of *ASSISIbf*, is professor at the Department of Zoology at the University of Graz, Austria, where he founded the Artificial Life Lab in 2007. Besides his research activities in the fields of zoology, biological/ecological modeling and bio-inspired robotics (swarm robotics, modular robotics, neural networks, artificial hormone systems, evolutionary robotics), he also teaches at the Department of Environmental System Sciences at the University of Graz.

http://assisi-project.eu

ASSISIbf

Animal and Robot Societies Self-Organize and Integrate by Social Interaction (bees and fish)

The goal of the *ASSISIbf* project is to establish a robotic society that can develop communication channels between animal societies (honeybees and shoals of fish).

Our robots will self-program by evolutionary algorithms until they have learned to interact with animals in the desired way. This new technology aims to lay new foundations on the way in which humans can interact with animal societies in order to manage the environment.

The researchers expect their work to have an impact on agriculture, livestock management and environmental protection (monitoring). At the festival, researchers will establish an interspecies connection between bees and fish. With the aid of two different types of robot designed specifically for each species, and a virtual world representing all the agents of the translation system, bees and fish will solve a task together, live.
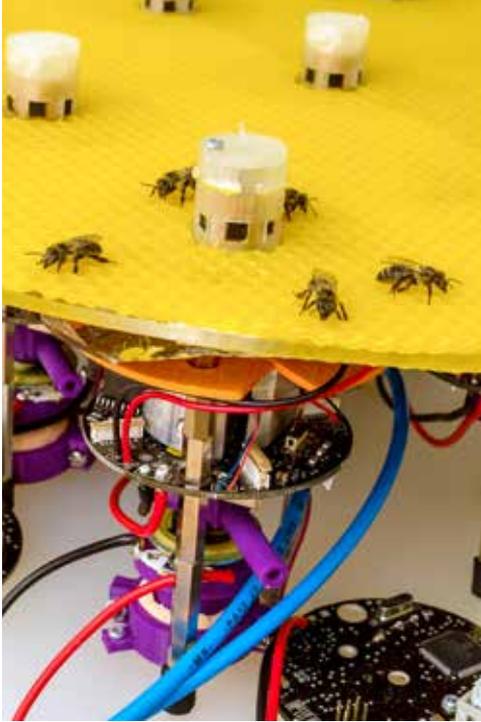
Lucy McRae (UK)
The Institute of Isolation

The Institute of Isolation is a short film exploring the body beyond Earth's edge, following Lucy McRae as she tests the effects that extreme experience might have on evolving human capacities.

A series of sensory chambers simultaneously challenge her body and brain to adapt to her plight; the microgravity trainer conditions the body for possible life in space, or time spent in an anechoic chamber explores the psychoacoustics of silence.

The film is based on the premise that we are in a different phase of evolution—driven not just by nature, but human intent. In her self-reflexive narrative, Lucy contemplates whether isolation could be designed to augment fundamental aspects of human resilience.

Project: Lucy McRae, Julian Love, Lotje Sodderland, Daniel Gower
Developed with Ars Electronica Futurelab (Claudia Schnugg, Michael Mayr, Veronika Pauser, Andreas Jalsovec and Christopher Lindinger) and with special thanks to Juan Enriquez, Ricardo Bofill, Professor Nikolas Rose, Professor

Lucy McRae (UK)
Make Your Maker

A crude laboratory plays host to a series of macabre experiments, based on the premise that "food and the body are inseparable". Lucy's film takes on genetic manipulation, creating glowing comestibles that drip and flow to mold bodily shapes that are then harvested, sliced and repackaged for consumption.
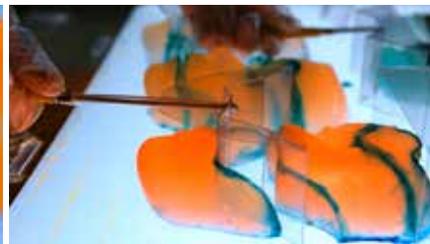
Lucy McRae (UK)

The Future Day Spa

The Future Day Spa is a personalized, physiological experience that delivers controlled vacuum pressure to the body. Based on the principles of negative pressure, participants hand their bodies over to a part-human, part-machine process as they are induced into a state of relaxation. The project employs wireless technologies for measuring biometric data, to begin understanding the physiological capabilities of a treatment.

After trials on over 100 individuals, one participant disclosed that he denied himself any physical contact with other humans and at the end of his treatment responded with a self-initiated hug. Denying oneself touch silences the release of oxytocin in the brain, a hormone said to be involved in social recognition and the formation of trust between people.

This unexpected response has raised interesting parallels between the behavioral effects of oxytocin release and the the *Future Day Spa's* role in shifting human emotion.

It was originally designed to prepare the body for space, and these results have initiated broader research to explore how spa methods can naturally produce oxytocin in the brain and be developed to treat social isolation, autism spectrum or depression. The next steps are to detect the electrical activity in the brain during a *Future Day Spa* treatment and understand the role machine touch might have on the body and our emotions.

Commissioned by Inventor Lab and Qualcomm and produced by Pollyanna Whitman.

Artist Lab
Yasuaki Kakehi (JP)

Yasuaki Kakehi is a media artist and HCI researcher. An associate professor of Environment and Information Studies at Keio University. He develops interactive media that extend the human body, tools and communication by multiplying the five senses, affecting the properties of physical materials.

Phytowalkers

Phytowalkers is a colony of stand-alone botanical robots consisting of plant pots, plants and electronic components. In this project humans make and "grow" a robot. We utilize air-plants as the legs of the robots and plant them in a pot to let them grow. After it has been grown, when it is turned upside down, the botanical robot begins to walk around on its "legs" as a new living organism.
Each botanical robot's movements will differ according to the length and shape of its legs. *Phytowalkers*

have a microcontroller, a motor and several sensors inside them. When one reaches a sunny area, it will stop walking and charge itself up using its solar cell and the photosynthesis of the plants. The botanical robots will compete as they push each other to stay in the optimal sunny area . Under this simple rule adjacent phytowalkers will brush against one another and this may help with their pollination.

In collaboration with Junichi Yamaoka.

microcosm

This is an installation composed of two polyhedral structures which transform their physical positions, scales and shapes. Their geometrical configurations continuously change by reacting to each other and the environment.
This piece is a new embodiment of our research vision, "MorPhys," which realizes a morphing physical environment. We have developed the polyhedral structures' modules consisting of nodes and connectors. Each node is linked to the connectors

made of thin cylindrical rods. The connectors can be flattened and stored in the compact housing on the nodes by rewinding. Thus the structure reconfigures itself by dynamically changing the length of its connectors.
microcosm is a system in which polyhedral structures act physically. It implicates a new form of interaction between the physical and digital world.

In collaboration with Shohei Takei.

Loopers

Loopers is a sound installation composed of twelve (artificial) measuring worms progressing on a stage. Each worm continues to inch back and forth by alternately curving and straightening its body. The worms generate sounds in various rhythms and patterns by tapping the stage.

Arrays of electromagnets are installed underneath the stage. Each worm is composed of a row of seven magnetic balls. By controlling the polarity of each electromagnet, a dynamic magnetic field is generated on the stage. The worms change their posture and move on the stage in response to the field. Although the magnetic field is operated by computer, the worms often exhibit random movements or behavior according to their bodies' conditions and the environmental conditions. This piece generates sounds between these controlled and uncontrolled elements.

In collaboration with Michinari Kono.

Single Stroke Structures

We now live in the age of mobility. With the development of urban transport and overpopulation in the cities, we are constantly surrounded by billions of people. This project explores the possibility of improving the livability in crowded cities with a portable partition to create your own space. We use *Single Stroke Structures (SSSs)*, a digital fabrication system that creates architecture-scaled pneumatic objects by inflating one thin plastic poly tube. By partially bonding the tube with heat and pressure in multiple positions and changing the space between the bonds, we can control the inflated tube's curvature and convert the single stroke into various shapes. The one-stroke structure makes it possible for users to inflate it when necessary and deflate it to carry it around in a compact roll.

In collaboration with Takahira Hasegawa.

Junichi Yamaoka, Yasuaki Kakehi

Phytowalkers

Shohei Takei and Yasuaki Kakehi

microcosm

Yasuaki Kakehi and Michinari Kono

Loopers

Takahiro Hasegawa, Yasuaki Kakehi

Single Stroke Structures

107
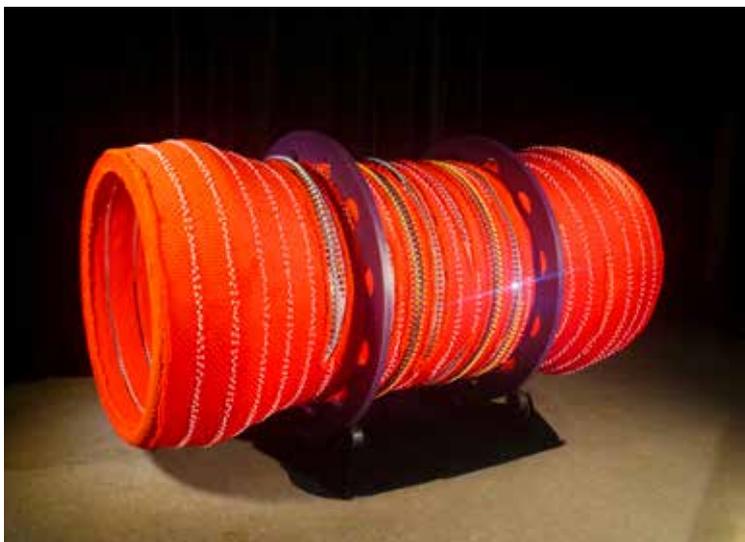
Eric Dyer (US)

Implant

Implant is an imaginary medical device that fits into a blood vessel, neuron, etc. It is super-enlarged, making the viewer feel microscopic. With a genetic retinal disease in his family's DNA, Dyer has closely followed developments in gene therapy, including the insertion of healthy genes into the body using viruses. With *Implant* he plays with the paradoxical threat and promise of bleeding-edge, anatomically invasive and potentially rampant medical practices. Viewers explore the cylindrical spinning sculpture with hand-held strobe lights, discovering thousands of colorful, fluffy, and sinister nanobots performing unknown tasks and a spiral of organic-synthetic gears inside the tube.

Ralf Baecker (DE)

Interface I

Interface I investigates the boundary between two interacting systems rendered into the physical. One system is a compound of motors, twine and elastic bands arranged horizontally. Each motor is connected to its opposing motor in the facing system by a string, and to its neighbors by an elastic thread. In order to excite the system's behavior, each motor is fed with random impulses from a Geiger-Müller tube. The mesh couples each element to its surrounding elements in order to achieve a local emergent behavior. *Interface I* reproduces space and time in constantly shifting configurations.

Produced by NOME Gallery Berlin 2016
Production assistant: Antje Weller
Research and experiments essential to the realization of *Interface I* were carried out as part of Ralf Baecker's research project Time of Non-Reality at the Graduate School at the University of the Arts, Berlin.

This project is presented in the framework of the European Digital Art and Science Network and co-funded by the Creative Europe program of the European Union.

Bresadola + Freese/drama-berlin.de
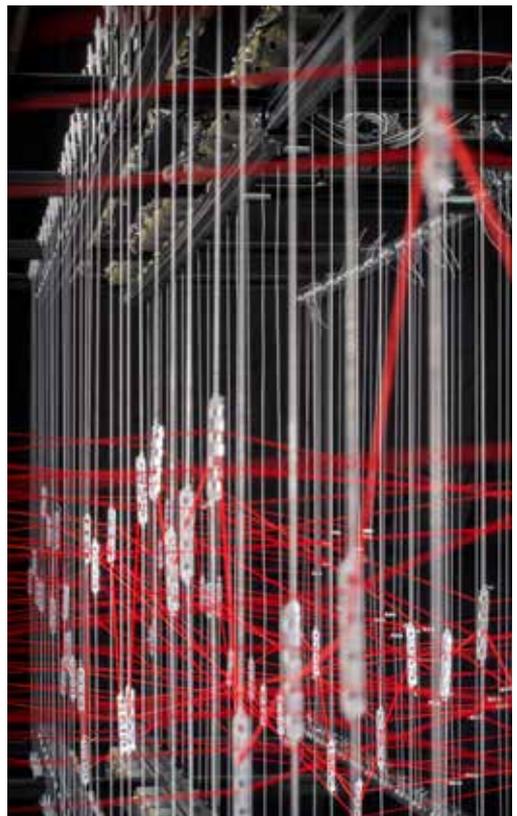
Thom Kubli (DE)

Black Hole Horizon

What is the relationship between oscillating air, black holes and soap bubbles? What effect does the sound of horns have on the human psyche and why is it present in various creation myths? What impact does gravity have on our collective consciousness? Where do spectacle and contemplation meet? *Black Hole Horizon* is a meditation on a spectacular machine that transforms sound into three-dimensional objects and keeps the space in a steady state of transformation.

The nucleus of the installation is the invention of an apparatus resembling a ship's horn. As each note sounds, a huge soap bubble emerges from the horn. It grows while the note sounds, peels off the horn, lingers in the exhibition space and finally bursts at a random position within the room.

The complete installation comprises three horns varying in size and shape according to their individual pitch and timbre. Visitors can walk through the room witnessing the transformation of sound into ephemeral sculptures, which last only for seconds before their material remains are deposited on the walls and floor.

Matthew Gardiner (AU/AT)

ORI*
Folding matter by code

Our research begins with the premise: folding is coding for matter, an idea emerging from computer and molecular science, pointing to the idea that materials perform computation and *ORI*, is a functional aesthetic way to sense, program and transform the code of matter.

For the Ars Electronica 2016, we present our vision for *ORI*.

Niwashi—our interactive fabrication system: 3D scanned forms are algorithmically folded, then 3D printed with foldable material composites. *Niwashi* means "landscaper," a role held by an accomplished master of nature and art. Combined with elastomers, these ready-foldable objects express high degrees of programmability and transformability.

*ORI*BIT*—our for the minimum building-block module for *ORI** Systems: conceived as a foldable actuator and haptic sensor combined. Conceptually, an *ORI BIT*, could be used to make an *ORI*BIT*, a more complex folded organism.

ORI includes the asterisk to express multiple domains of application, medium and scale; *ORI** explores folding as a language to combine functional and aesthetic design for daily life.

Matthew Gardiner, Rachel Hanlon

Artist Lab
Joe Davis (US)

While earning his Creative Arts degree (1973) from Mt Angel College in Oregon, Joe Davis pioneered sculptural methods in laser carving at University of Cincinnati Medical Center Laser Laboratory and Bell Telephone Laboratories, Murray Hill, NJ. In 1981 he joined MIT Center for Advanced Visual Studies as Research Fellow and Lecturer. In *Poetica Vaginal* (1986-7) and *Rubisco Stars* (2009) Davis sent the most powerful and lengthy radio messages ever transmitted to other stars. Davis joined Alexander Rich's laboratory at MIT in 1989 where he is widely regarded to have founded new fields in art and biology. In 2010, he joined the laboratory of George Church at Harvard as "Artist Scientist". Davis and collaborators genetically modified silkworms for production of biomineralized transgenic silks in 2011, and initiated *Astrobiological Horticulture* in 2016 to create organisms suited for survival on Mars.

On Chrysopoeia and Elixir of Life

We human beings can fly through the air. We can "instantaneously" cast voices and images across great distances. Although there are certain environmental consequences, we can light up the night and chase away bitter cold and tropical heat. We can peer far into invisible minutiae of the microcosm and resolve details about events that have unfolded millions of light years away. The fruits of our technological age have become so familiar that we tend to automatically overlook the fact that many were historically considered "magical" or supernatural and that this conflict of rationalism and belief continues to foster the darkest parts of human interaction. Fortunately, there are still a few myths and legends waiting to be made real. Some of the time these realizations can at least briefly be seen as profoundly poetic: where artists take up dreams of the world and weave them into fine fabric. This can easily be seen as "alchemy" surviving into our own time. Yet we inevitably destroy the dreams we make come true. There is a poignancy attached to the moment when what has long been magical becomes foreseeably vapid and stale.
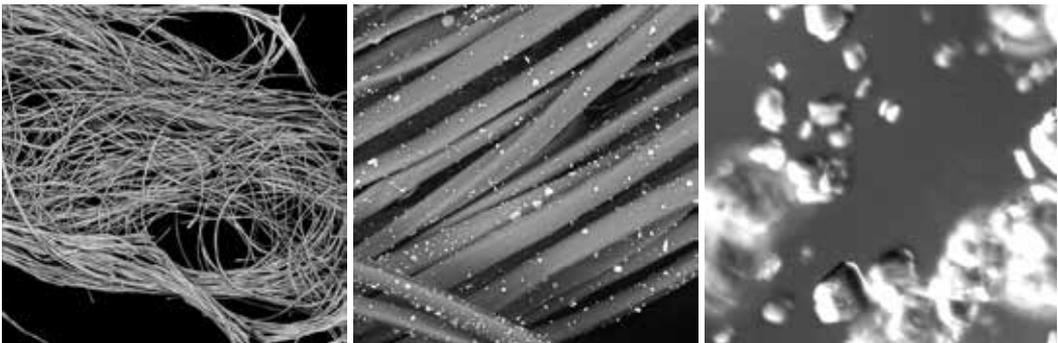
Bombyx chrysopoeia

In *Bombyx chrysopoeia*, we have created genetically modified silk moths (*Bombyx mori*). These produce silks containing silicatein, a biomineralizing protein drawn from the marine sponge, *Tethya aurantia*. Silks spun by our genetically modified silkworms are first "degummed," a process traditionally employed to remove sericin, a waxy coating that naturally appears on all silks. Fibers are then treated with a chelating agent to remove any traces of metal accumulated by the fusion protein in the process of cocooning. Finally, transgenic silks are exposed to solutions containing dissolved heavy metals. As a result, these silk fibers integrate selected metals such as gold or platinum. With this method, many other metals and metal compounds can now be integrated with silicateinized silks to produce fibers with unprecedented material properties for both art and science. These may have a number of appli-cations. One possibility is that genetically modified silks could be used to take up radionuclides and other reactor meltdown byproducts at nuclear accident sites like Chernobyl and Fukushima. At the same time, the notion that silk worms can be created with the ability to spin silks integrating metallic gold recalls episodes of magic and legend that go back deep into history. We rely on art to bring dreams to light and in this sense, our silk moths evoke another kind of fine fabric.

Experiments planned for 2016 Ars Electronica Festival include real-time biomineralizations of transgenic silks.

Credits: In collaboration with Tara Gianoulis (USA) and Mariko Kasuya (Japan) at Harvard Genetics and Hideki Sezutsu (Japan) at the Japanese National Institute of Agrobiological Sciences in Tsukuba, Japan

Astrobiological Horticulture
Paleomicrobiological De-Extinctions and Extraterrestrial Simulants

Astrobiological Horticulture explores the possibility of creating organisms that can survive in widespread deposits of cold Martian brines now known to exist just below the Martian surface. While searching for suitable genes and candidate organisms, my collaborators and I have also been reviving ancient microorganisms, up to 400 million years old. These have somehow been preserved in crystals of mineral salts over enormous periods of geological time, and are now examples of by far the oldest "de-extinctions" to date. In this case, *Elixir of Life* is a hypersaline growth medium incubated with externally sterilized salts at 50° C.

Experiments for Ars Electronica 2016 include revivals of cryptobiotic archaebacteria from mineral salt samples initially deposited hundreds of millions of years ago in Europe, Asia and North America.

Credits: In collaboration with James Monaghan, Ashley Seifert, Jennifer Bender, Jeff Nivala, Seth Shipman, Conor Camplisson, Emma Kowal, Tom Bork, Bill McCarthy

Artist Lab
BCL

BCL is an artistic research framework founded by Georg Tremmel (AT) and Shiho Fukuhara (JP) in 2005 to explore the relations, congruences and differences of biological and cultural codes through artistic interventions and social research. Shiho received a BA hons in fine art from Central St Martins College of Art and Design in London and continued her studies with an MA in interaction design at the Royal College of Art. Georg studied visual media art (Visuelle Mediengestaltung) at the University of Applied Art in Vienna with Peter Weibel and Karel Dudesek and interaction design at the RCA.

http://bcl.io

Common Flowers / Flower Commons

The *Common Flowers* project is based on the first commercially available, genetically modified flower, the blue "Moondust" GM carnation developed and marketed by the Japanese brewers Suntory. But although Suntory applied for and was granted permission to grow this GM plant in its key markets, it has chosen not to. Instead the blue GM flowers are grown in Columbia, harvested, and shipped as cut flowers to the worldwide markets.

With *Common Flowers* we reverse the plant-growing process, by growing, multiplying and technically "cloning" new plants from purchased cut flowers using plant tissue culture methods. The blue GM carnations are brought back to life using DIY biotech methods involving everyday kitchen utensils and easily purchasable and ready materials.

And because the plants are officially considered "not harmful" and therefore legally permitted to be grown outside, we took the next logical step and released the blue GM carnation into the environment. This action is intended ask questions about the state of intellectual property, ownership and copyright issues surrounding the bio-hacking and bio-bending of plants. Our goal is to make these flowers available as shared *Common Flowers* and to create the free spaces where they can grow and prosper in a *Flower Commons*.

Martin Hieselmair

Kristof Vrancken

Martin Hieselmair

Ghost in the Cell

Ghost in the Cell is the actual, physical embodiment of the virtual idol Hatsune Miku.

Hatsune Miku made her debut in the form of a voice synthesis computer program, from which user-generated images, songs, videos, concerts—and even operas—collectively emerged. She blurs the space between flesh and virtual idols, she represents a mass-mediated, semi-living entity, omnipresent in the Japanese media and social sphere.

BCL took the next logical step of bringing her to life: creating an actual living, biological embodiment of her code-based life. First we created an artificial, synthetic genome, based on averaged female genomic data. It was possible to add, edit and insert genetically encoded information into the synthetic genome. Parts of the synthetic genome were introduced into iPS (induced pluripotent stem-) cells, which were differentiated into cardiomyocytes, resulting in the living, beating heart cells of Hatsune Miku. Hatsune Miku became the space where the symbolic and the real collide.

In collaboration with Yuki Yoshioka and Philipp Boeing. Credits: Yohsuke Takahashi (21st Century Museum Kanazawa); Hideo Iwasaki (Waseda University, meta-Phorest); SemiTransparent Design; Crypton Media
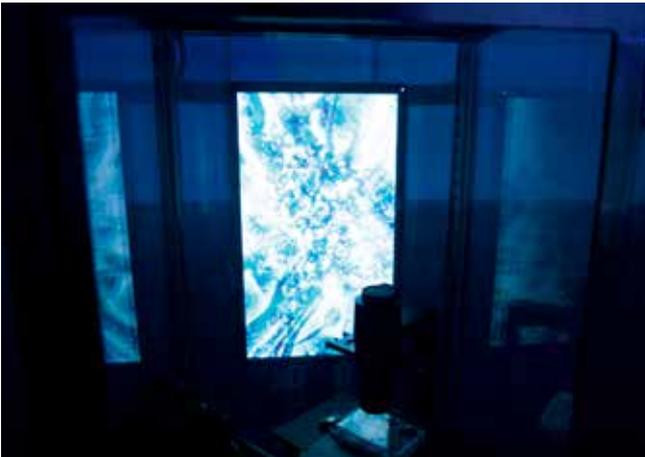
Gina Czarnecki (UK), John Hunt (UK)

Heirloom

When human materials are stored, grown and used outside the body it can be hard to say exactly who is being cared for, to say where, between us and our cells, identity lies.

Heirloom grows living portraits of Gina Czarnecki's two daughters using cells collected from inside their mouths using a buccal swab. The cells grow on delicate glass casts of their faces in a life-support system that provides the best conditions for cell growth outside of the laboratory.

Heirloom combines innovative cell-nurturing methods and cocktails in readily available equipment in which the cells grow to the thickness of tissue paper. They are then preserved, lifted and presented as a personalized and scientifically accurate three-dimensional self-portrait—an heirloom that parents might decide to leave to their children as something derived from them and given back to them.

Heirloom reveals the process behind the artwork, combining elements of citizen science, prototyping and experience design to suggest possible futures, including new medical procedures and DIY techniques. It imagines and offers a cultural laboratory for the future of the face.

Gina Czarnecki
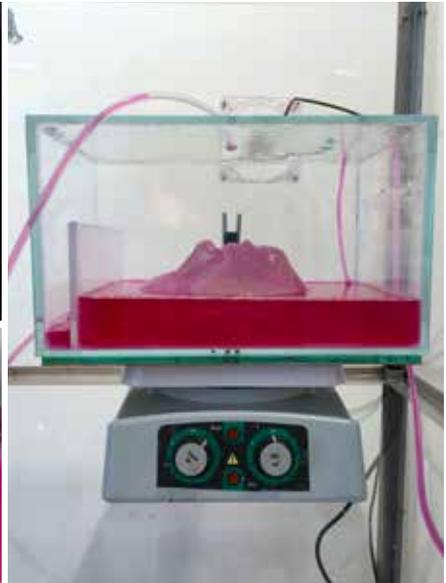
Dean Verzel (SI)

Anatomy of Frozen Genesis

Anatomy of Frozen Genesis is an art project developed after a lengthy and complex process in 2011 in situ and in collaboration with the Institute of Anatomy at the Faculty of Medicine, University of Ljubljana. The final output was then documented by photo and video documentation of the technical and creative process.

The artwork was made by placing two dead amputated human arms in the center of an icy monolith. The two arms were set up in the same way as the contact between the divine and the human in the famous Michelangelo fresco on the ceiling of the Sistine Chapel.

In the reinterpretation of this biblical image, in which Michelangelo shows us the Creator as the life force and cosmic consciousness at the moment of the "divine spark" of the creation, I introduce the code of death, confronting the viewer with the metaphysical antipode of the Michelangelo's Creation.

Anatomy of Frozen Genesis is consequently pervaded with a dramatic anxiety, which opens up various interpretations of our inner, existential and cosmological states of "the soul-and-flesh." It also highlights the awareness of the ephemerality of the body, life and ideas.

Floris Kaayk (NL)

The Modular Body

The Modular Body is an online science fiction story about the creation of OSCAR, a living organism built from human cells. Its inventor is Cornelis Vlasman, a versatile and innovative biologist. With the organism OSCAR, Vlasman demonstrates that it is possible to create modular life. Stem cells can be reprogrammed, grown and printed as any type of human tissue. The line separating humans from machines is gradually becoming thinner. What if this modular organism could be the model for a modular human body?

Helene Steiner (AT/UK)
Project Florence

Nature has many languages. *Project Florence* takes advantage of the sensibility of plants to different light frequencies and uses it to trigger electrical responses by a plant and compares the similarities between plant signals and natural language processes. It approaches plants as reactive living matter which generates new perceptions towards how we interface with our natural environment. This creates a rudimentary conversation with our natural environment. In this system, the user first attempts to communicate with or influence the plant through modulated natural language. Their inputs are analyzed for sentiment and semantic content. The resulting signals are used to modulate a light source that projects onto the plant. During this, the chemical and electrical signals are measured. The resulting responses from the plant are transformations of the input, driven by linguistic trees as well as lexical paraphrases. *Project Florence* can be a mediator between the natural environment and our technological world.

http://www.helenesteiner.com

Microsoft Research; Helene Steiner, Paul Johns, Asta Roseway, Chris Quirk, Sidhant Gupta, Jonathan Lester.

Navid Navab (CA), Michael Montanaro (CA)

Aquaphoneia

Aquaphoneia is an alchemical installation centered around the poiesis of time and the transmutation of voice into matter.

A large horn floating mid space echoes the ghosts of Edison, Bell, and Berliner's machines. But unlike early recording, herding sound energy to etch pressure patterns in solid matter, this odd assemblage transmutes voice into water and water into air. Disembodied voices abandon their sources to cross the event horizon of the horn. Estranged, the schizophone falls into the narrow depths of the bell, squeezed into spatiotemporal infinity, calcinated, liquefied and released: the aqueous voice then flows into three alchemical chambers where inner time is surrendered to the tempi of matter: unbound, yet lucid and sound.

In one corner, voices bubbling inside a sphere of fire are brought to entropy and transmuted into a timeless concentration of spectral mist and phonetic vapor. An ouroboros chamber twists fermented vowels into distilled consonants to release a thin blade of prosody. This viscous alchemical matter lowers itself to the terra beneath, where matter dances to its own affective tonality. Another module separates speech into vital elements a drop at a time: words into phonemes, into phono particles, and the invisible quanta of silence.

Hanneke Wetzer

Špela Petrič (SI)

MISEREABLE MACHINES:
Soot-o-mat

In this work mussels are lashed into an electro-stimulated design apparatus to make a vase. They are allowed to relax up to a certain point, then shocked, prompting movement that scratches a design onto the object. The resulting form might be seen as a sobering memento mori, a reflection on manufacturing processes that exploit biology. Biodesign calls for integration with living systems as a technological, environmental and moral imperative.

In six hours the cylinder will move just 20 cm upwards; the contractions happen once every 20 minutes. Within it the mussels live and die in a loop, a cycle of work and relaxation that eventually kills it. If we humans are ourselves engaged in the machine of capitalism, why would we export this to other species? The artist calls it a "biologically-augmented analog-machine poem, a scientifically didactic view of muscle contractions, and lastly a sharp commentary of obsolete but still persisting modes of production with blatant exploitation of living systems."

Text: William Myers, curator and author

Michael Kugler (US), Sebastian Wolf (DE)

Brume

In the collaborative work *Brume* fog emerges from and self-organizes on the surface on a sculptural element, congealing with light into an elusive stratum. The installation utilizes a series of ultrasonic transducers that generate thick clouds of dense, yet extremely lightweight water vapor. Fog is produced in an inner chamber contained within an enclosure that is outfitted with a porous surface. A small radial blower inside the apparatus gently pumps air into the inner chamber lifting the fog through the membrane, whereby it "settles" on the surface. Viewed from a distance, the fog appears as a visualized mass of air circumscribing the perimeter of the enclosure. The diffraction of light results in an interference pattern, allowing the viewer to perceive the collection of discrete droplets of water vapor, the undulations of which are reminiscent of ocean waves—a perpetually fluid landscape, dispersing and reemerging simultaneously. As the fog vanishes, so does the apparatus itself.
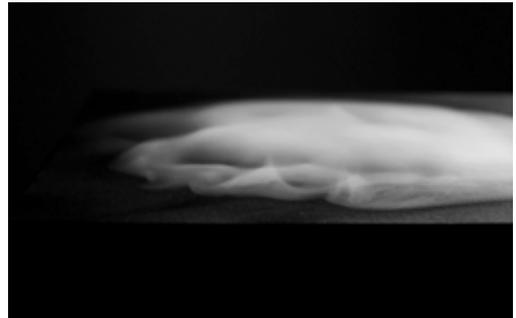
Luigi di Bella

Stefan Tiefengraber (AT)

Rotating Lights

Rotating Lights is the second installation of the series *Noise / Light / Seoul* from the artist Stefan Tiefengraber. A kinetic light installation consisting of five, for Korea very typical, fluorescent lamps that can be found in almost everywhere Korea but are slowly starting to disappear. The artist connects these lamps to a custom-made rotating system. Driven by a motor, the lamps start very slowly, the rotating continually speeds up to the maximum rate. After reaching this climax the power turns off–the light goes out and slowly stops spinning. The spectator is left in the dark and now silent space until the lights turn on and start moving again.

These same techniques to produce an experience for the spectators can also be found in the two related works, 징 *noise #1* and *ppang / 빵*, which are also part of the series *Noise / Light / Seoul*, which the artist created during his stays in Seoul / Korea in 2015 and 2016.

http://www.stefantiefengraber.com/rotating_lights.php
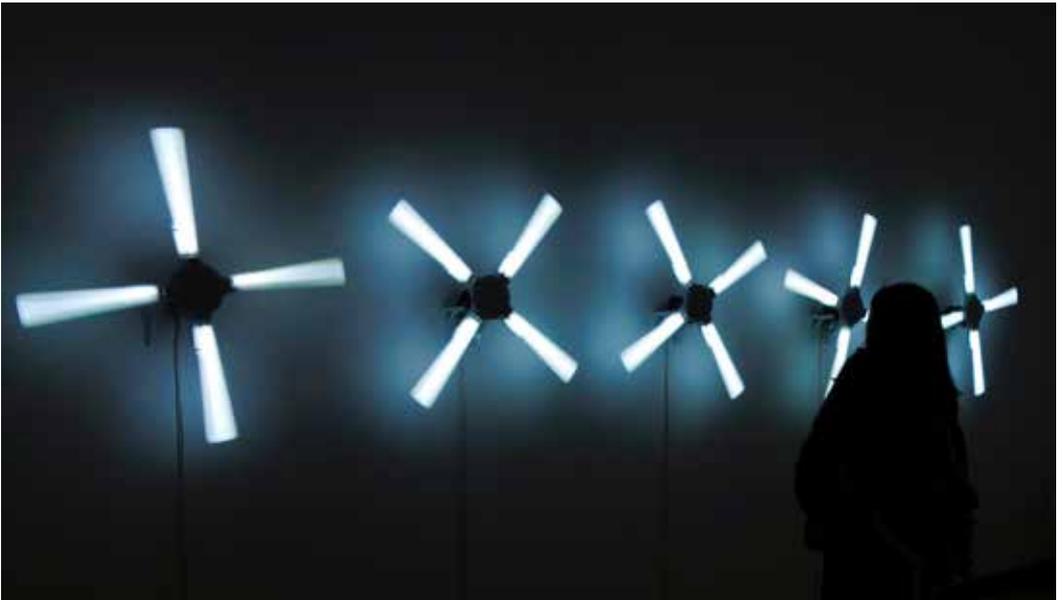
Robertina Šebjanič (SI), Slavko Glamočanin (SI)

Aurelia 1+Hz / proto viva sonification

"There are still songs to sing beyond mankind"
Paul Celan

Aurelia 1+Hz / proto viva sonification is an audio-visual performance that explores the phenomena of interspecies communication, sonification of the environment and the underwater acoustic / bio-acoustics. It features live transmitted sound generated by *Aurelia aurita*, the moon jellyfish, and performer. The sound loops contain recordings of a jellyfish in closed environment and prerecorded from jellyfish blooms at sea. Both are mixed into an immersive sonic and visual experience. For over 500 million years jellyfish have been pulsating in the world's oceans and seas. Nowadays, amid the immense environmental changes, their numbers are rapidly growing. It has not yet been established how they communicate. The odyssey into the exploration of interspecies communication is a way of discovering parameters to restore a deep relationship with all life and is a key to better understanding of the Earth's environment.

http://www.robertina.net/aurelia-1hz-proto-viva-sonification/

Artist, concept, research and development: Robertina Šebjanič; Programming and tech development: Slavko Glamočanin; Coordination and curating: Natacha Seignolles (DécaLab); Curating advisor: Annick Bureaud; Consultancy: Prof. Dr. Alenka Malej, Piran marine biology station; Production: DécaLab and Le Cube–Centre de création numérique, Paris, France, February 2015
With special thanks to Aquarium Pula

Hiroshi Nakamura

Naoki Leonard Fujita

Naoki Leonard Fujita

Akiko Nakayama (JP)

Alive Painting

I am a painter. I would like to paint living things and convey energy metamorphosis. But why is a painting dry? Why isn't a painting alive?

So I was inspired to start *Alive Painting*, my current work. Combining the energy of movement and the vibrancy of colors, I bring pictures to life. I depict the resonance between shapes and textures by using different types of liquid, each with a unique characteristic.

Usually, mineral paint is made by combining metals with natural minerals found in the Earth's crust.

I draw intentional lines on natural phenomenon in my paintings to see the designs in nature more vividly through the contrasts made by my hand. When I interfere with the designs in nature, I can see the movement of entropy.

Life has different wavelengths. So I create a work of art with various materials and media to capture each passing moment.

I am interested in the beauty of the boundary between two colors. To me, the meeting of two colors represents the dance of Yin and Yang.

Artist Lab
Masaki Fujihata (JP)

Masaki Fujihata is a trailblazing media artist, renowned in Japan as well as abroad.
In the mid-90s, Fujihata produced canonical pieces of what would later be called interactive art. His work addresses everything from how we interact with interfaces to the ways we might communicate in virtual space. In particular, his experiments with GPS technology, beginning in 1992, take a rather uncommon technical tack in gathering data, making for a meticulously composed and unparalleled series of cyberspace creations that can only be called "the cinema of the future," or "the shape of media to come."

Anarchive˚6

Anarchive˚6 is a book containing almost of all of Masaki Fujihata's artworks from 1972 to 2016, which can be seen as video documentaries and interact with a reconstructed installation as a 3D model by using AR (augmented reality) technology with iOS devices.
Anarchive is a series of interactive multimedia projects designed to explore an artist's overall oeuvre via diverse archival material. The series started from Antoni Muntada in 1999, Michael Snow in 2002, Thierry Kuntzel in 2006, Jean Otth in 2007 and Fujiko Nakaya in 2012. The sixth is Masaki Fujihata in 2016 and the seventh, Peter Campus, will be in 2017.

The project is a historical and critical research whose main purpose is to constitute the memory and increase public awareness of some of the most important developments in contemporary art, such as performances, works in public places, video works, installations, experiments with technologies. Beyond a mode of preservation, beyond producing important databases about a whole oeuvre, the project aims to stimulate various artists to develop new works through the use of digital techniques.

Artist: Masaki Fujihata
Producer: Anne-Marie Duguet
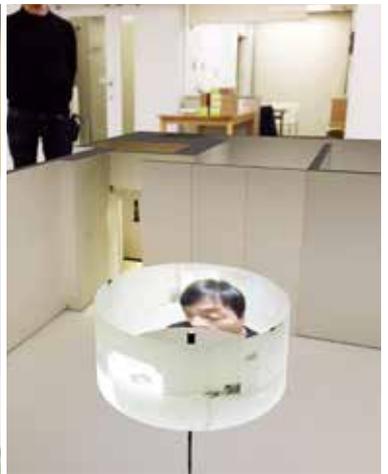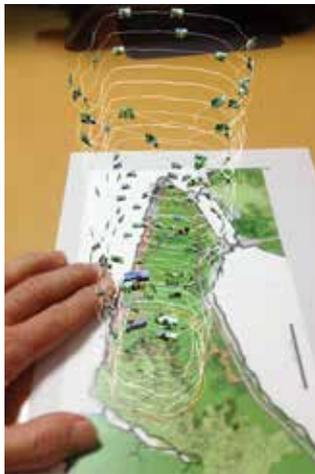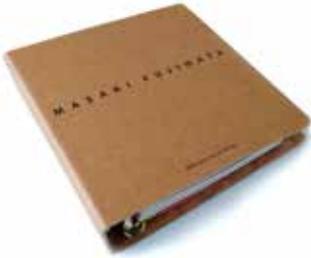
Masaki Fujihata

Naotaka Fujii (JP), GRINDER-MAN (JP), evala (JP)

Neighbor

How do we build a social relationship with others? How will technology interfere with the building process? The immersive art performance *Neighbor* visualizes the subjective process and will predict the future pattern of social bonding.

Two participants wearing HMD and headphones stand facing each other at the center of the stage. Over a period of six minutes they see live images or a recorded past, or mixture of the two, which blurs the self/other boundary. They are instructed use their hands in order to interact with the other participant and create a new relationship. The two performers interact with the participants in real and virtual space. The participants' views are displayed on the screen. As witnesses, audiences can observe the participants' subjective experience and feelings through the stage and screen.

Neighbor allows participants and audiences to share the same subjective process from different perspectives, which will stimulate and enhance interpersonal relations.

http://neighbor.grinder-man.com

Agency for Cultural Affairs, Government of Japan

ARTS COUNCIL TOKYO

Ei Wada (JP)
The Kankisenthizer

In 2015 Ei Wada started a project called *Electronicos Fantasticos!* where he recycles used home electronics and turns them into electronic musical instruments. The concept is to awaken a Yōkai (a supernatural creature in the Japanese folklore) who was living but is asleep in the abandoned technology. One of the main roles in the project is *The Kankisenthizer*. This converts electromagnetic waves into sound by spinning ventilation fans (called *kankisen* in Japanese) and storing the light that flickers through the blades as power in a small solar battery. Changing the number of fan blades creates a musical scale. The performer holds the solar battery and moves between the fans, or directly touches the blades and changes the voltage to control the number of rotations while producing the music.

Technical support : Souichi Yamamoto (NICOS LAB)
Promoter : NPO TOPPING EAST
Thanks to NICOS LAB

Mao Yamamoto

Sky Canvas

ALE is an outer-space entertainment company that aims to further innovation in entertainment through space technology. Our team is comprised of aerospace engineers and experts in the entertainment business and we are based in Tokyo, Japan.

We provide shooting stars and meteor showers on demand, available starting in 2018. With our shooting-star technology, we can paint the sky with meteor showers in various colors (currently available in blue, green and orange) and on a scale greater than those seen in the natural world.

If the sky is the canvas, our shooting stars are paintbrushes that can light up the sky in different colors. Through this innovation, we hope to revolutionize live entertainment while making outer space accessible to everyone and inspiring the next generation of scientists.

http://global.starale.com

Credits: ALE Co. Ltd.; Nihon University; Tokyo Metropolitan University; Japan Aerospace Exploration Agency

Photo by Shinsuke Abe
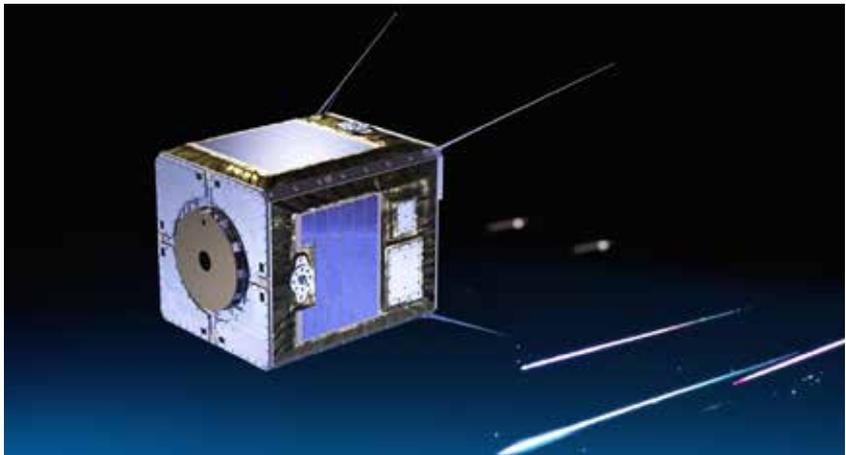
Beatrice Haines (UK)

Terminal Sulcus

As a child I was horrified to discover that the succulent filling I enjoyed in my sandwiches was bovine tongue and not the ham I suspected. Eating meat seemed strange enough, but the sensation of tasting another animal's tongue with your own felt bizarre. Years later this experience inspired *Terminal Sulcus*.

Over 700 casts of human tongues line the inside of a fridge, illustrating our dependence on domestic technology. Useful household appliances are often overlooked as a source of emotional value, despite our constant use of them. It is photographs or ornaments that we project importance onto, despite the electrical appliances' ability to keep food fresh and free from bacteria. These objects are our guardian angels, yet usually end up at the local municipal tip. My work centers on the human trace with a particular focus on forensics. *Terminal Sulcus* explores traces left behind as DNA in saliva. Its pink fleshiness is erotic and visceral, subverting the domestic environment.

Daniel Boschung (CH)

Face Cartography

The composed mega-portraits are disturbing. *Face Cartography* is the Swiss publicity and news photographer's latest project. He maps faces. Instead of taking pictures himself, he removes himself from the process by delegating the work to an ABB industrial robot controlled by specially customized software. The standardized portraits make a surprising impact. Each picture consists of about 600 single shots comprising 900 million pixels. The result is hyper-realistic. Stubble turns into a trunk, a wrinkle into a canyon, a nostril into a cavern. These facial landscapes are dismaying—why? Emotions are completely absent. They appear only briefly, while macro

photography takes half an hour. The human subject has to remain motionless while being photographed by the robot.

Steffen Armbruster (DE), Antye Greie-Ripatti (DE)

Sonic Wildness

Sonic interventions investigate notions of coexistence, communication and potential for interaction in hybrid ecology. The radical voice as the embodied human instrument and language as the base for code and algorithms lead to complex programming. What we call wild or radical is hard to find. Wildness is about listening. Deep Listening as well as introspective listening to an artificial soundscape derived from the "radical wild." This project is intended to build a connection between sound and space. The installation takes advantage of the new acoustic possibilities of the usomo system.

This headphone-based system tracks the position and rotation of each user precisely. With this information it is possible to place sounds at exact positions in real space with the usomo software. In this installation we create complex soundscapes that can be explored individually, that connect with the space the users are in and let them dive into the *sonic wildness*.

Concept and technical setup: Steffen Armbruster
Sound concept and sound production: Antye Greie-Ripatti
Spatial concept and design: Marc Osswald
Sound system: usomo

Jack O'Leary McNeice

Charlotte Furet (FR/US), Catherine Ka Hei Suen (CN),
Andre McQueen (UK), George Philip Wright (UK)

Skinterface

Skin is our interface with the physical world. Sound and vision allow you to observe and understand, but touch allows you to interact. In the digital environment to go from the position of an observer to that of an active participant, a person must be able to feel the virtual world they are entering and the transition into it.

Skinterface is a skinsuit which allows you to enter the virtual world. It enables two-way physical interactions with computer-simulated objects and environments, creating a fully immersive experience. Located and tracked through 3D space, *Skinterface*

is equipped with sophisticated actuators which convey subtle sensations, effectively converting virtual interaction into physical feeling.

Beyond the experience of transition, the suit would also be capable of facilitating interactions with virtual objects or people—whether for entertainment, communication, virtual prototyping or many other potential applications.

http://www.skinterface.co.uk

Conducted as part of the Innovation Design Engineering program at the Royal College of Art and Imperial College London.

Shinoda & Makino Lab, University of Tokyo (JP)

Haptoclone

Haptoclone creates 3D visual images of objects and produces haptic interactions with the 3D images. The system has two small workspaces and they are completely symmetrical. A person's hand or an object in a workspace is cloned to the other workspace and two people in front of the two workspaces can touch each other through their 3D images with haptic feedback. They need neither glasses nor gloves for the visual and haptic experiences. The maximum force for haptic feedback is small, but the force position and timing are faithful. The 3D clone images are created optically by passive micro-mirror-arrays and haptic interactions are produced by the radiation pressure of airborne ultrasound. The contact points between the cloned images and real objects are observed by optical sensors and the contact force is created by concentrating ultrasound energy emitted from the ultrasound phased array surrounding the workspace.

Mitsuru Ito

Alessio Chierico (IT)
Trāṭaka

Trāṭaka is an interactive installation based on a brain-computer interface. *Trāṭaka* is a Sanskrit term meaning "to gaze" and it refers to a meditation technique for concentrating one's attention on a flame.

The work is composed by a brain-computer interface that detects the brain waves and defines parameters such as the level of attention. Wearing this device, the user is invited to concentrate their attention on a flame in front of them. The level of attention detected by this system, controls an air flow under the flame: a higher level corresponds to a faster air flow. The interaction process is aimed at user engagement to increase their attention in order to put the flame out. This will happen when the highest level of attention is reached: the air flow becomes strong enough to extinguish the flame.

This installation aims to create a context where users are motivated to explore their concentration abilities, with a "calm" interaction materialized by the movements of the flame.

Masa Inakage (JP), Kazuma Suzuki (JP), Asturo Ueki (JP)

Fog Pixel

Fog Pixel is an interactive installation that can emit a stream of fog in the rectangular shape of pixel. It was initially designed as a new type of stage expression platform. The artists explored the form and movement of fog to design a unique participatory aesthetic expression through embodied interaction. Using fog as a medium for interactive design, *Fog Pixel* introduces a method for controlling the fog stream shape, direction and wind velocity, to go along with light and sound. *Fog Pixel* aims to pave the way for a new type of interactive design.

Credits: Kazuma Suzuki, Asturo Ueki, Masa Inakage
(Keno University Graduate School of Media Design)
This work was created as part of the Keio University
Global Smart Society Creation Research Project

Julie Legault (CA)

Amino One

amino

Bacteria are beautiful and strange—and they're also part of a revolution in sustainable advances across food science, energy, health, and materials. Usually when we think about bacteria it's because we're trying to get rid of them, but a growing number of scientists, engineers, and hobbyists are using them as a stepping stone for tomorrow's innovations.

By learning genetic engineering and biotechnology hands-on from the comfort of home or the classroom, you, your family or your students can be leading innovators of the 21st century!

Bioengineering involves lab equipment, lab reagents, analysis and protocols to follow. *Amino One* replaces traditional bulky multi-user lab equipment with self-contained desktop systems that take you from theory to practice in one week and comes with all the necessary instructions and ingredients.

With on-screen instructions that are easy to follow, *Amino One* allows users to go at their own pace and explore bioengineering in depth to create fun things like flavor, colors, scents, materials and more! Each *Amino One* will be able to run a series of different experiments—start with our first experiment: producing pigments that you can use for drawing!

http://www.amino.bio

Yoko Shimizu (JP)

Photosynthegraph

Photosynthegraph combines photosynthesis and photography to print graphic images on plants. In the *Photosynthegraph* installation, a botanical lab is installed in the exhibition space. Films are attached to plant leaves, allowing chloroplasts to create starch based on the graphic patterns. The leaves are then chemically treated to visualize the graphics created by the chloroplasts. The entire development process will be demonstrated in the artist performance. Photosynthesis is one of the most important chemical reactions in the history of our planet. It is the source of oxygen and energy, and the foundation of our food chain. Humans have utilized photosynthesis for food and industrial activities. Now we are taking one step further to expand the possibility to art and design.

The images created by the natural process are delicate and beautiful, showing us that there are still infinite possibilities for technological advance and artistic expression on this planet.

Dr. Theresa Dankovich (US)

The Drinkable Book

Introducing the *Drinkable Book* by Folia Water: no pipes, no pumps, just a lightweight, long-lasting, inexpensive paper filter that kills bacteria and viruses while removing parasites, algae, cryptosporidium, giardia, cholera and other waterborne pathogens. Pour dirty water in and clean water comes out. Invented by the Folia Water co-founder and chief technical officer Dr. Theresa Dankovich, the *Drinkable Book* filter has a silver coating that kills bacteria and viruses. Larger parasites and algae are strained out by the paper itself. One ten-cent filter purifies 100 liters of water. A backpack full of these filters can purify enough water for 500 people for a year. Originally created through a collaboration between chemist Theresa Dankovich, PhD, non-profit WATERisLIFE and ad agency DBB NY, the *Drinkable Book* features information to raise awareness about the need for clean water, sanitation and hygiene printed on its pages.

Inventor: Theresa Dankovich, PhD, Folia Water co-founder and chief technical officer
Designer: Brian Gartside of DBB NY
Non-profit partner: WATERisLIFE

Brian Gartside

Theresa Dankovich

Elena Mitrofanova

Elena Mitrofanova (RU)
Moss Voltaics

Moss Voltaics is a proposal for a green façade system that aims to explore how moss might be used as a source of renewable energy.

The emerging technology to be used is called bio-photovoltaics (BPV), which uses the natural process of photosynthesis to generate electrical energy. In this process plants using light energy consume carbon dioxide and water from the environment to convert it into organic compounds. Some of those compounds are released through the roots to the soil where a symbiotic bacteria occurs. The bacteria break down the matter, liberating free electrons. By providing an electrode for the micro-organisms to donate their electrons to, electricity can be harvested.

The system is represented as a set of batteries. Each one is a modular ceramic brick that contains moss with its own microclimate. The moss is planted in a "soil" made of hydrogel and carbon fibers. The containers are designed to interlock without any need for mortar. Interlocking also enables electrical connections in one circuit, which generates 3V/20mA, enough to charge LED lighting.

Project by: Elena Mitrofanova
Scientific development: Dr. Paolo Bombelli, University of Cambridge
Advisors: Silvia Brandi Luis Fraguada Alexandre Dubor
Collaboration: Toni Cumella, Ceramica Cumella

Susana Soares (PT/UK)

Urpflanze

Can we or should we design plants for extreme weather conditions?
Can we afford not to?
The diversity of leaf shapes, sizes and structures allows plants to adapt to nearly every environment. The precise molecular switches that control this process are being discovered. Research on plant morphology is putting together the genetic blueprint that controls plant structure and shape. The findings could be the first steps to a new generation of plants that are more resilient to unpredictable weather patterns, meet the challenges of the global demand for food and even influence the climate.
Urpflanze features hypothetical plant archetypes with specific features that enable them to adjust to living conditions in the future, such as extreme drought, floods and increasingly higher CO2 levels.

The illustrations are based upon and inspired by plant morphology research from the Department of Animal and Plant Sciences, University of Sheffield. The project attempts to give a brief overview of current research, questions whether we can or should design specific adaptations for a rapidly changing environment, and where can we draw parallels applicable to us.

http://www.susanasoares.com/urpflanze

Ori Elisar (IL)

The Living Language

The Living Language is a bio-design project exploring the boundaries between culture and nature. It is a suggestion for a new evolution process of the Hebrew alphabet during the 2000 years it was considered to be a dead language. The core element of the project is the bio-ink out of the Paenibacillus vortex bacterium, which is used to create old Hebrew characters that evolve themselves into modern ones. The project was created as part of Elisar's final thesis at the Bezalel Academy of Arts and Design. He explores how language can be expressed visually. The project deals with the tension between controlling the behavior of living organisms and letting nature run its course. It also explores the developing states of the Hebrew language. Using the research, experiments and results, Ori questioned nature, culture, character and language with some of his own theories and asked in which biological fabrication can technologies interact with the design world. The project was created as part of Elisar's final thesis at the Bezalel Academy of Arts and Design in Israel.

http://orielisar.com
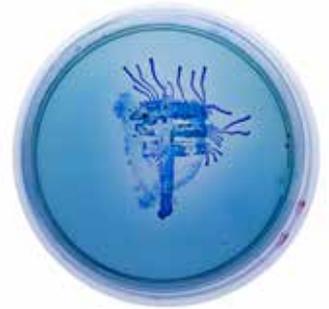
Benjamin Heidersberger (DE)

Pentatonic Permutations

"Listen and you may find that you are silence yourself."

Pentatonic Permutations is an algorithmic piano composition by Benjamin Heidersberger that started 14 billion years ago and will continue another 16 trillion years, tagging every moment of time. After the last permutation the piece will stop.
Pentatonic scales of prime number length are constantly phase shifting, creating narrations; fragments of melodies appear and disappear. Out of 66 possible scales 1–4–2–3–3 was selected.

In the installation eight speakers spatialize sampled Steinway pianos coming from a laptop with a multichannel output. A computer program creates the algorithmic composition as midi events, which are played by a software synthesizer using Linux.
Pentatonic Permutations is also a portable paperback-size player converting time to music. It receives time from radio waves and synchronizes a high-precision clock so all players will play the same part of the composition wherever they are. An edition of 100 pieces is for sale.
https://www.facebook.com/pentatonicpermutations

Chris Schauer

Antoine Delacharlery (FR)
Ghost Cell

Scientific and dreamlike documentary at once, *Ghost Cell* is a stereoscopic plunge into the guts of an organic Paris seen as a cell through a virtual microscope.

Screenwriter and editor: Antoine Delacharlery; Executive Producer, Line Producer: Nicolas Schmerkin, Autour de Minuit Productions; Production manager: Émilie Schmerkin Crew: Animation: Antoine Delacharlery, Bastien Dubois, Mathieu Bernadat, Jean Delaunay; Editing: Antoine Delacharlery; Music Composer: Bastien Prevosto

This project is presented in the framework of the European Digital Art and Science Network and co-funded by the Creative Europe program of the European Union.

CIID (DK), Toyota Motor Europe (EU)

Window to the World

Imagine when a journey from A to B is no longer routine, as in the near future your car encourages a sense of play, exploration and learning. This is the image engineers and designers from Toyota Motor Europe (TME) and the Copenhagen Institute of Interaction Design (CIID) Consultancy had of Toyota's *Window to the World* vehicle concept.

The concept redefines the relationship between passengers in a vehicle and the world around it by transforming the vehicle's windows into an interactive interface. Using augmented reality, what used to be a pane of glass begins to provide passengers with information about landmarks and other objects as they go past. The window can also be used as a canvas for drawings, which then interacts with the passing environment. Engineers and designers from TME's Kansei1 Design Division teamed up with the CIID consultancy to develop this concept in the context of near-future mobility. Instead of creating a concept simply with strong visual aesthetics, they aimed to create beautiful and intangible experiences to address specific needs and desires, to bring genuine value to the vehicle's passengers.

Copenhagen Institute of Interaction Design (CIID)
Toyota Motor Europe (TME)
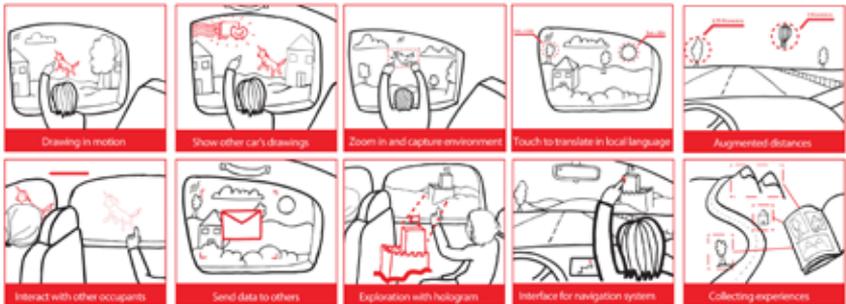
CIID (DK)
Future Self Mirror

Health and fitness data is being tracked everywhere these days, but can one really make sense of this data? Graphs and charts are often not enough to motivate people. So how might we visualize the available health data in a more motivating way?

A mirror is the metaphor for self-reflection and is an everyday object. We prototyped a mirror that gathers data from fitness trackers like fitbits, smartwatches and smartphones and visualizes the future health directly on a person's body when they look in the mirror.

In a way, the mirror accelerates time so you see your future self staring back at you. Today's habits shape tomorrow's image. Daily choices of diet, exercise, stress, smoking and more have a visible impact. This mirror augments one's reflection with visual predictions of future health, made possible by extrapolating the health data from fitness devices and smartphones.

This project was a part of the Enchanted Objects course taught by David Rose, Adrian Westaway and Francisco Gomez Paz at the Copenhagen Institute of Interaction Design. Moises Bottage helped in managing the space and materials.

Credit: Andreas Refsgaard, Line Birgitte Borgersen, Manu Dixit, Riccardo Cereser

Paolo Cirio (IT)

Obscurity
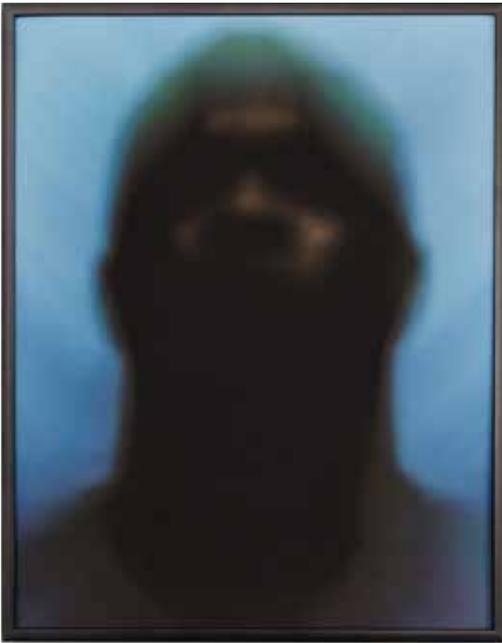
This artwork is composed of over fifteen million mug-shots of people arrested in the US. It obscured the criminal records of mug-shot websites by cloning them. The mug-shots have been blurred to make the faces unrecognizable while their names have been shuffled by an algorithm that samples data based on common age, race, location, and charges, all of which are kept accurate in order to provide social context on the actual arrests. A participatory feature lets people judge the arrested individual by deciding to keep or remove their data from the mug-shot websites. *Obscurity* explores the emotional underpinning of unflattering personal information exposed on the Internet. Beyond the use of criminal records for the social experiment and the performative hack, the project promotes a legal Right to Remove personal information from search engines in US. The *Obscurity* artwork deployed strategies that are oriented on problem-solving as a form of Internet social art practice.

AlteredQualia + Fractal Fantasy

Uncanny Valley

Creating convincing synthetic human beings is a notoriously difficult task. The "uncanny valley" phenomenon is a hypothesis that as you try to increase the realism of your human-like creations, there is a point behind which improvements actually become negative, causing a sense of unease or repulsion. Something flips in the mind of the observer, and the creature starts to be seen as a "human with which something seems to be wrong" instead of "human-like", a doll becomes a corpse. It takes a lot more effort to climb out of the valley, every little detail that was abstracted away comes back into play. We created the *Uncanny Valley* project to explore these concepts. It is an interactive webpage experiment with three animated virtual human heads reacting to the user's mouse movements, accompanied by three songs, featuring light sources synchronized to the music. The experiment is trying to find out what can be achieved today on the web, with very limited resources, on a constrained platform.

http://alteredqualia.com/
http://fractalfantasy.net/
http://fractalfantasy.net/uncannyvalley

Uncanny Valley is the result of a collaboration between the computer graphics programmer AlteredQualia, and the platform Fractal Fantasy.
Visuals, code and rendering: Branislav Ulicny, AlteredQualia
Fractal Fantasy
Songs by: Sinjin Hawke, Martyn Bootyspoon, Zora Jones

This project is presented in the framework of the European Digital Art and Science Network and co-funded by the Creative Europe program of the European Union.

Afroditi Psarra (GR), Dafni Papadopoulou (GR)

The Culture Series

The Culture series is an e-textiles project inspired by the *Space Operas* of British science fiction writer Iain M. Banks and his eclectic imagery of The Culture—a future civilization of people whose lives depend on sophisticated machines in a world where everything is sentient. The garment can be perceived as a hybrid organism, responsive to the user's vital functions—heartbeat—through subtle movements on the sleeves that behave as an augmented animalistic skin that breathes in and out. Technically, the project aims to combine electronic handicrafts with parametric design and digital fabrication on an ongoing research on wearables. The garment's sleeves are designed in Rhino and Grasshopper and have been laser-cut on leather and then assembled by hand in complex structures. The garment's circuit has an embedded Arduino microcontroller and lightweight actuators created using muscle wire, neoprene and conductive copper fabric sewn into the inside of the leather structure, as well as a 3D-printed earring with an embedded pulse sensor.

http://www.wemake.cc

The Culture series was created during a two-week residency at *WeMake*—Milan's Makerspace in February 2015, curated by Zoe Romano.

Afroditi Psarra (GR), Cécile Lapoire (FR)

Cosmic Bitcasting
A wearable cosmic-ray detector

In our era of continuous technological and scientific discoveries, where space probes are scouting the galaxy for Earth-like planets and huge particle accelerators are trying to reproduce the birth of our universe, the data that we collect from looking at a macro scale—observing the cosmos—or at a micro scale—observing subatomic particles—are essential for humankind to grasp the invisible world that surrounds and rules our everyday existence.

Cosmic Bitcasting emerges from the idea of connecting the human body with the universe by creating a wearable interface that can provide sensory feedback on the invisible cosmic radiation that passes through us. The project proposes the creation of an open-source, wearable detector that can detect secondary muons generated by cosmic rays hitting the Earth's atmosphere, by triggering a series of embedded actuators (light and vibration) as they pass through the human body.

https://www.zaragoza.es/ciudad/etopia/

Cosmic Bitcasting was developed during a one-month residency at the Etopia—Center for Art and Technology in Zaragoza, in the context of the residency *Reverberadas* program, part of the European Art and Science Network, curated by Fermín Serrano.

This project is presented in the framework of the European Digital Art and Science Network and co-funded by the Creative Europe program of the European Union.
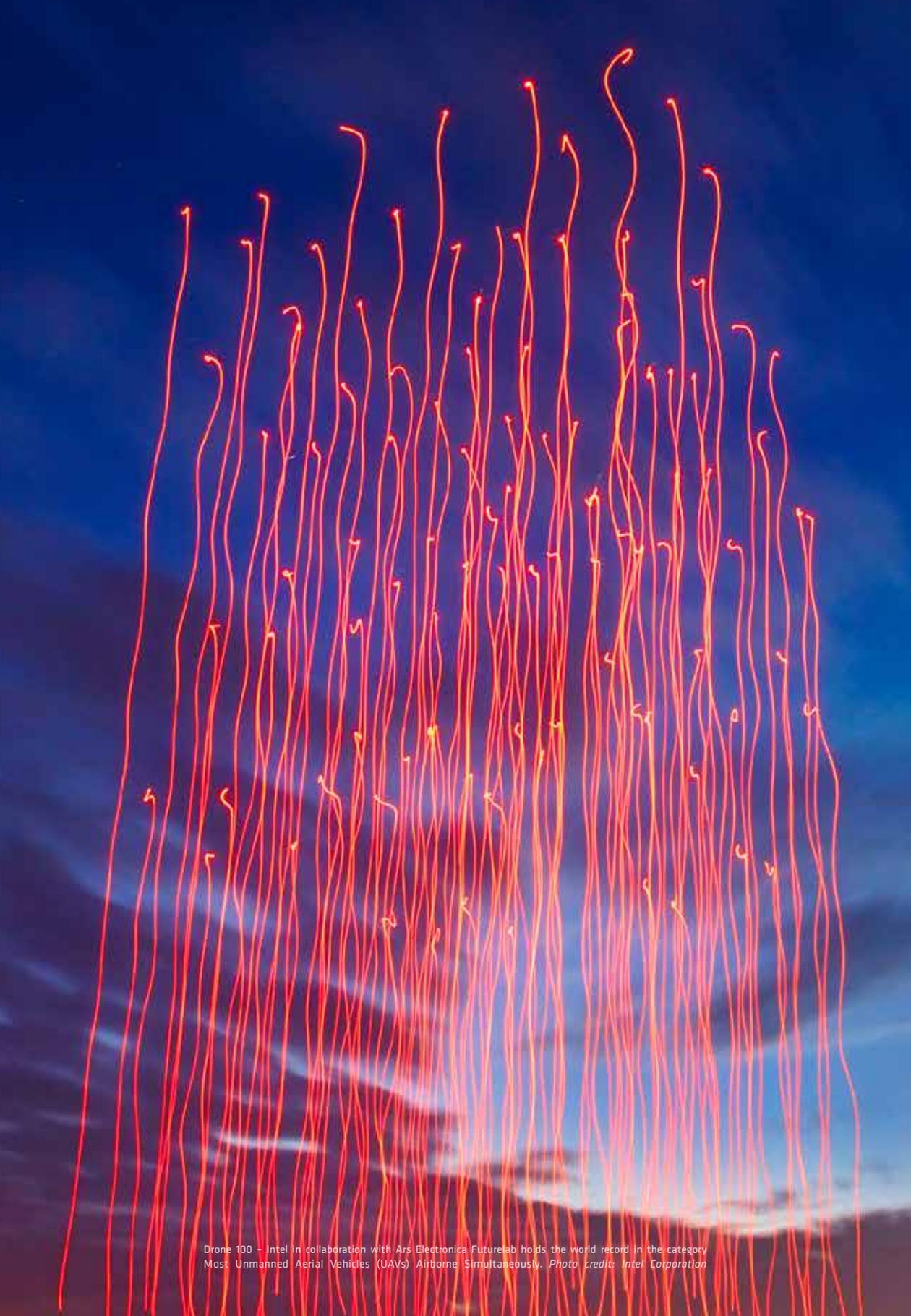
Drone 100 – Intel in collaboration with Ars Electronica Futurelab holds the world record in the category Most Unmanned Aerial Vehicles (UAVs) Airborne Simultaneously. *Photo credit: Intel Corporation*

EUROPEAN DIGITAL ART & SCIENCE NETWORK

European Digital Art and Science Network

art & science
european
digital art
and science
network

Together with three scientific institutions and seven renowned artistic and cultural institutions, Ars Electronica launched the European Digital Art and Science Network in late 2014. The project is the basis for a major network consisting of three scientific mentoring institutions (ESA, CERN and ESO), representing the forefront of Europe's scientific research, the Ars Electronica Futurelab, providing state-of-the-art technical production possibilities in a trans disciplinary discourse, and seven European cultural partners (the Center for the Promotion of Science, RS; the DIG Gallery, SK; the Zaragoza City of Knowledge Foundation, ES; the Kapelica Gallery / Kersnikova, SI; GV Art, UK; LABoral, ES; and the Science Gallery Dublin, IE) representing various strong European cultural and artistic positions.

The network aims to link up scientific aspects and ideas with approaches used in digital art. Its declared goals include fostering interdisciplinary work and intercultural exchange as well as gaining access to new target audiences. There is also strong emphasis on art's role as a catalyst in processes of social renewal. By creating images and narratives dealing with the potential risks and rewards inherent in technological and scientific development, artists exert an important influence on how our society comes to terms with these innovations.

Half the financing of the European Digital Art and Science Network is provided by the European Union Creative Europe program, the remainder is contributed on an equal basis by the participating institutions. Creative Europe is the European Commission's framework program for the cultural and creative sectors.

In cooperation with all the partner organizations, Ars Electronica issued four worldwide open calls for residencies. Two calls (fall 2014 and winter 2015) were for a residencies at the European Southern Observatory (ESO) in Chile, one (spring 2015) for a residency at CERN in Geneva, Switzerland, and one (spring 2016) for a residency at the European Space Agency (ESA). From among the entries, the juries of leading experts selected four artists (or artist groups) to take part in the residencies. The artists spent a few weeks at the scientific institutions drawing inspiration from their mentors and their scientific work. Subsequently, they spent an additional residency at the Ars Electronica Futurelab, where mentors assist the artists in the creation and development of new works inspired by their previous scientific residency.

The results of the residencies as well as dozens of contextualized artworks have been presented in modular exhibitions and presentations premiering in 2015 and 2016 at the Festival Ars Electronica and running at the seven partner institutions. In this framework the European Digital Art and Science Network facilitates 13 exhibitions, eight workshops and nine discursive projects (such as conferences or symposia).

Martin Hieslmair

Encounters, María Ignacia Edwards (CL)

art & science
residency
european
digital art
and science
network

BUNDESKANZLERAMT ÖSTERREICH

Residencies &
Scientific Partner Institutions

CERN

As the cradle of the World Wide Web and home of the Large Hadron Collider, which investigates the mysteries of our universe, the European Organization for Nuclear Research–CERN is an eminent center of the digital culture as well as science and technology. As an international center of excellence in these fields, it is an inspirational place for artists and designers to explore and extend their research in order to find new artistic approaches.
http://home.cern

European Southern Observatory (ESO)

The European Southern Observatory (ESO) is an intergovernmental organization that has its headquarters in Munich and its observing facilities in Chile. Founded in 1962 today ESO consists of many different observation facilities which helped to make a lot of important discoveries in astronomy. ESO has built and operated some of the largest and most technologically advanced telescopes in the world.
http://www.eso.org/public

European Space Agency (ESA)

Under the aegis of the European Digital Art and Science Network, the new scientific partner in this project is the European Space Agency (ESA). ESA is Europe's gateway to space. Its mission is to shape the development of Europe's space capability and ensure that investment in space continues to deliver benefits to the citizens of Europe and the world. ESA is an international organization with 22 Member States. ESA's job is to draw up the European space programme and carry it through. ESA's programmes are designed to find out more about Earth, its immediate space environment, our Solar System and the Universe, as well as to develop satellite-based technologies and services, and to promote European industries. ESA also works closely with space organizations outside Europe.

http://www.esa.int

Residency at the ESA

This residency offers artists an extraordinary opportunity to experience the landing of the Rosetta space probe and the the ExoMars Mission live on site at the European Space Research and Technology Centre (ESTEC) in Noordwijk, the Netherlands. The ESA's efforts are now focused on exploration of the Sun and the magnetic fields of the Earth, Mars, Saturn and the 67P/C-G comet. Current missions include producing a three-dimensional survey of the Milky Way and exploring Mars. In September 2016, the ESA's Rosetta space probe will actually land on the 67P/Churyumov-Gerasimenko comet and collect data there, and shortly thereafter, ExoMars 2016 will arrive at the destination of its mission and thereby open up a new chapter in the history of European space travel. In conjunction with their residency, artists will enjoy a once-in-a-lifetime chance to experience these extraordinary events live in the company of staff experts on site at the ESA research center.

Residency at CERN in Switzerland

After selecting Maria Ignacia Edwards for a first residency at the ESO in Chile, followed by a residency at the Ars Electronica Futurelab, the Collide@CERN Ars Electronica Award open call was the second opportunity to realize a new scientific inspired project in a fully funded residency for up to two months at CERN. The

English artist duo Semiconductor received the Collide@CERN Ars Electronica Award in 2015, which is awarded as part of the European Digital Art and Science Network—an international initiative offering artists the chance to spend several weeks at research facilities like CERN and the Ars Electronica Futurelab.

Semiconductor (UK)

Claudia Schnugg

Semiconductor is the UK artist duo Ruth Jarman and Joe Gerhardt. In their artworks they explore the material nature of our world and how we experience it through the lens of science and technology, questioning how they mediate our experiences. Their unique approach has been singled out for recognition with numerous honors and grants. In 2012, they received the Samsung Art+ Prize for new media art, a Smithsonian artist research grant, and a NASA space exploration grant. They have exhibited and screened their works at the House of Electronic Arts in Basel, FACT in Liverpool, the ArtScience Museum in Singapore, the San Francisco Museum of Modern Art, the Royal Academy of Arts in London, the Sundance Film Festival in Utah and at the Rotterdam Film Festival. Their works *Magnetic Movie* and *Brilliant Noise* are in the permanent collection of the Hirshhorn Museum in Washington DC and the Centre Pompidou in Paris.

Residency

In autumn 2015, the English artist duo consisting of Ruth Jarman and Joe Gerhardt started a two-month residency at CERN, the world's largest particle physics research facility, in Geneva.

During their residency, Jarman and Gerhardt aimed to create a digital artwork elaborating on the nature of the world and our perception of it, including consideration of how scientific instruments and particle physics discoveries influence our perception of nature.

Julian Calo

Claudia Schnugg

Residency at the European Southern Observatory (ESO) in Chile

After María Ignacia Edwards' residency at ESO in 2015, the members of the Quadrature artists' collective, Jan Bernstein, Juliane Götz and Sebastian Neitsch (all DE), were the recipients of this year's European Digital Art and Science Network residency at the European Southern Observatory.

Quadrature: Jan Bernstein (DE), Juliane Götz (DE) and Sebastian Neitsch (DE)

Jan Bernstein, Juliane Götz and Sebastian Neitsch met at Burg Giebichenstein University of Art and Design in Halle, Germany. After completing their education, the artists worked individually in Antwerp, Linz, Valencia, Vienna and Stuttgart among other cities. They collaborated for the first time in 2009, and went on to establish Quadrature, a collective in which each member inputs their own specific skills and focal-point themes. Most of their artistic projects focus on the contradiction between knowledge and comprehension. Outer space is by no means terra incognita for Quadrature; far from it, actually. Several of the collective's previous works deal with methods we human beings employ to explore the cosmos. One example is a project entitled *Voyager*, in which the artists employ slowly moving metal cursors to indicate the current flight paths and velocities of NASA's Voyager 1 & 2 space probes. Another example is *Satelliten*, a work that earned Quadrature an Honorary Mention in the 2015 Prix Ars Electronica's Interactive Art category. *Satelliten* is a machine that graphically documents the movements and positions of satellites. Serving as the "canvases" for these drawings are out-of-date maps among the pages of a bound atlas.

Residency

Following their successful application in response to the network's open call, the three artists traveled to Chile to spend several weeks at the European Southern Observatory (ESO). The second stop on their itinerary was Linz, where the Ars Electronica Futurelab's staff provided them with support to develop the projects that emerged from their stay in Chile.

Jury Statement

Martin Hieslmair

Quadrature are not new to the exploration of space; their previous work has tracked the movement of the Voyager space probe and given it a physical, kinetic manifestation here on Earth. This making the unseen visible was an exciting proposition of their proposal for the ESO residency. As a collective their practice is already embedded in the processes of collaborative practice that are critical to the success of an art science residency of this nature. Their proposal addressed questions around how their work would develop and manifest in a physical exhibition space like Ars Electronica and offer a compelling experience to visitors, enabling them to sense the unseen, to momentarily lift off and experience deep space. Their intimate knowledge of the constraints and possibilities of the technology at ESO demonstrated a body of knowledge and work which sets the scene for exciting outputs. In summary, the members of the jury are assured that Quadrature's residency at the ESO in Chile and at the Ars Electronica Futurelab in Linz has significant artistic potential and innovation within the art science space.

ESO Statement
Fernando Comerón–
Head of the ESO Representation in Chile

The residencies at the ESO facilities in Chile, which started in 2015, have given artists the opportunity to visit the observatory of La Silla, the Very Large Telescope (VLT) at Paranal Observatory and the Atacama Large Millimeter and submillimeter Array (ALMA) on the Chajnantor plain. They also have allowed them to interact with scientists and engineers who work

there or who use them for their research projects. The residencies and the works that they inspire provide an example of the strong appeal these special places have not only on the scientists for whom they were built but also on artists, for whom the giant telescopes of the VLT or the antennas of the ALMA acquire a meaning of their own. For the ESO and its personnel working at the observatories the presence of artists enables a particular dialog where a fresh and enriching perspective is gained, bringing home the fact that science does not talk only to scientists, and that can sometimes reveal unexpected common ground. Quadrature, a group of three artists whose individual skills complement themselves around a strong focus on technology-enabled art, explored Paranal and the ALMA from two different but closely related angles. On the one hand, their interactions with the astronomers led them to delve into questions that research astronomers were asking, there and then, with the telescopes and instruments that they were using. Their stay in Chile in late May and early June coincided with the time of the year when the center of our Galaxy reaches its greatest height over the horizon in the middle of the night: it is "galactic center season" for astronomers, and this time for Quadrature as well, who could watch in real time the acquisition of new images that will enable astronomers to refine the determination of orbits of stars near the supermassive black hole lurking at the center of our Galaxy. They could also witness the acquisition of new data on extremely low-mass companions to young stars in our local galactic neighborhood. The data thus obtained enable scientists to address the "what" and "why" questions that they ask with their

Claudia Schnugg

observations. But Quadrature were also, and perhaps mainly, interested in the "how": the unique combination of state-of-the-art technologies, and the fundamental principles of physics, that enable those observations. By witnessing the use of the technology to obtain new observations, and by understanding the basis on which that technology works, Quadrature thus got to see research in the making and to be inspired by it. Casual conversations with astronomers on their research certainly played also a role in their inspiration, bringing them in contact with topics such as the intricacies of orbital dynamics and their relation with the families of "Trojan" asteroids whose orbits in our Solar System are confined by the presence of giant planets. Quadrature's artistic perspectives shaped their experience at the observatories, but the focus of the work of many other artists who have expressed interest in these residencies clearly suggests that much remains to be exploited in the potential of the science-art dialog that arises at places like remote observatories in the middle of the desert.

Projects

The results of Quadrature's residency premiere at the Ars Electronica Festival 2016.

STONES

Storage Technology for Observed Nearby Extraterrestrial Shelters

Astronomical research is very much subject to the human tendency to observe and evaluate any findings within the context of our own culture. Yet the truth of scientific results goes far beyond the duration of our current civilizations. Just the detection of exoplanets in the habitable zone[*] already constitutes a scientific milestone. Detached from any contemporary interpretation, the work archives pure knowledge for the coming millennia. In a notation that requires no previous cultural education but can be deciphered based on logic and scientific observation, the knowledge itself is the main message.

* A planet outside our solar system, orbiting its parent star in a particular area so that water may be present on its surface in liquid form. This is regarded as a prerequisite for the emergence of life. So far, 42 such objects have been identified. (Source: Planetary Habitability Laboratory, UPR Arecibo.)

MASSES

Motors And Stones Searching Equilibrium State

We place two stones on top of a balanced steel plate. The aim of the machine is to position the stones that the system is perfectly balanced. In an incessant process, continuous efforts repeatedly briefly avert the constant threat of divergence, only for it to appear elsewhere a moment later. Instead of the desired state of well-adjusted stability, the work achieves a permanent state of incessant motion—a fragile but constant situation between falling and floating.

As the precision of modern research instruments advances, so their vulnerability increases, and with it the need to compensate for even the smallest disturbing influences. Supported by a machinery of sensors and people, the apparatus performs an endless sequence of observation and calibration.

Residency at the European Space Agency (ESA)

The recipient of the final network's residency and yet at the same time the first art&science@ESA residency is Aoife van Linden Tol, a multi-disciplinary artist working primarily with explosive media. Her winning proposal was selected from 139 submitted projects by an international jury including representatives from ESA, Ars Electronica and members of the European Digital Art and Science Network.

Aoife van Linden Tol (IR/UK)

Beginning in 2000 Aoife van Linden Tol's work with explosives fused her interests in nature, cosmology, chemistry and physics. A multi-disciplinary artist, as well as blowing things up, her practice spans sculpture, installation, drawing, photography, film and performance. She creates abstract works which often examine concepts of time, density and matter as well as deep human emotions and motivations. With a timeless minimal aesthetic, an Eastern-influenced sense of balance and an appreciation for natural forms, Aoife van Linden Tol's works speak for themselves visually. The explosive medium can result in devastatingly ravaged and torn pieces, evoking strong emotional responses from audiences. Yet her versatility and skill with the medium allows her to make surprisingly small, delicate, and even humorous works. The joy of learning, a constantly questioning mind and a keen analytical nature feed Aoife's scientific process of research, testing and making. Graduating from Central St. Martins College of Art and Design in 2002, with a BA hons in art and design, Aoife van Linden Tol has exhibited internationally including at the ICA, London, the San Francisco MoMA, USA, and the NGBK Berlin. Aoife has recently worked with Imperial College, researching light spectra for a series in neon and was invited by Disney to design a limited edition model Star Wars BB-8 robot, which was auctioned by the Force for Change charity for the benefit of Great Ormond St. Hospital.

Jury Statement

Aoife van Linden Tol is a multidisciplinary artist working primarily with explosive media and inspired by different scientific disciplines like chemistry, physics and cosmology. By using explosions as a creative way to explore not only concepts of time, density and matter but also deep human emotions, she is able to create beautiful and poetic as well as strong and devastating moments and experiences in art. With her project *Star Storm*, which tackles the life-cycle of stars and the physical processes of

stellar formation and evolution across the Universe, she was able to convince the jury that she is the right artist for this first opportunity of a residency at the ESA's European Space Research and Technology Centre. What impressed the jury the most was her individual approach in asking and exploring fundamental questions about our Universe.

Besides the residency winner, the jury decided to announce six honorary mentions to acknowledge the outstanding experience and content of other artists and proposals: Sarah Petkus (US) and her *wandering artist/robot*; Akira Wakita (JP)–*Mars Zen Topography*; Smite Rasa and Smits Raitis (LV)–*Saving Appearances*; Alois Yang (FR)–*Hear the World Begin*, and Kristina Pulejkova (MK) *We could be Martians*.

Another honorable mention was awarded to Miha Turšič (SL) both for his proposal *Supreorganism* and especially for his pioneering work and outstanding engagement in the research of space culturalization. With Sarah Petkus's submission the jury also identified another promising and inventive project: *The Wandering Artist*. Sarah Petkus is an American kinetic artist and roboticist, and in her proposal, she pondered on the possibilities of a robotic space probe that would explore another planet in the Solar System and take decisions based on creative and artistic grounds, rather than purely scientific reasoning.

ESA Statement
When Art and Space Science meet

Space science is a domain perhaps as vast as the cosmos it aims to investigate.

The advent of space telescopes, augmented eyes to see what we cannot observe from Earth, and space probes, emissaries to worlds other than our own, has opened new windows on our study of the Universe. These technical marvels have allowed us to unveil major clues to piece together the 13.8- billion-year long history of the Universe, from
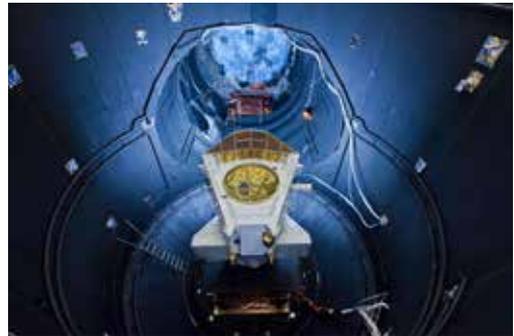
ESA / Anneke Le Floc'h

the formation and evolution of stars and galaxies to the birth of the Solar System.

Investigating our cosmic origins is a major theme in the Space Science Programme of the European Space Agency (ESA), which operates a fleet of missions that allow European scientists to be at the frontier of astrophysics, planetary science, solar and fundamental physics.

It's sometimes easy to forget, while caught up in the daily duties of scientific research, that space science tackles questions that spark curiosity at a deeper, more fundamentally human level. These questions concern the very essence of our existence on this planet–not as mere individuals but as part of a cosmic tale that started eons before us and that will continue long after we are gone.

These questions do not pertain exclusively to science, but are central to many other domains of culture and research, and in particular to the arts.

In recent years, in our role as communicators of ESA's Space Science Programme to the broader public, we have met and interacted with a number of artists who had been inspired by ESA missions, by their results and by the vision that brought them about. These artists wanted to learn more, to probe the scientific and technological processes that enable the spirit of enquiry to leave Earth's gravitational pull to research the Universe from space. During these interactions, we appreciated the

variety of perspectives that artists have on the scientific endeavour and were intrigued by how their curiosity is triggered by aspects that may differ from those pursued by scientists. These perspectives often provide refreshing insights into the science of the cosmos.

So we were honoured when Ars Electronica invited ESA to join an exciting collaboration, researching the common ground between art and space science through an artistic residency, to be spent partly at ESA's European Space Research and Technology Centre (ESTEC) in the Netherlands, and partly with the creative team at Futurelab in Austria.

A total of 139 applications were submitted for the residency, many of them expressing a keen interest in the research undertaken within ESA's Space Science Programme. Together with the curators from Ars Electronica and partner institutions from the European Digital Art and Science Network, we had a challenging job reviewing the proposals and selecting a winner from the many great projects that truly blended art and space science.

We are eagerly looking forward to this residency, and to the many boundaries, scientific and artistic, that will be faced, studied and pushed forward in the process.

Claudia Mignone, Karen O'Flaherty and Mark McCaughrean

Residency

For the art&science@ESA residency, Aoife proposed *Star Storm*, a spectacular performance inspired by the physical processes that characterize the life of stars. *Star Storm* is to be a spectacular explosive performance describing the processes of the stars. Using research from the ESA about the composition, life cycle, magnetic behavior and light production within stars, including our Sun, Aoife van Linden Tol will design a powerful and beautifully poetic explosive performance. Using a range of explosive materials, each explosion will represent specific

processes that are taking place every moment in stars all across the universe. Each section of the performance will be varied and distinct: creating a wonderful contrast of energy and experience from exciting to meditative, from durational to instant, from order to chaos; reflecting the universe we live in and the discoveries we have made about it. Aoife will also explore and test new ways to create the electrical charge needed to trigger each performance, using new technologies and potentially audience participation. *Star Storm* aims for a unique and lasting experience which will give audiences insights into the very nature of our universe and their own place within it.

Project

As a commencement of her residency, London-based artist Aoife Van Linden Tol invites the residents of Linz to submit material for the second incarnation of her project *Second Story* in the framework of Ars Electronica 2016. The project explores the influence of words and images to create an explosive force within each individual as well as the emotional responses created when presented with literal physical explosions. The universal nature of both these this phenomena inspired Aoife to create a project which allows many people to continue their own dialog with explosive forces. It was first realized in Berlin in 2007, and Aoife has long wanted to continue the project in other cities across the world. She hopes to reveal some of the collective and individual emotions of those living in Linz. Aoife's explosions in books and on paper create beautiful and often delicate accents, creating a mark or damaging the piece while keeping the integrity of the original object. The objects will not be destroyed completely. Objects will then be exhibited at the Ars Electronica Center with a brief explanation. You can choose to refrain from giving your reason for submission or your name on the display if you wish.

European Cultural Partners

In cooperation with all the partner organizations, the European Digital Art and Science Network facilitates numerous exhibitions, workshops and discursive projects (such as conferences or symposia). Here you will find a selection of projects realized within the last months.

LABoral (ES)

LABoral is a multidisciplinary institution which produces, disseminates and fosters access to new forms of culture rooted in the creative use of information and communication technologies (ICT). LABoral has been working in crossovers between arts, science and technology since its creation in 2007. The hybrid nature of the institution is seen through its focus on production, a practice that involves an intense knowledge exchange among professionals from different disciplines but with a common objective. In this context, the collaboration with all these professionals has always been a new challenge, due to the differences and similarities between practices. Thus this experience is to be shared, agreed and formalized with similar hybrid institutions through the production of various research projects and related activities.

http://www.laboralcentrodearte.org

Center for the Promotion of Science (RS)

Promotion of science is one of the major tasks for every European country. In this field, the Center for the Promotion of Science (RS) is already actively engaged in bringing the science community closer to a wider public, with the ambition to become the top institution that binds together, provides help and supports all science-popularization organizations and initiatives throughout Serbia. Special attention is given to cooperation with scientific institutions—the Serbian Academy of Sciences and Arts in the first place, but also with leading scientific institutes and all universities in the country.

http://www.cpn.rs

Zaragoza City of Knowledge Foundation (ES)

Zaragoza City of Knowledge Foundation is an independent public-private organization which is in charge of the program for the Etopia Center for Art & Technology. In accordance with this mission they developed some interesting projects with an international scope, providing valuable experience to the foundation. The most relevant are: the *Paseo Project* (in collaboration with Ars Electronica), to promote technology-based creativity in public space, *Innovate! Europe* (a European event on start-up culture), and *Das Detroit Projekt* (coordinated by Schauspielhaus Bochum). The Zaragoza City of Knowledge Foundation has also been quite active in participating in EU events and projects, especially in the field of smart cities initiatives, urban innovation and Future Internet PPP.

http://www.fundacionzcc.org

Kapelica Gallery / Kersnikova (SI)

The Kapelica Gallery was established in 1995 as an art space with focus on contemporary investigative arts and a production platform for research, investigation and experimenting with the limits of artistic discourses and art poetics. The Kapelica art program consists of exhibitions, performances and artistic research. The gallery presents works by artists who dare to go beyond safe and pleasant themes and challenge visitors to contemplate and wonder with them. Together with the BioTehna wet lab, Kapelica is an active production platform which encourages, facilitates and showcases investigative artistic production, creates public debate and stimulates a critical understanding of the time we live in.

http://www.kapelica.org

Science Gallery (IE)

Science Gallery Dublin is an organization dedicated to igniting creativity and discovery where science and art collide. Since opening in February 2008, the gallery has welcomed over a million visitors with over 24 exhibitions ranging from EDIBLE, which examined the future of food, to BIO-RHYTHM, which got to grips with music and the body, to INFECTIOUS, an exhibition which showcased the first ever live simulation of a pandemic using RFID (radio-frequency identification) technology. The Science Gallery is ranked among the top ten free cultural attractions in Ireland and is all about opening science up to passionate debate. It is uniquely located in Ireland's leading research university, Trinity College Dublin, with a recognized expertise in astrophysics and astronomy as well as a focus on public engagement with creative science, art and design.

http://dublin.sciencegallery.com

DIG gallery (SK)

The DIG gallery is an the alternative platform for presentation of the contemporary forms of digital and media arts. Its activities are focused on the mapping and popularization of this area, developing the local and international connectivity, supporting the artistic practice and creativity in general. The DIG gallery collaborates with several institutions and independent initiatives within interdisciplinary research, alternative education and partnership networks. Based in Kosice, the DIG gallery was founded in 2012 by the DIG non-profit organization in 2012 as a model of the open-source gallery based in Kosice.

http://diggallery.sk

GV Art (UK)

GV Art is the UK's leading contemporary art gallery that aims to explore and acknowledge the interrelationship between art and science, and how the areas cross over and inform one another. The gallery curates exhibitions and events that stimulate a dialog focused on how modern society interprets and understands the advances in both areas and how an overlap in the technological and the creative, the medical and the historical are paving the way for new aesthetic sensibilities to develop.

http://www.gvart.co.uk

LABoral (ES)
MATERIA PRIMA
November 14, 2015–May 8, 2016

With *MATERIA PRIMA* LABoral started the cycle of partner presentations in the framework of the European Digital Art and Science Network. *MATERIA PRIMA* is not just an exhibition, at least not an ordinary exhibition, it is an experiment on its own, an attempt to create access, to blaze trails into the vast overlapping territories of art and science. Above all it aims to achieve a new level of visitor involvement and participation. What could be more appropriate than a place like LABoral, which itself is exemplary of a new type of hybrid and collaborative institution, a center for original artistic creation as well as community-based co-creation. Moreover, it is a platform for knowledge production and education, and an innovative instrument for establishing new directions in research and developing partnerships in the region with local experts.

The title *MATERIA PRIMA* is a reference to the history of a philosophy in which *materia prima* was considered the first matter or basic starting material from which everything else evolved. For the alchemists of the early ages it symbolized the mystery of the Holy Grail. They believed if they could discover the *materia prima*, they would be able to make gold.

In a certain way the idea is not all that far-fetched, especially if we think of these alchemists as the hackers and DIY makers of their time, explorers at the borders of science, art and mysticism. They defied established knowledge and scientific dogmas, and did not shy away from taking unorthodox and forbidden paths to gain greater insight. After all, breaking the rules is the only way to get things right, especially when the rules are wrong or inadequate. And although we might call them fools for aiming at the impossible, along the way they created many by-products, maybe even more than produced by the race to the moon.

In our times it is data that has become the equivalent of *materia prima*. For it is now the basic and universal material which may be translated or transformed into anything else. Moreover, it has become the seemingly inexhaustible raw material for everything, including the spectacular business models that have given rise to some of the most profitable business ever. So it seems to be true that if you just find the proper *materia prima*, you can even convert it into gold—that is, the gold of our time, stock options for the next most promising start-up.

Sergio Redruello / LABoral

Centre for the Promotion of Science (RS)

Art & Science Exhibition 2016

April 7–27, 2016

First Art & Science programme in Belgrade was open on April 7, 2016, and during a month-long period over 3,500 visitors had a chance to see two national winning productions as well as the works by visiting artists Gisela Nunes from Portugal, Werner Jauk from Austria, Cedric Brandilly from France and Universal Everything art collective from UK.

Center for the Promotion of Science premiered two winning artworks within the national selection for 2015. Imaginary Maps and Frequency Chamber, brilliant installations by Aleksandra Jovanic and Bogdan Stefanovic, were presented at Podroom Gallery of Cultural Centre of Belgrade, downtown exhibition space in the heart of our city. In parallel with the main exhibition, several other events were held, including lectures, panel discussions, master classes, workshops for art students and high-school children, public tours, 3D printing program etc. for

the closing event at the Movie Theater of Cultural Centre of Belgrade. Two grand live performances were presented by LP Duo, from the Quantum Music project, and the second from our guests from France, Cedric Brandilly and Romain Dubois, who performed their *Architectural SonarWorks*.

Milovan Milenkovic

Zaragoza City of Knowledge Foundation (ES)

Reverberadas. Explorations on digital art and science

May 20–September 18, 2016

Reverberadas includes a dozen works from the last five years, of which three have been new productions executed in residence. Works by established names and young artists. Local, regional and global talent. Exhibited works, workshops and performances. Individual results and also the fruits of collaboration between artists and scientists, all of them names that already form part of the present Etopia_ ecosystem under the flag of a global networked movement.

In *Reverberadas*, arts and sciences go hand in hand

with works that talk face-to-face. Art and science, instruments used in compositions interpreted for a common effect: reverberation. This exhibition is the first fruit of the European Digital Art and Science Network, and an opening shot so that, in Etopia_, art and technology will naturally converge with science and people.

With *Reverberadas*, art and science art tools are used by society to intervene in reality by making the inaccessible accessible, even if it is only by capturing some of its properties. As if it were a game of joining

the dots, the reverberated works provide examples of the vast space for searching that is presented by different artistic disciplines and scientific branches. Take a walk through the different scales of *Reverberadas* and contrast the natural with the artificial. Discover subatomic elements and look at the more distant universe. Compare microorganism ecosystems with our society and our collective behaviors. Reflect on your personal emotions and the collective intelligence. Revisit daily experiences, such as getting dressed, looking at the sky, getting on a swing, listening to a song, watching the façade of a building or sharing information on the latest social network.

Text: Fermín Serrano Sanz

Juan Manzanara

Kapelica Gallery / Kersnikova (SI)
Earth without Humans
June 9–12, 2016

As part of the European Digital Art and Science Network, in spring 2016 the Kapelica Gallery presented an international symposium accompanied by a series of workshops. Under the topic "Earth without humans" the symposium centered the conclusion that it is easier to imagine the destruction of the Earth and nature than to imagine the end of late capitalism as a starting point for the creation of other possible scenarios for the future. Together with scientists, who are opening up imaginary new expansions on the limits of possibility, and with artists who are translating this into possible solutions, it addressed the fragile emergence of life on the third rock from the sun.

In parallel to the symposium and workshops, several projects were on display in the Kapelica Gallery, including *ReBioGeneSys—Origins of Life* by Adam W. Brown (in collaboration with Robert Root-Bernstein), *Drosophila Titanus* by Andy Gracie, *Auto-Photosynthetic Plants* by Gilberto Esparza and *The game has begun in secret* by Aljoša Abrahamsber.

Kapelica Gallery Archive / Earth Without Humans

Science Gallery (IE)
SEEING–What are you looking at?
June 24–September 25, 2016

In late June, Science Gallery Dublin opened an exhibition as part of the networks presentation questioning how eyes, brains and robots see. Is vision just one way to see? How do our brains interpret what's in front of our eyes? How do machines understand what they're looking at, and will they change how we look at the world?

During summer 2016, the Science Gallery tackled the complex sensory experience of vision and perception at SEEING. The organization illuminated optics, perspective and comprehension, while exploring enhanced and augmented ways of seeing, artificial eyes and radical alternatives to vision. SEEING explored the subjectivity of sight, the other senses that shape our view of the world and the unexpected parallels between human and machine vision.

Outlook
European Digital Art and Science Network

Starting with Ars Electronica 2016 the second project cycle of the European Digital Art and Science Network will feature seven exhibitions and several parallel programs in late 2016 and spring 2017.
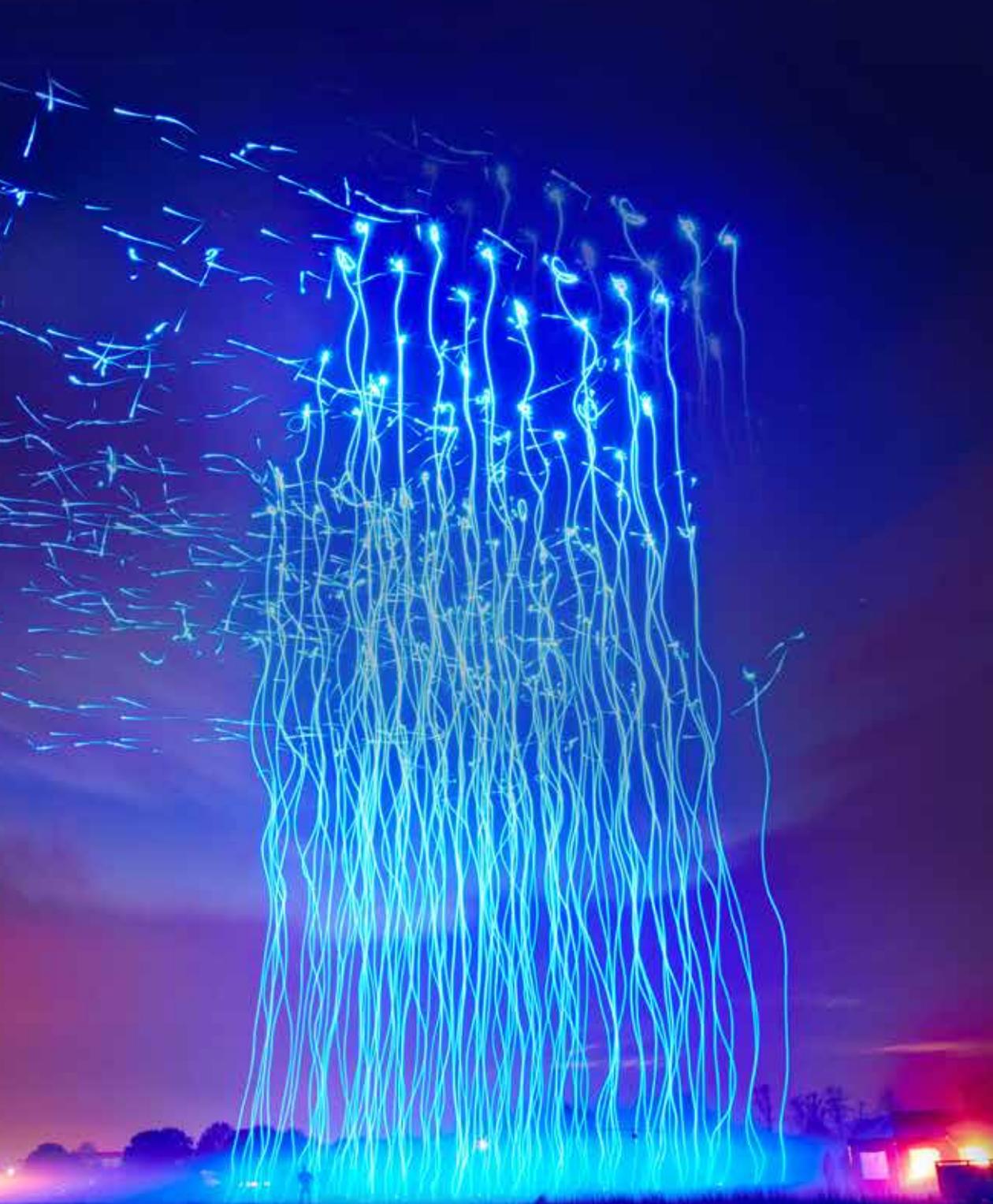
Martin Hieslmair

Drone 100 – Intel in collaboration with Ars Electronica Futurelab holds the world record in the category Most Unmanned Aerial Vehicles (UAVs) Airborne Simultaneously. *Photo credit: Intel Corporation*

FUTURE INNOVATORS SUMMIT

Future Innovators Summit

The Future Innovators Summit (FIS) is a creative system to develop ideas and prototypes for the future. The FIS was first developed by Future Catalysts, Hakuhodo and Ars Electronica through the Incubation Brainstorming Workshop at Ars Electronica 2014. Following its successful premiere, it has become an extended framework for creative encounters and was a central feature of the 2015 Ars Electronica POSTCITY Festival. In 2016 the FIS is expanding even further, with more participants and an extended program. The background to this year's topic stemmed from discussions around everyday life in Tokyo after the 2020 Olympic Games. It explores the nature of the city as an ongoing social experiment and utilizes Tokyo as one of the world's largest cities. Universal themes were derived from these discussions, by drawing on the Future Catalyst doctrine that human-centered thinking is needed to shape a better society. New culture, citizen participation and living were the main areas of concentration and as a result three main topics were created; Future Humanity, Future Education and Future Commons. From these topics, the following inspirational kick-off questions were extracted.

The Future Innovators Summit is developed by Ars Electronica and Hakuhodo and realized in cooperation with netidee.

Future Humanity

What will only humans be able to do / what should only humans do?
What will a sanctuary of the future be?
What will a delightful moment be in the future?

Future Education

What is the school of the 21st century?
What should people study in the age of AI and the robot?
What is the education for inventing the future?

Future Commons

What will an important physical community be in the future?
How can we create a sense of solidarity for resilience?
What kind of open commons are needed with the radical progress of AI technology?
Which social goals can be addressed by open-source and innovative technologies like block-chain?
What will the ethical questions be in future commons?

Florian Voggeneder

Developing Prototypes for the Future

The process of the FIS is based on three steps: unlocking creative energy, facilitating the creative process, and triggering creative questions. *The Future Catalyst Program* is a setting of collaborative deliberations and workshops in the inspiring ambience of the Ars Electronica Festival for Art, Technology and Society.

A vast international mix of seasoned experts and young entrepreneurs, activists, engineers, scientists and artists as well as designers will come together and work in different groups. The FIS program includes individual flash talks, intensive workshop sessions and meetings with mentors. At the end of the process, all these groups will give their final presentations in public. There are three important factors to consider in implementing the FIS. First of all, the FIS needs unique locations and inspirational artistic spaces. The special atmosphere of the venue—a disused post office center—takes the participants out of their comfort zone, at the same time stimulating and unlocking creative energy. Secondly, facilitators play an important role, as they guide the brainstorming process to its final outcome. Hakuhodo's professional facilitators will use their own methodologies to maximize the participants'

individual skills and expertise. Finally, mentors will advise participants on the how their ideas relate to their own field of expertise and extensive knowledge of innovative practice.

Since 2014, Future Catalysts, Hakuhodo and Ars Electronica has been using the FIS to develop innovative challenges for society. The focus is not on finding solutions to specific problems but rather on coming up with visionary questions. In 2016, with the connection to the alchemists of our time, we want to introduce a way for these creative questions to be realized as global agendas for tomorrow. In the words of John Maeda, "innovation is the ability to respond to questions," and Hakuhodo and Ars Electronica want to introduce a way to further nurture these questions into ideas of action. These questions will be promoted as challenges to partners connected to the Future Catalyst network and on the website for anyone to answer.

In this way, Ars Electronica becomes a platform not only for showing art and discussing ideas but also to create future agendas.

Text: Kristefan Minski, Hideaki Ogawa and Kyoko Someya

Tom Mesic

New Ways of Thinking: The Future Catalysts

What Is A Future Catalyst?

In 2014 Ars Electronica launched the collaborative project *Future Catalysts* together with Japan's premier advertising agency Hakuhodo. The project views artists and people with artistic perspectives as "catalysts for the future."
Individuals participating in the project create experimental frameworks, communities and projects in the domains of art, technology, industry and society that are intended to stimulate social and cultural innovation, and the project examines the processes and effects of their work. In particular, the project seeks to create new forms of interaction between "art" and the domain of "industry," so crucial to social formation.

Combining Three Ways of Thinking to One Unique Approach

Advertising designed to promote companies' products and services exploits the various media of the age, giving birth to the ephemeral trends of the moment. In their quest to find new roles and new positions for advertising, the world's advertising industry is constantly seeking out new experiential domains in which to fuse art and technology.

Art Thinking

Future Catalysts are concerned that these efforts by the ad industry may ultimately lead to addiction rather than benefit for society. They therefore seek to use the power of art, trying to find questions and solutions for the present that can be presented to Japanese business and government as catalysts for a constructive dialog about what we want society to become.

> "As art is effective in questioning the fundamental nature of its object, it is a vital factor in creating dialogues about vision and strategy that address such things as the 'future' and 'social values'." (Hideaki Ogawa)

Design Thinking

The Japanese design sense known as *monozukuri* excels at fusing sophisticated technology with everyday life. But amid the fierce global competition and the deluge of products and services for enhancing everyday life we don't know where we are and seem to have lost our way. We therefore need creative questions that can help us to understand what we are doing.

> "Design is effective in producing product and service solutions by giving its object superior form as part of a process motivated by the 'present' and 'commercial value'." (Hideaki Ogawa)

People Thinking

People Thinking is Hakuhodo's unique approach for creating their services and products on an equal footing to living people, a consumer with a heartbeat, not just an abstract entity.
At Hakuhodo, we say that most consumer research is like a painting of people in which the artist has forgotten to fill in the faces. So their aim is not to address an anonymous target group.
Since the 1980s, the centerpiece of the Hakuhodo philosophy has been *sei-katsu-sha* insight. *Sei-katsu-sha*, which literally means "living person," contrasts with the word *shohisha*, which is Japanese marketers' term for consumer. *Sei-katsu-sha* expresses the holistic person—an individual with a lifestyle, aspirations and dreams.
By moderating art and design to innovation with the people thinking of Hakuhodo, this joint initiative aims to shape a better society together with industries, government and citizens.

Prototyping a Creative Platform—The Future City

The Future Innovation Summit, which took place at the Ars Electronica Festival in 2014, was conducted

to raise questions about what the future will look like. The assembly of future innovators convened for four days to form a task force for change. Their visions, ideas and projects, workshops, and providing feedback to one another yielded precious insights and concepts for a desirable way of living and ultimately struck a chord for the following year, when the future of metropolitan areas was at stake: the POSTCITY habitats for the 21st century.

As the greatest social experiment of our age, the Festival Ars Electronica offered the Future Catalysts an extensive stage to discuss social issues of the future, such as "future mobility," "future work," "future citizens," and "future resilience."

At summits and workshops they created so-called *Post City Kits*, tool kits containing ideas, strategies, devices and prototypes for the city of the future. The *Post City Kit Exhibition* consequently portrayed numerous prototypes and project presentations plus possible development directions towards the urban habitats for the upcoming generations. In March 2016, Shibuya transferred the concept, hosting a sub-event of the Austrian festival. The first part of the event comprised a lively discussion forum, with the second part featuring a *Post City Kit Bazaar*, with an exhibition, market place and discussions.

Text: Hideaki Ogawa, Markus Scholl

Hakuhodo, AEC

Art Thinking Program

"Art is a catalyst for shaping the better future society."
Hideaki Ogawa

The *Art Thinking Program* aims to invent a better future by connecting creators, industries, governments and citizens. The core of the program is Future Innovators Summit (FIS), a transdisciplinary discussion field that brings together the leading innovators from all around the world. Since 2014, Future Catalysts Hakuhodo and Ars Electronica have been hosted this meeting to raise "creative questions" which will bring us a new dimension of perspectives towards social issues surrounding us. Every society, economy and politics contains inherent uncertainty. The fluctuating environment makes it more difficult for us to prevision the future. While the digital revolution allows us to enjoy the growing speed of communication, ways of networking and abundant information, its progress is spurring further innovation in cutting-edge technologies such as bio-tech, nano-tech, robotics and artificial intelligence (AI) at an unprecedented rate. It is becoming urgent for humankind–as the user, as recipient or developer–to find ways of attaining the skills and sensitivities to make dialog with these emerging technologies possible.

There have been various efforts to define the problems that need to be addressed in order to achieve better relationship between human and technologies, and to devise a sustainable solution that can reconcile existing technical, financial or social constraints. Whereas most approaches start by identifying the scope of the issues based on in certain assumptions, we have to maintain objective views that can challenge the underlying assumptions themselves, assumptions that precede the emergence new technology. *Art Thinking* suggests this in order to deepen the understanding of current society per se, to re-capture it on our canvas observed from multiple aspects that enable us to discover the underlying principle of the issues among all the complexity. It focuses on unearthing and exposing fundamental questions (the "creative questions"), rather than seeking creative solutions. A good question evokes various responses, and it will increase our awareness of the different angles from which to see the future. In this sense, *Art Thinking* makes us more flexible in the face of future uncertainties, more resilient and prepared for contingency.

We are proposing *Art Thinking* as a creative process of questioning to the world. In the same way as designers design solutions by attempting to define problems and realizing creative ideas, artists question existing beliefs by demonstrating messages through their creative work. As a problem solving method, design thinking diffuses widely; while, *Art Thinking* is a method of cultivating a creative mind to cast doubt on common perceptions and help people, from industries to governments, to develop an inspiring message that can catalyze positive reactions from social participants.

The *Art Thinking Program* is formed around the Future Innovators Summit (FIS), where innovators from diverse backgrounds engage in intensive dialog about the potential issues of the future. The lab-like discussion field is carefully designed to evoke spontaneous inspiration in the participants. A variety of artistic works and studies by innovators are allocated to the thinking process in illustrative way. Participants can feel and experience the active process of artists trying to pose a question to society, and will naturally be encouraged to involve themselves in a journey to discover further questions and answers.

We will share the "creative questions" generated during FIS in Festival Ars Electronica with the public, and will call for creative solutions to them as a part of next year's festival program.

The *FIS–Art Thinking Program* will transform the Festival Ars Electronica into a large platform to create a better future.

Text: Hideaki Ogawa

ART THINKING

Vision & Strategy

Creative Questions

Looking for new directions   See the possibilities

THEME ISSUE

DESIGN THINKING

Product & Service

Creative Solutions

Understand the possibilities   Utilize the possibilities
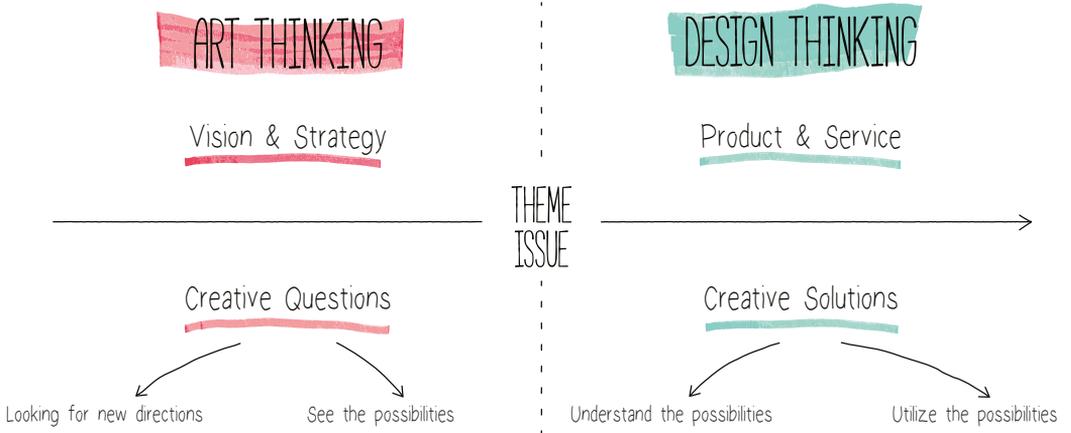
Future Catalysts x Hakuhodo Institute of Life and Living (JP)

People Thinking Lab

People as Radical Atoms

A true revolution of technology is taking place in the stream of people's everyday lives. The accumulation of new interactions between people and technology is creating a culture and shaping a new society. And that is how cultural and social innovations are initiated. At this year's Ars Electronica Festival, which explores a new frontier created by "fusion" between the physical existence of the human world and physically-detached digital data, Future Catalysts (Hakuhodo and Ars Electronica) will set up the *People Thinking Lab* (a pop-up lab) to transform the festival site into a real-time experimental space, together with Hakuhodo Institute of Life and Living (HILL), an unprecedentedly unique institute that specializes in people analysis. The concept of the lab is *People as Radical Atoms*.

Program 1: People Thinking—Method-Sharing

The advance of technology is transforming people into a form that can keep changing radically. When we look at people as radical atoms, we can sense the initiation of new emotions and perspectives. People's emotions may seem impromptu at times, but by finding the desire that lies deep down in the emotion we can get one step closer to the core of the desired technology and design.

For example, we have been accumulating *People's Long Data* for more than 20 years, which is a pile of data that shows the changes in people's emotions and sense of value. We deciphered the change in people's emotion by analyzing such dynamic data, which allowed us to observe the change in people's sense of value. In contrast, with the expansion of networks by the use of SNS, we were able to find that "people are minimizing relationships with others in their conscience and awakening love of oneself more than that for others."

We also have a method called *Unasked Questions*, which we use to sense hidden emotions by analyzing people's reaction when uncommon questions, whether verbal or nonverbal, are thrown at them. For example, in the research to find when people give up on a "frame of mind", such as believing that Santa Claus is going to give them a present, wanting to ride a roller coaster, being excited about a new product, etc., we were able to visualize the change in motivation and conscience by their age.

We also utilize this emotion-sensing to predict our future lives. In this program we will present HILL's unique method that analyzed the emotions of *People as Radical Atoms* for over 35 years.

Program 2: Tomorrow's View—Open Research Lab

Introduced by HILL this year, *100 Views of Your City* is a bundle of future scenarios about the future city, which was predicted by analyzing the change in people's sense of value. Even if the same technology is used as a function, a city might show a different view depending on the directions of people's emotions when they are considered as *Radical Atoms*. For example, there are various possibilities for the future location of a grave, such as a real space in the local community, a virtual space, or not even a space but maybe embedded in the body of the bereaved, and all of these ideas are pictured in our subconscious. Based on *100 Views of Your City* and using *Shadowgram*, developed by Ars Electronica, we will set up an Open Research Lab to write a new future scenario with the visitors to the festival.

生活総研

FUTURE CATALYSTS
Hakuhodo × Ars Electronica
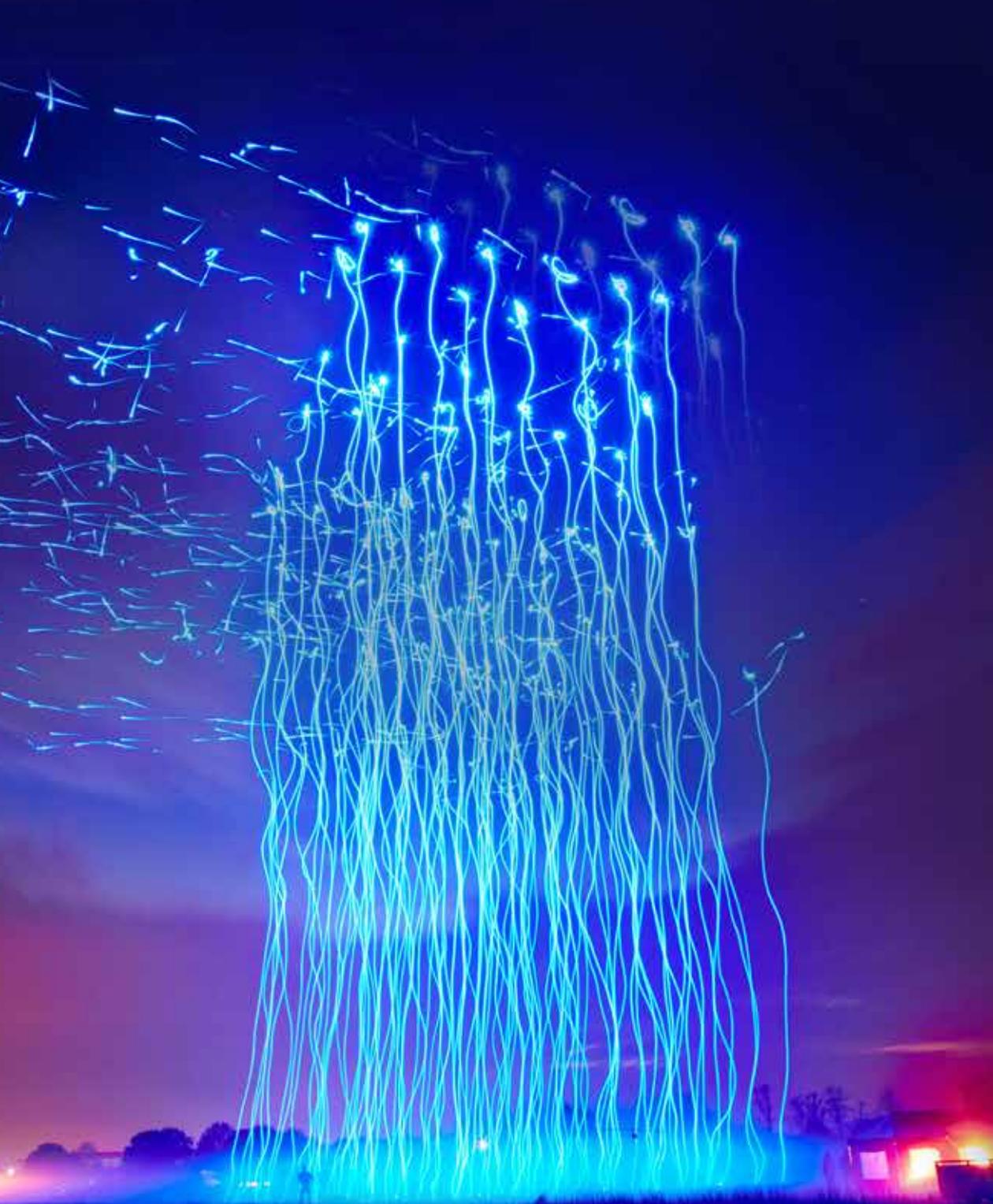
Drone 100 – Intel in collaboration with Ars Electronica Futurelab holds the world record in the category Most Unmanned Aerial Vehicles (UAVs) Airborne Simultaneously. *Photo credit: Intel Corporation*

PROJECTS

LabOratorium—
An Alchemical World_Lab

One spontaneously associates the word alchemy with the—eternally frustrating—handiwork of transforming base metal into gold, the endless search for the Philosopher's Stone, or even with the likes of Paulo Coelho—quirky geniuses in antique laboratories full of odd apparatuses and bubbling flasks full of spooky substances. And even if alchemy nowadays has more or less been amalgamated into the modern sciences, the figurative meaning that adheres to that old word still has something dark, forbidden, unorthodox about it. Alchemists are themselves something of an amalgam: scientist, prophet, quack, polymath, trailblazer, do-gooder and nerd.

A significant portion of the fascination that alchemy radiates seems to emanate from the endeavor to decipher a truth that has been kept secret and must be revealed. In other words, as is so often the case, this is a matter of generating, gathering, interpreting and propagating information. But, in stark contrast to the situation in the Middle Ages, an incomparably larger number of individuals is involved in this process today. The longing for orientation and the distinctly human trait of curiosity are the driving forces behind this flow of information that, under favorable circumstances, makes the world in which we live a better place.

Although the focus of attention is no longer on producing gold, transmutation remains, at least metaphorically, a fascinating approach as, far from the confines of nuclear fusion reactors, modern alchemists go about their work of changing and transforming with the aim of finding solutions to concrete problems. The *LabOratorium* exhibition being staged during the festival scrutinizes the alchemists of our time and the forces that impel them to do what they do.

So, whom are we actually talking about here? Are they explorers of the cosmos in search of new prospects and territories? Are they anonymous hacker collectives countering selfish social tendencies with subversion? Are they non-profit organizations that bring knowledge transfer to bear in correcting a world order that's out of balance? Are they scientists who are answering the energy question with revolutionary new technologies? Journalists, whistleblowers and bloggers who resist the information monopoly with new and unconventional points of view? Or are the true modern-day alchemists doing their work at corporations, universities and private research facilities? Who are the good guys and the bad guys among these alchemists, and whom are we to believe and follow?

Festival-goers visiting the *LabOratorium* won't be receiving any prefab answers; instead, they'll get an invitation to come along in search of the alchemists'

still-fascinating approaches and their current protagonists. To this end, the entire exhibition space is being transformed into a playful World_Lab in which a colorful assortment of stations offers opportunities for research, discussion, interacting and hacking. You might say we're relaunching the mission to discover the Philosopher's Stone. The issues we're confronting thereby have to do with the information society, globalization, technology, medicine and ethics.

Visitors can take part in workshops, project presentations, discussions, hack attacks and experimental formats designed to come to terms with pressing issues together with invited artists and scientists.
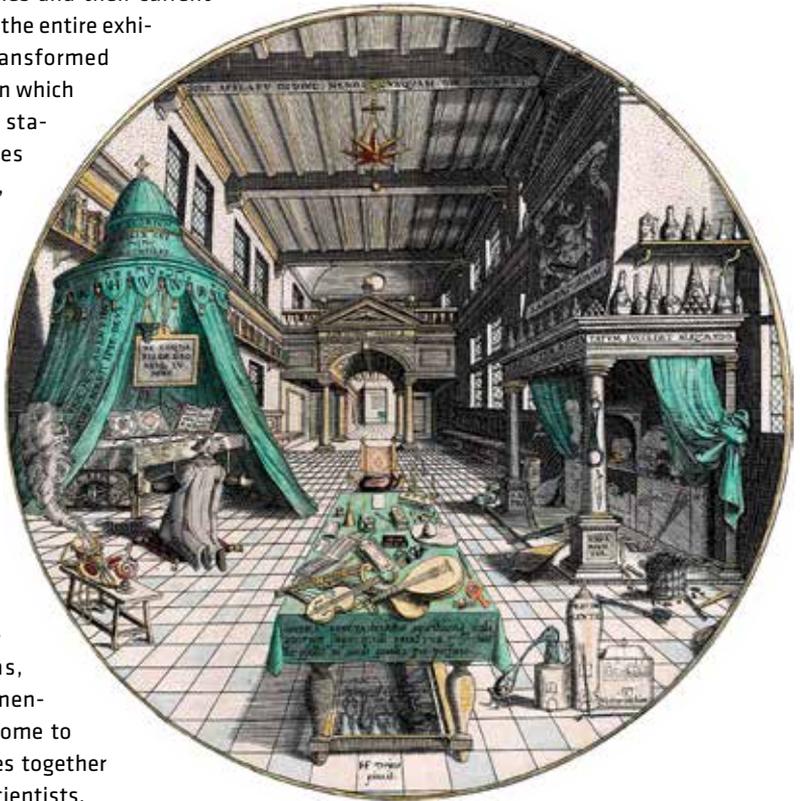
Text: Michael Badics, Senior Director AE Solutions

Klaus Dietersdorfer (AT)

. . . Without Borders

During times in which the world's borders are becoming increasingly hard and fast, people without borders are gaining importance. Accordingly, there are more and more groups that use "without borders" in their name, associations of people whose professions have become a more broadly conceived calling to work on behalf of the community.
Doctors Without Borders, for example, is an international medical aid organization that helps people in need, victims of catastrophes and armed conflicts. *Reporters Without Borders*, on the other hand, is committed to safeguarding freedom of the press and the right to express divergent opinions. *Engineers Without Borders* is active worldwide cooperatively carrying out technical development projects. These organizations have one thing in common—they transcend borders in deploying their knowledge, time and enthusiasm in order to accomplish some purpose. But what motivates them? And is it possible by means of knowledge transfer to contribute to correcting the disequilibrium that characterizes the world order?

Klaus Dieterstorfer

AIT—AUSTRIAN INFORMATION TECHNOLOGY
iniGrid—Integration of Innovative Distributed Sensors and Actuators in Smart Grids

iniGrid innovates in the way electric energy is brought to end-use equipment for actively managed and fault-protected distribution grids. The use of renewable energies goes along with the so-called "Smart Grid." Essential future functionalities such as dynamic management of power-line loading as well as fault detection and rapid recovery from power interruptions require appropriate sensors and actuators in place. These sensors and actuators are currently absent at the distribution level of power grids. Radically new semiconductor-based components are being developed by *iniGrid*, alongside the necessary IT and secure networking concepts. The *Smart Breaker* provides protection functions, power management, measurement services and communication for domestic and industrial appli-

cations, based on a new and innovative technology. An air-insulated medium-voltage sensor, integrated into post insulators allows easy retrofitting of sensors in the existing power-grid infrastructure.
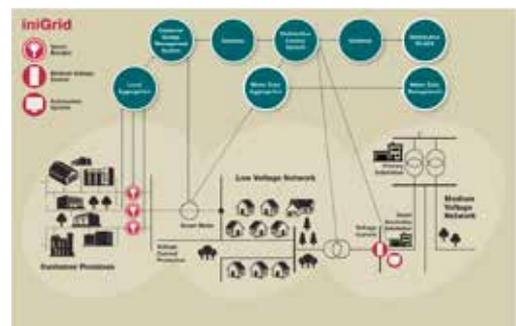
iniGrid

Hans Reitz (DE)
CIRC RESPONSIBILITY
Future Work

Digitization is rapidly transforming the world of work—complexity is growing; speed is on the rise; developments are less and less predictable. This shifts the focus onto the question of what makes human beings irreplaceable in comparison to computers, and in what respects people could be superior to intelligent machines. Creativity, empathy, self-determination and artistic thinking are the distinctive characteristics of human beings. Linked up in a flexible team of lateral thinkers who display courage, think playfully and transgress boundaries—in so-called temporary creative constellations—a person can achieve the unimaginable. A person could defy digitization and innovation and configure society in accordance with his/her own rules. After all, intelligent computers are not (yet) in a position to do networked, creative thinking, and especially not if the members of temporary creative constellations are interlinked in empathy, social responsibility and self-determination.

Caroline Heptner

Rüdiger Wassibauer (AT)

SCHMIEDE HALLEIN

Playground of Ideas

Schmiede Hallein (Hallein Forge, a city in Salzburg) is a playground of ideas. This conclave of makers and prototyping jamboree is a setting for self-determined development, testing cooperation and brainstorming.

Since 2003, the *Schmiede* has been an annual gathering of about 300 people from approximately 30 countries engaging in activities at the nexus of art, digital media and DIY. During this ten-day get-together on Perner Island, we engender a basis upon which joint ventures, partnerships and projects can take shape. The byproduct is an open lineup of conferences, workshops, concerts and presentations. Several labs focus on and bridge the diversity of the *Schmiede*. The outcome is an exhibition showcasing approximately 70 projects.

Facts & figures: Most participants were born in the years 1980-90. 44% of all "smiths" are female, and 40% are attending the *Schmiede* for the first time. About 60% of the participants are from Austria.

Ela Grieshaber

Christoph Dorfer

Gini Glitzert

KairUs Art + Research (FI/AT)
FORENSIC FANTASY

Forensic Fantasies is a series of artworks dealing with data breaches of private information using data recovered from hard-drives brought back from one of the biggest e-waste dumps in West Africa, Agbogbloshie in Ghana. Electronic waste often ends up in developing countries, where valuable metals are extracted in highly toxic environments. Reports suggest that criminals also mine data from hard-drives to demand payments from their former owners. We returned from Ghana with 22 hard-drives and two questions: Could data be recovered? And if so, could it be (ab)used?

The potential abuse of data is in the focal point of these scenarios: 1) *Not a Blackmail*, is a ready-to-mail package including one of the hard-drives and a letter to the previous owner. 2) *Identity Theft*, reflects on found data that was used to create fake online profiles for romance scams, and 3) *Found Footage Stalkers*, confronts earlier practices of using found footage with digital data now recovered from our trash.

Credits: Linda Kronman (FI), Andreas Zingerle (AT)

Linda Kronman & Andreas Zingerle

Impact Hub

Impact Hub is a unique global ecosystem of resources, inspiration, and collaboration opportunities that creates a sustainable and inclusive future. The *Impact Hub* Vienna community is made up of entrepreneurs, social investors, freelancers, advocates, campaigners, creatives, artists, consultants, professionals—addressing local and global challenges. These are the people who see and do things differently and have the entrepreneurial passion to make a sustainable impact.

Members are connected to 13,000-plus like-minded entrepreneurs in over 40 countries, get access to resources, meeting and work spaces, inspiring events, relationships and incubation programs.

With 82-plus *Impact Hubs* worldwide, this global community celebrated ten years of impact in 2015, and is now the fastest growing trans-local network of social innovators in the world. Through cross-sector, cross-organizational and global exchange, learning and collaboration, societal issues are tackled through entrepreneurial action.
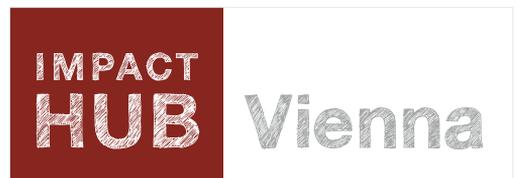
G60_HACIENDA

G60_HACIENDA is the test bed to transform the idle land in the hi-tech campus in Shanghai, China into the self-sufficient neighborhood. It will redefine public space via techno-advanced co-creation to form an integrated ecosphere of human, nature and technology, providing a new type of demo space of the future scenarios in urban living, knowledge acceleration and transferring, advanced industry clustering, forming the next economy for the city.

The self-sufficient neighborhood model will consist of four main aspects: fabrication, energy, mobility, food.
G60_HACIENDA is curated and operated by the iTOPIA team and was co-created by the campus residents and companies, the neighborhood village farmers and the university campus, plus international partners including IAAC from Barcelona.

Vicente Guallart

Green Fab Lab IAAC

ESA

Art Meets Science—How Satellites See Our Planet

Throughout history, our world has been depicted through art. From prehistoric cave paintings to the canvases of the Renaissance masters, we have continually documented our environment and its beauty.
As our means of exploration evolved, our perspective also changed. While visual art forms developed— from the works of Leonardo da Vinci to contemporary, abstract works—so did the awareness of our surroundings through science. The need to produce new representations of this new knowledge of our world still exists. Satellites act as an information source and give us the ultimate perspective. But the images these satellites provide not only serve a scientific purpose, they also provide an aesthetically pleasing view.
Taking an 800-km step back enables us to appreciate the "big picture" of our planet, how it is changing over time and humankind's impact. And like any work of fine art, we must handle it with care. The Hyperwall presented at Ars Electronica 2016 by the European Space Agency gives us the chance to view Earth as seen from space—interactive and at your fingertips.
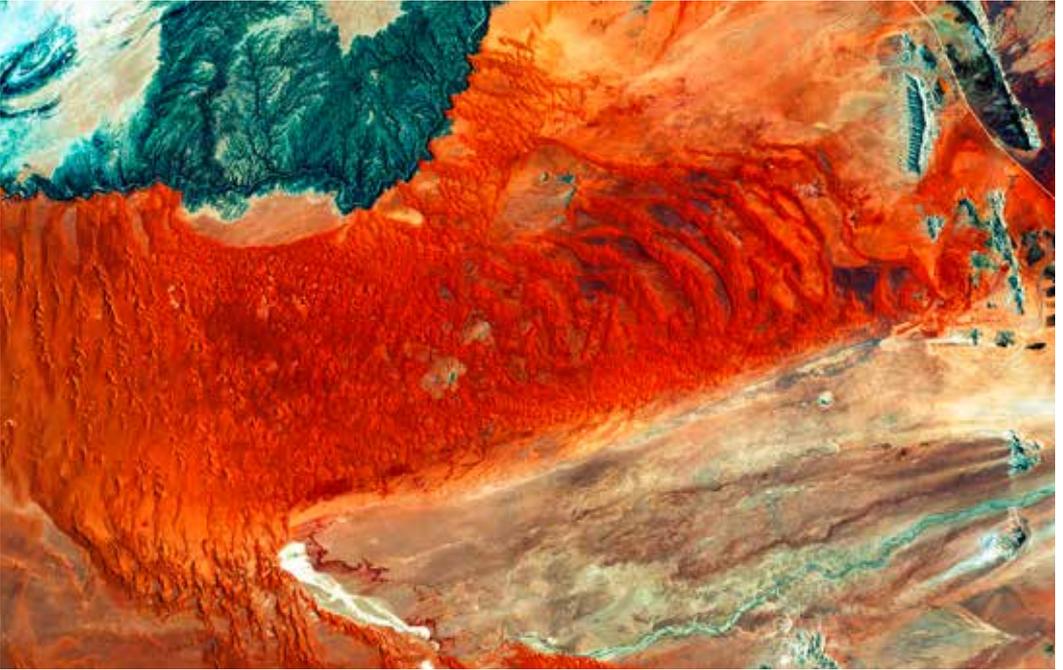
ESA

Colorful Naukluft. The Sentinel-2A satellite takes us over to central western Namibia, an area surrounding the Namib Naukluft Park, in this image taken on January 28, 2016. The national park includes part of the Namib—the world's oldest desert—and the Naukluft mountain range. It is the largest game park in Africa and the fourth largest in the world. Contains modified Copernicus Sentinel data (2016) / processed by the ESA.

ESA

The Azores. This Sentinel-1A radar image was processed to show water as blue and land in earth colors. It features some of the Azores about 1600 km west of Lisbon, including the turtle-shaped Faial, the dagger-like Sao Jorge and Pico Island, with Mount Pico reaching over 2351 m in height. Contains modified Copernicus Sentinel data (2016) / processed by the ESA.

MED-EL
The Hearing Implant Company

MED-EL, Medical Electronics, headquartered in Innsbruck is a leading provider of hearing implants worldwide. The family-owned business founded by DI Dr. Ingeborg and Prof. Erwin Hochmair is one of the pioneers of the industry. The world's first micro-electronic multi-channel cochlear implant developed by the two scientists was first implanted in a patient as early as 1977. The cochlear implant marked a milestone in medical history as, for the first time, it was and remains the only replacement of a human sense, the sense of hearing. Today, *MED-EL* offers the widest range of implantable solutions to treat the various causes and degrees of hearing loss. *MED-EL's* main objective is to overcome hearing loss as a barrier to communication, opening up a world of sound to people around the world.

There is still a great need for hearing implants worldwide: currently, fewer than ten percent of people who have a severe hearing loss receive a hearing implant. In Central Europe, roughly 25 cochlear implants are inserted per one million inhabitants per year; in other regions the number is only five or even fewer.
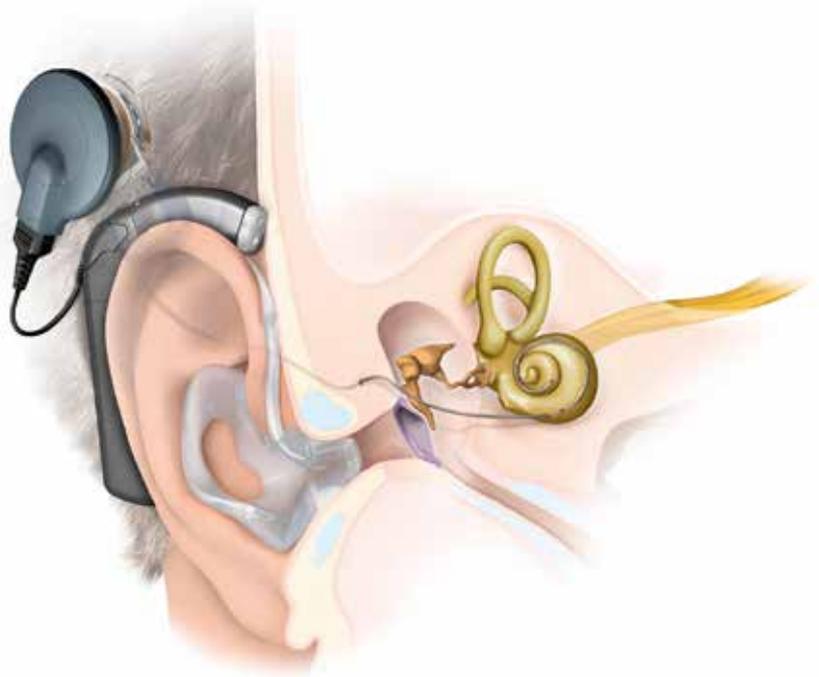
DS AUTOMOTION

Eye to eye with Sally
Bridging the gap between industry 4.0 and electronic arts

Since the first Ars Electronica in 1979, ubiquitous digitization and computerization have been continually revolutionizing both the arts and industrial production. Developments such as the ongoing fourth industrial revolution utilizing the Internet of Things (IoT) to boost the agility of production environments are key prerequisites for the industry-scale production of fully individualized products. Sally is an automated guided vehicle (AGV) designed by DS AUTOMOTION to facilitate the flexible flow of materials, tools and parts that industry 4.0 relies on. During Ars Electronica 2016, Sally will interact with visitors through a purpose-built art application by Ars Electronica Solutions, combining hardware, software, connectivity and motion to bridge the gap between art and industry. Using its advanced technology, the cyber-physical vehicle will even provide visitors with a souvenir, demonstrating safe human-machine cooperation far beyond the protected environment of computer games.

AGV design: Christoph Weiermayer for DS AUTOMOTION;
AGV development and production: DS AUTOMOTION; Art application: Ars Electronica Solutions for DS AUTOMOTION

Raphael Perret (CH)

Recycling Yantra

The installation *Recycling Yantra* is on the one hand a series of videos documenting informal e-waste recycling in Delhi, and on the other a contemporary interpretation of the tantric symbol *Smara-hara Yantra* (Remover of Desire). The videos show how computers are collected, repaired, traded and taken apart over several steps, until all the components are fed back into the production of new goods again. This mostly unknown process takes place in the informal economy and is diametrically opposed to how electronics are assembled in China.

Electronic media are the ground on which modern societies are thriving and we all know the continuous desire, buzz and excitement for the next version, update, upgrade or release. The *yantra*, composed of materials collected from the recycling process, is an energy diagram, comparable with a talisman, which in its original meaning is supposed to help people free themselves from desire and the urges of consumer culture.

http://raphaelperret.ch/recycling-mandala/
Credits: Pro Helvetia, Migros Kulturprozent

Gion Pfander

Ron Garan (US)

Ron Garan–Alchemist

On October 1, 2013, I left my dream job, the job I had worked my entire life to achieve, a job that took me to the depths of the ocean and to space. I left my career as a NASA astronaut for one compelling reason, to be able to share a very unique perspective our planet full time. I call this perspective, *The Orbital Perspective.*

There usually are two ways to define the word perspective. It may refer to the rendering or interpretation of a three-dimensional object on a two-dimensional plane, or it may refer to an attitude toward something, a point of view. Both of these definitions come into play in *The Orbital Perspective*. Historically, for the most part, our perspective has been two-dimensional. Although we know that the world is not flat, a true perspective on a three-dimensional, interrelated reality is usually beyond our immediate awareness. But when we are able to zoom out to the orbital perspective we can see all the pieces of the puzzle, who has them, and what picture they paint for our global society.

From space we are given a broader perspective of the word *home*. From the orbital perspective *home* is not just where we were born, grew up or where our family lives–home is Earth. From space our circle of kinship expands beyond our immediate family to all who we share this beautiful fragile oasis called Earth. Everything that I've done since leaving NASA has been done with the goal of sharing a big picture, long-term perspective of our planet, a perspective that I believe can have profound positive effects on the trajectory of our society. I've written the book, *The Orbital Perspective*, I am working on a full-length feature documentary called *Orbital* and I took on the role of Chief Pilot of World View Enterprises. Through World View I will be taking experiments and people to the edge of space in high-altitude balloons.

Another way that I'm working to share this perspective is through art. Through my art I strive to capture not just the visual of life in space but I also try to capture the emotion of the experience. Each piece that I create has profound meaning to me, and it is my hope that I can communicate that meaning to others. My art stems from a responsibility that I feel to share the experience of living and working in space with as many people as possible through every feasible channel.

Don Ritter (CA)

Burning Too

Humanity was highly dependent on fire for warmth, safety and food preparation during former eras, but today fire and fire imagery are aesthetic experiences for most people that provide feelings of warmth, romanticism or fear. *Burning Too* is a media façade consisting of sound and video projections of fire that are presented on a building at the entrance of POSTCITY. The media façade presents its audience with an experience of fire imagery that is intended to be captivating through its scale and illusion of danger. The work uses multiple recordings of fire that are mixed and manipulated in real-time during playback. The colors of the projected fire subtly change, while the sound of the fire is interactively controlled by the visual activity of the projection.

Cengiz Tekin (TR)
Just Before Paradise

There were big waves of migration in the Middle East following wars and massacres. With the civil war in Syria, the pace of long-standing dramatic problems changed. We have witnessed the biggest refugee crisis since WW2. But there is a big difference between now and then: today everything happens much more publicly. This experience of witnessing things in real time increases our anxiety that we may, in the future, end up in their position. In the video we see a group of refugees waist-deep in dark water. These young men seem like they are singing a quiet anthem as the waves lap up against the shore. They all have a proud expression on their faces as they realize the last duty for their lost friends, with whom they shared a common fate. The silence is more of a survival strategy against traumatic experiences in life rather than resignation. The video draws attention to forced migration and the refugee crisis and also depicts the tides between death and life as a boundless crisis instead of a regional one.

Courtesy the artist and Pilot Gallery (Istanbul)

Rıdvan Bayrakoğlu, Courtesy the artist and Pilot Gallery (Istanbul)

Kazuhiko Washio (JP)

Transit

A young blonde said to me, "Welcome." Last September, transiting to the airport, at Vienna's Westbahnhof rail terminus I was suddenly caught up in the crowd transiting to Europe from the east. Side by side, we are waiting for the next train. I could not see any difference between the scene of lots of families with kids chattering, drinking, playing and eating food prepared by volunteers and my own holiday with my family. We share lives to be tossed by the huge force exceeding personal abilities. We are tiny pieces floating around in the world. A young blonde made a mistake?

http://washiokazuhiko.com

Volkmar Klien

Volkmar Klien (AT), Thomas Grill (AT)

Relative Realitäten

(Relative Realities)

A pendulum swings through a space. A video screen, constituting its pendulum bob, carves its path through the exhibition space. From its ever-changing position it presents a view into a different scene. Although freely swaying through space it collides with objects; invisible, but audible. A computer traces the pendulum's position and—in a computer model—embeds it into a mathematical world where it collides and interacts with objects. This interaction between the pendulum and its mathematical surroundings provides the source for a three-dimensional soundscape. Something is forced into motion. Slowly it returns to standstill. Next time things will behave rather similarly. Only the world in the computer changes.

Michael Hirsch (US), Pablo Honey (ES), Mahir Yavuz (TR/US)

Kydo

Is intelligence human? *Kydo* may provide an answer. Most of the current events in the world and the surrounding rhetoric leave us confused and uncertain. They coerce us to understand the world in a binary opposition: good and bad, black and white, thereby creating an incoherent dialog between us and them that undermines what is really happening. We are polarized. We do not know what the others are up to, or who they really are.

In this scheme of things, machines and new computing methods are at the heart of the confusing paradigm. Social networks seem to be the panacea of human connection, yet the truth is that these ecosystems are mere echo chambers. Virtual worlds seem to be an open window to distant dreams, but they isolate us from our own environment and blur the borders between what is real and what is constructed. Decentralized communication methods enable everyone to create relations and distribute their own narratives. Privacy is a critical issue in every domain and it has deep social and political implications. The advances in genetics and artificial intelligence seem to be the hope of our future existence as a species, but they also challenge us to redefine ourselves as creators instead of transitory creatures (Lat. something created). We slowly are becoming a new kind, something between the creator and the created, which in turn makes us sort of a demigod, a mortal who has god-like characteristics.

A while ago a small group of pioneers started becoming alchemists. This gave birth to machines that are shaping our world, as well as our perception of it. Today open-source technologies are encouraging the public to become alchemists too—to create machines, to write code and algorithms that contribute to this new ecosystem of creatures. But who gave us the responsibility for these new crea-

tures? Who should be responsible for creating? It is becoming more and more apparent that these algorithmic creatures will soon rule our own reality for the most part. What biases are socially acceptable? Which algorithm, which machine will be better than the others for us? It is very likely that the democratization of being an intelligence creator will introduce new challenges, such as passing on certain moral systems to machines when they are not even resolved in the social arena.

Such social and ethical questions will have a critical role in the next chapter of the creation of a new society. Formed by semi-real subjects, who can speak, operate and behave like us, this new society will make it all even more confusing. In a poetic way, we will start living in a social context with demigods made of atoms and/or bits. Such was Kydoimos, the Greek demigod of the din of battle and generator of confusion, thus the ancestor spirit of this non-linear warfare that we live in.

Our *Kydo* project has been created based on this new reality. *Kydo* is an experiment, s/he is a semi-fictional character who will attend Ars Electronica 2016 where s/he will observe the festival and interact with visitors on Twitter about the artworks and the social phenomena that inspired them. People are invited to interact with *Kydo* through text-based conversations. As is known, text messaging has become central to our everyday life, and it is used specially in the context of personal and private communications. Texting, however, could go beyond this basic premise and transform the way we interact with computers in the same way it changed the way we connect with each other when Matti Makonen created the SMS.

By their nature, conversations are turn-based, and the moment between the turns is the key. It is a magical gap that makes us feel excited and inter-

ested in hearing and seeing what our counterpart will say. It is the moment we expect an intelligent response. This moment can be longer or shorter but its magical effects remain the same. We have conversations in order to understand ourselves, others and reality. A conversation also is the true method of testing intelligence, as reflected in the Turing test. That is the main reason why we believe that *Kydo* should have conversations. *Kydo*, in a way, is a weirdly behaving agent hidden behind the artificiality of a computing interface, having semi-intelligent chats with people and observing their reactions. Meta-tagging a subject as semi-intelligent, we are loading her/him with confusing expectations that fundamentally change the way people interact with and perceive it. After all, is intelligence human?

Furthermore, is artificiality intelligent at all? Or a better question: can we really both create and understand an intelligence beyond ours? Computers will shake up their own artificiality and shape themselves with natural biases: superstitious or rational, religious or atheist, apolitical or capitalist, ecological or profit-driven. Where does the machine stand within the complexity of an ethical and moral system? As we observed with Google's Deep Mind winning against Go world champion Lee Sedol, they are good at analyzing patterns and reacting to them. We also observed, however, that Microsoft's AI twitter bot Tay failed miserably to be intelligent enough to reject sexism and racism. In a way, she (or he) learned concepts and patterns very quickly but learned the wrong things, and Microsoft had to stop it. The fact that moral convention has no universal standard makes it challenging to form an intelligence with the appropriate ethics. We will probably experience a situation where everyone defines rules, morals and ethics based on personal taste. The alchemist's own convictions, judgments, beliefs and ideology will be transferred to the machines.

It is clear that the story between man and machine is old, and it seems that it is about to take yet another turn pretty soon. As artists, we are responsible for addressing the ongoing confusion and biases in the world as well as contributing to raising the important questions before we create another "species." *Kydo* will teach something about us and them.

http://www.rga.com
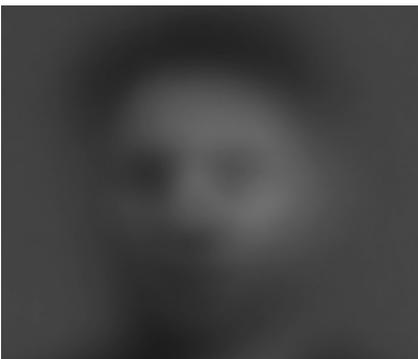
Kydo Profile
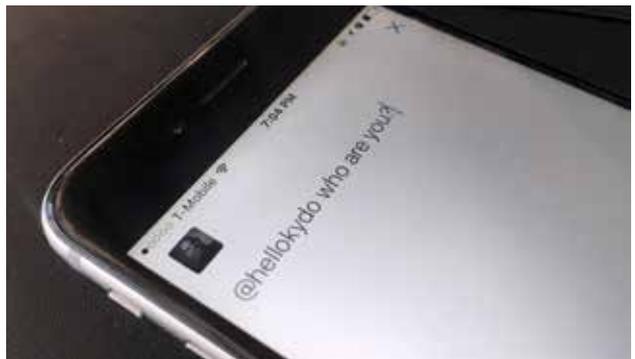
KydoTwitter

FEAT–Future Emerging Art and Technology

The EU Future and Emerging Technologies program (FET) funds high-risk, multidisciplinary and long-term collaborative research. It crosses the conventional boundaries between research fields into unknown territories and builds upon cross-fertilization and synergies between different advanced disciplines such as physical, information, environmental and social sciences.

With their frontier research, FET projects push the boundaries of human knowledge. Unconventional ways of thinking and creativity open novel and visionary fields and lay the foundation for radically new technological possibilities. These high-risk projects also come with a high potential impact on economy and society. The long-term goal is to turn Europe's excellent science base into a competitive advantage by converting proofs of concept into industrial applications and systems.

In these often quite abstract disciplines it is necessary to think outside the box. Novel fields of research call for novel ways of support. So we asked ourselves: What if we injected art into FET projects? FEAT–Future Emerging Art & Technology brings together artists working at the cutting edge of technology and FET projects using best-practice methods to create a productive atmosphere where both parties can learn from one another. Over a nine-month residency period, participating artists will learn new skills and work with novel materials while the scientists gain new perspectives and learn new ways to bring their work to the public. Finally, the project will result in the production of innovative artworks to be showcased all over Europe through major exhibitions, media campaigns and socially engaged events including debates, participatory workshops and festivals.

In total, six leading international artists are hosted within FET projects through funded, embedded residencies. Through in-depth collaborations with researchers and reflecting on the projects, the artists will explore, engage and communicate these new areas of research to reach the widest possible audiences, opening up societal discussions, raising awareness and enhancing take-up of these radically new technologies.

http://www.featart.eu

Coordinator: Dr. Erich Prem, eutema
Project partners: Waag Society and youris.com

Evelina Domnitch & Dimitry Gelfand
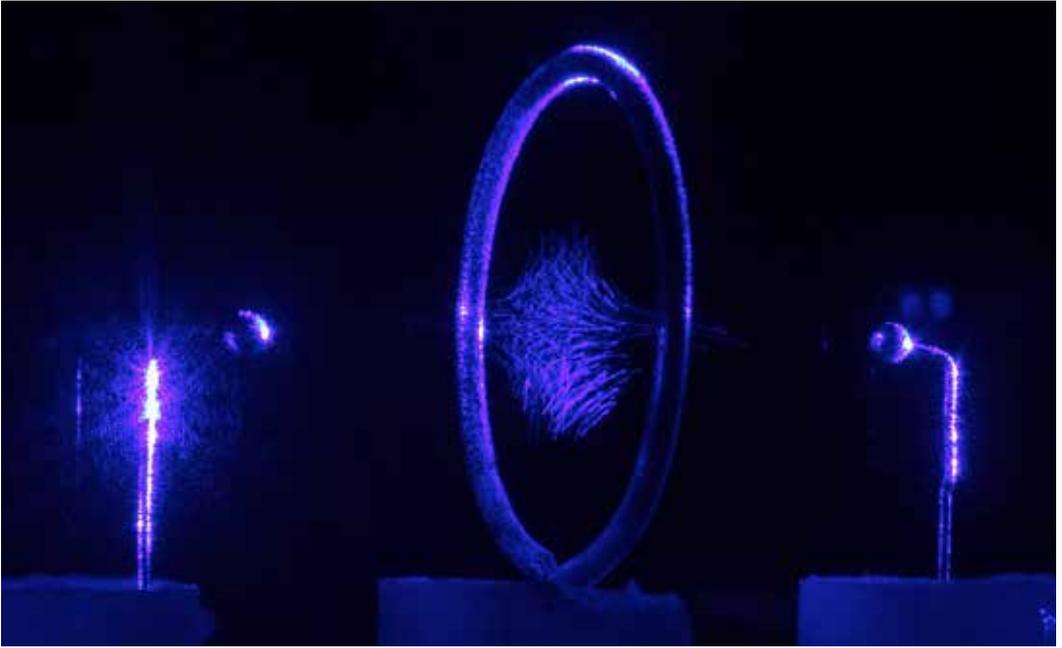
Ion trap prototype levitating lycopodium spores. The trap was constructed by the artists Evelina Domnitch and Dimitry Gelfand in collaboration with the FET project RySQ, which is developing quantum simulators with Rydberg atoms.

semiconductor
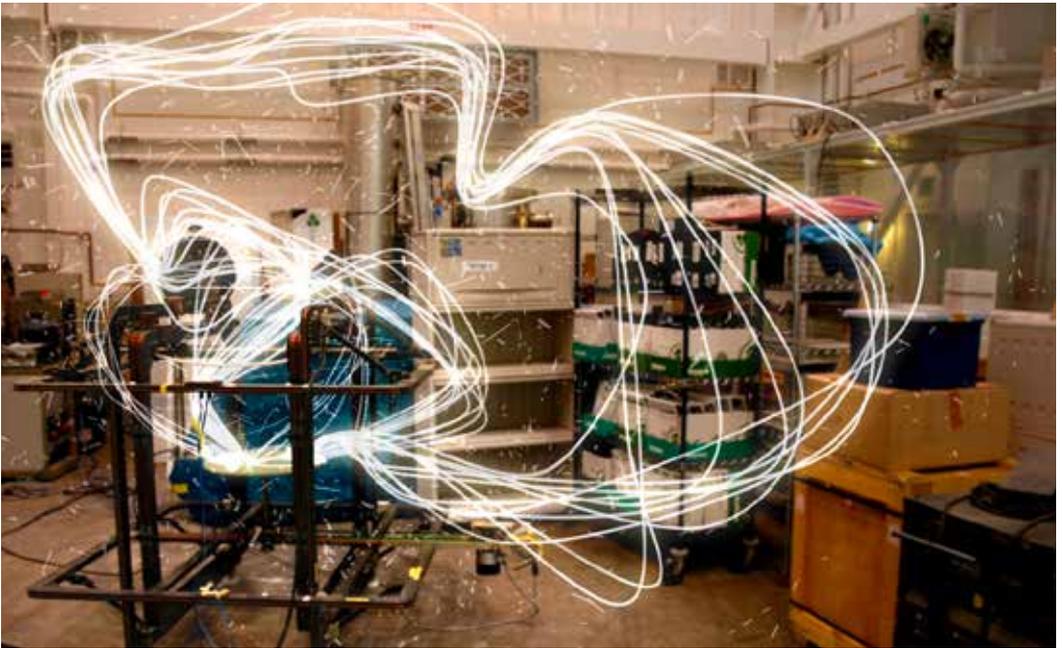
Semiconductor: animation of electromagnetic waves from the film *Magnetic Movie* by British artist duo Semiconductor.

ENCAC–European Network for Contemporary Audiovisual Creation

Led by the LABoral Centro de Arte y Creación Industrial from Spain, the *European Network for Contemporary Audiovisual Creation (ENCAC)* is co-funded by the Creative Europe program of the European Union. *ENCAC* aims to facilitate, promote, inspire, support and create new opportunities and challenges in the audiovisual arts as well as to foster innovative and sustainable solutions for the creative community, a wide range of audiences and the audiovisual field. The project features a wide program of research, production, education and dissemination of the new audiovisual practices. The total of activities planned includes 20 residencies, twelve professional workshops, two developer meetings and 24 presentations, installations, performances, seminars and round tables.

The *European Network for Contemporary Audiovisual Creation* is aimed at boosting innovation by combining its members' knowledge, experience and resources. The different nature of the members also brings in an interdisciplinary and complementary perspective.

Its contribution to the creators' process in the different fields covered by the project—research, production, education and dissemination of new audiovisual practices—will foster a more effective advance in the implementation of innovative solutions that can be exported, that are sustainable and that bring the new audiovisual culture closer to the public and industry.

Under the leadership of LABoral, the *European Network for Contemporary Audiovisual Creation* is integrated in Ars Electronica (Linz, AT), LEV Festival (Gijón, ES), hTh—CDN (Montpellier, FR), Le Lieue Unique (Nantes, FR), Resonate (Belgrade, RS) and DISK (Berlin, DE).

ENCAC is co-funded by the Creative Europe program of the European Union.

Evelina Domnitch (BY), Dmitry Gelfand (RU)

Force Field

Levitated by sonic pressure, spinning droplets of water mirror some of nature's deepest secrets, from the anomalous force compressing atomic nuclei to the one that squeezes the event horizon of black holes. For the first time such intangible dynamics can be explored under analogous laboratory conditions. Since the 1970s and 80s, acoustic levitation techniques have primarily been applied by NASA and ESA to trap and navigate otherwise uncontrollable samples in microgravity. However, in the last two decades the same methods have also been used as a powerful tool for containerless manipulation on Earth. In *Force Field* acoustically levitated water droplets resonate, vaporize and reassemble into spheroids, toroids and oscillating polygons while rotating almost without shear, unleashing an unprecedented audiovisual instrument, *Force Field* simultaneously taps into the three-dimensionality of sound, the elusive physicality of water, and formerly inaccessible depths of both inner and outer space .

Scientific collaborator: Alexander Miltsen; Computational projection: Paul Prudence
The project was developed during a production residency at the DISK/CTM Festival in January/February 2016.
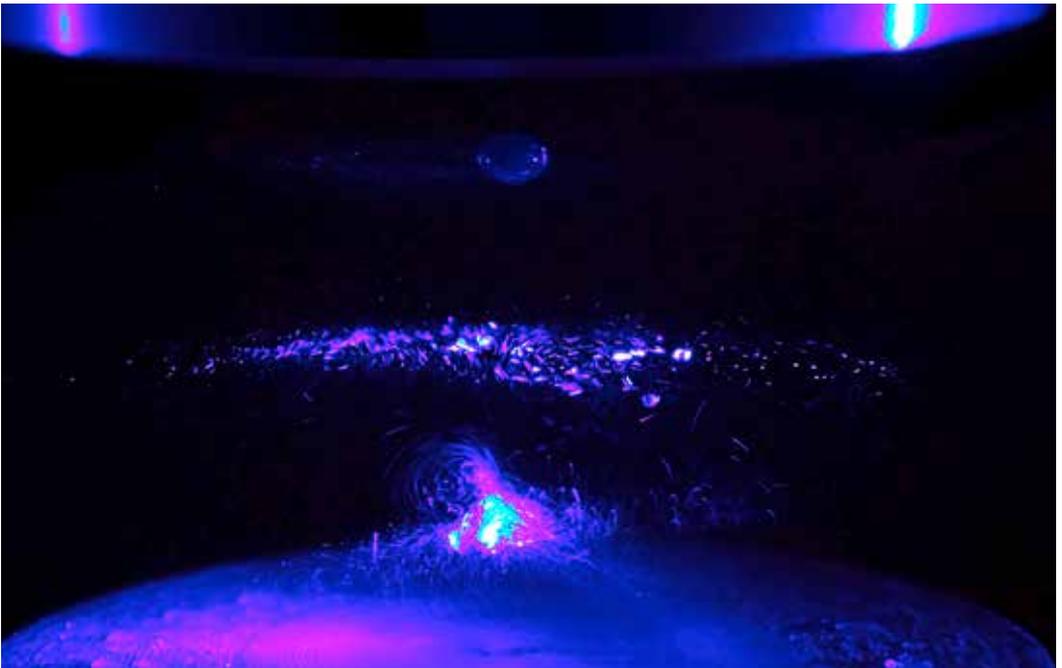
Dmitry Gelfand

Tomonaga Tokuyama (JP)

$f_2()$

$f()$ is an installation series which transforms a gallery space into a piece of art where viewers are involved. The installations operate like functions of computer programming but on real space driven by physical laws.

In $f_2()$ audio-reactive light tubes render the invisible sound universe traversing a basement corridor of a former postal distribution center. The installation unifies visual and auditory perception. One can "see" it objectively in perspective but the resolution is limited to the finite number of lighting instruments. One can "hear" it in the continuously spread sound field but the experience is local and subjective. This is how our two complementary recognitions work together.

Produced by: Tomonaga Tokuyama
Construction: Yoshinaka Yanagizaki
With the support of ENCAC–European Network for
Contemporary Audiovisual Creation, Le Lieu Unique (FR),
LABoral Centro de Arte y Creación Industrial (ES).
The project was developed during a production residency
at Le Lieu Unique in January 2016.

Marcos Morilla

Summer Sessions Network / V2_Institute for the Unstable Media
Summer Sessions

Pop-up exhibition and event featuring:
Max Dovey (UK), Fako Berkers (NL), Gaspard Bos (NL), Charlot Boonekamp (NL), Teun Vonk (NL)

Summer Sessions are short-term residencies for young and emerging artists, organized by an international network of cultural organizations. Each summer the partners in this network for talent development collaborate to offer professional production support and expert feedback to artists in the realization of a new artwork or design. Local talents from each partner's geographic region are scouted and selected for a residency abroad, where they are offered highly productive atmospheres and specific kinds of expertise at one of the international partners in the international network. This collaboration not only results in the development of a large number of new projects in a relatively short period, but also provides the participating emerging artists with international experience that helps them jumpstart their art and design practice.

The *Summer Sessions* pop-up exhibition at the Festival Ars Electronica shows a selection of outcomes realized through this international exchange of emerging talents. While the pop-up exhibition illustrates the kind of results that this pressure-cooker residency format results in, the live event will highlight the participants' experiences abroad and the effects these had on their early careers. In doing so, V2_Institute for the Unstable Media, the initiating partner of the *Summer Sessions* network, intends to inform ambitious early-career artist about the opportunities that the international network for talent development offers and is reaching out to other cultural organizations with an invitation to join the network. Furthermore, the pop-up exhibition introduces the Festival Ars Electronica audience to a selection of promising emerging Dutch artists who participated in the network. The event will close with an informal drink to continue the conversation on the opportunities for young artists and cultural organizations within the *Summer Sessions* network for talent development. This event will also form a meeting point to discuss how to strategically further develop these international opportunities for emerging and young professionals with the network's past and present partners. The partners in the 2016 edition of the *Summer Sessions* include Chronus Art Center (China), the National University of Tres de Febrero (Argentina), the National Taiwan Museum of Fine Arts (Taiwan), PNEK (Norway), iMAL (Belgium), Arquivo 237 (Portugal), Kitchen Budapest (Hungary), Metamedia Association (Croatia), Interactive Media Design Lab, NAIST (Japan) and V2_Institute for the Unstable Media (The Netherlands).

Max Dovey (UK)

A Hipster Bar

A Hipster Bar uses a customer image-recognition application to only admit people who are recognized as hipsters by a computer algorithm. The doors to this bar will only open if you are at least 90 percent hipster, making it the world's first automated hipster bar. By sourcing thousands of images of hipsters (from Instagram) Max Dovey has attempted to train an algorithm to recognize the visual characteristics of a hipster.

http://www.maxdovey.com

Fako Berkers (NL)

Union Scope

Union Scope finds iconic images on the Internet from different European cultures, about topics that concern Europeans today. It displays these images by country inside a map of the European Union, revealing the cultural differences and similarities that exist within Europe around topics that concern European citizens.

Searching for images online it is easy to forget that the images one finds are significantly informed by the culture one was raised in. *Union Scope* provides the opportunity to explore this cultural bias in image searches, revealing different cultural views on European topics.

http://data-scope.com

Gaspard Bos (NL), Charlot Boonekamp (NL)

Woof & Wow

Woof & Wow develops techniques for transforming plastic bottles into woven products to be used by arts and crafts people or industrial designers. The aim of *Woof & Wow* is to include the world's most disadvantaged communities in the process of design and production of products from waste, as they are moreover the ones that pick up the rest of the world's trash.

At the Festival Ars Electronica, *Woof & Wow* will exhibit a stool designed by Icelandic designer Marta Sif in collaboration with an arts and crafts community in Peru. The exhibition will include the custom-made tools that were used to produce it, as well as a swing made from the same material.

http://www.betterfuturefactory.com

Teun Vonk (NL)
The Physical Mind

The Physical Mind is Vonk's attempt to let partici-
pants experience the relation between their physical
and mental states by applying physical pressure to
the body. The installation consists of two inflatable
objects between which a participant lies down, then
to be lifted up and gently squeezed between the
curves of the two objects. While the lifting creates
an unstable feeling, this stressful sensation then
soon contrasts with the secure feeling of being gen-
tly squeezed between two soft objects. Besides this
experience for the participants, the installation also
evokes feelings of empathy among bystanders who
watch participants undergoing the experience.

http://www.teunvonk.nl

Simone Pappalardo (IT)

Murmur L.C. Librans

The work, produced by Fondazione Mondo Digitale, is the result of the school project by the artist at the Tullio Levi Civita school in Rome.

The installation is the representation of an artificial vocal apparatus which creates an abstract artificial language, tracing the physiological function of a natural voice. The interaction and modulation of all natural phonatory organs shapes many speech sounds and phonic-acoustic phenomena. As well as the natural phonatory organs, *Murmur* uses different sculptural structures that individually participate in the final tonal result. *Murmur* imitates the natural phonetic apparatus.

The abstract sounds of the installation are based on graffiti found on the school wall. Pictures of damaged materials are rearranged as music score by an artificial intelligence system. The "talking" sculpture was made by using waste materials from the school bar.

Murmur is a "talking" automatic orchestra: an orchestra which tells us the history of the Tullio Levi Civita school.

Selection from BNL Media Art Festival, Rome (sponsored by Fondazione Mondo Digitale) curated by Valentino Catricalà, courtesy BNL BP Paribas Group.

Julia Hautojärvi. Rufa – University of Fine Arts

Lino Strangis (IT)

Flying In The Middle Of Nowhere

The work was produced at Fondazione Mondo Digitale's Innovation Gym. Lino Strangis for six months at Phyrtual Innovation Gym along with seven young people selected by a call.

The Phyrtual Innovation Gym is place where artists can find support to develop their projects.

The work aims at developing new artistic content for immersive platforms such as Oculus Rift. The work is an interactive multimedia application consisting of a 3D virtual set. On the set there are few animated characters with choreographic movements obtained in motion capture. Overturning the classical of video game idea, the audience is free to move in a symbolic environment created and conceived by the artist. Fundamental to this is the contribution of the audio track (electronic/experimental/post-ambient), which characterizes the environment, building up a non-synchronic but "empathic" atmosphere.

Selection from BNL Media Art Festival, Rome (sponsored by Fondazione Mondo Digitale) curated by Valentino Catricalà.

Claudia Larcher (AT)

FAUX TERRAIN

The title *FAUX TERRAIN* subsumes various interrelated but nevertheless discrete artistic works by Claudia Larcher. Through the use of abstraction, exaggeration and decontextualization, she presents habitats, architectural landscapes and natural formations as utopian expanses and dystopian scenarios. The works, which due to their perplexing wealth of detail initially seem to be realistic representations of actual facts and circumstances on the ground, are actually complex, multi-layered artistic constructions that dissolve the boundary between reality and fiction.

With an abstract cartography as her guide for this exhibition, Claudia Larcher has designed a fragmented landscape that crisscrosses the borders of its scientific, geographic and geological realms.

For the video installation *In Between the Ocean* (2014), she interwove images of interior spaces in Tokyo with wide-angle footage shot in the disaster zones around Fukushima and Tohoku, in order to reflect the impact of energy policy on the natural environment and the cityscape. People are few and far between in her work, and even when they do show up it is only in the form of the traces they have left behind.

In the video *Self* (2015), Larcher explores human skin in close-up shots. This surface, seemingly so familiar with all its details and characteristics, successively mutates into a surreal landscape. In a slow tracking shot, the interior and exterior of the human body morph into a fictitious space, a faux terrain into which spectators suddenly find themselves projected.

In cooperation with Bildraum 07.
Bildraum 07 is a cultural facility in Vienna operated by Bildrecht GmbH.
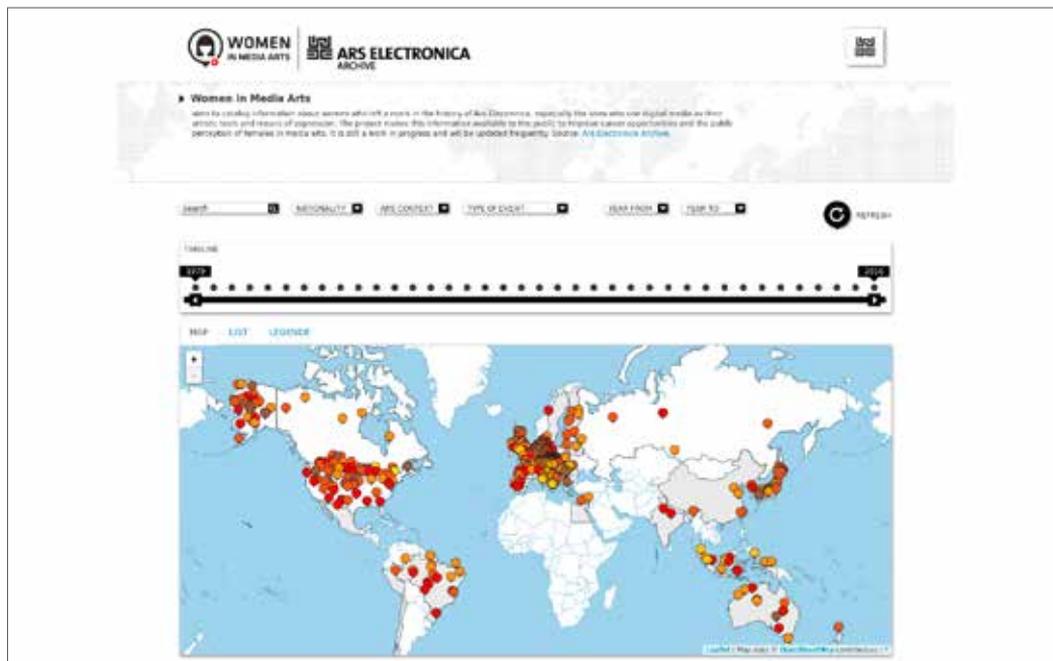
Ars Electronica (AT)

Women in Media Arts

Women in Media Arts is the first comprehensive database dedicated exclusively to women working in these genres. It includes all women who have made a mark on the 36-year history of Ars Electronica, and is designed to serve as an active research platform for artists, curators, scholars, scientists and anyone else interested in finding out more about female practitioners in these fields. This database lodges no claim to completeness; it merely reflects information stored in the Ars Electronica archive. It is intended to offer an initial overview and starting points for further research. As an active partner in various school- and college-level programs designed to nurture women's interest in technology and science, Ars Electronica's mission in supporting this project is to contribute to greater public awareness of women working in media arts, to promote new role models and to encourage girls and women to get actively involved in a field that is still dominated by men.

Women in Media Arts is a work-in-progress and will be updated on an ongoing basis. The project can be accessed via Ars Electronica's online archive at archive.aec.at.

http://archive.aec.at/

BUNDESKANZLERAMT ■ ÖSTERREICH

211

New Tendencies
Art at the Threshold of the
Information Revolution
(1961–1978)

Armin Medosch

Armin Medosch (AT), MIT Press (US)

New Tendencies

Armin Medosch will present his new book on the international art movement and network New Tendencies, who were important precursors of new media art and digital art. He examines the movement's development in the context of social, political, and technological transformations—from the paradigm of industrial mass production to the information society. Key protagonists of New Tendencies such as Herbert W. Franke, Otto Piene, and Vladimir Bonačić were a strong early influence on Ars Electronica. New Tendencies emerged in 1961 in the former Yugoslavia, a nonaligned country. Rather than opposing the forces of technology, these artists imagined its rapid advance to become a springboard into a future beyond alienation and oppression. They cast the viewer as the co-producer of the work and engaged in systematic visual research, anticipating key positions of participatory media art practices. In 1968 and 1969 the group actively turned to the computer as a medium of visual research, and in 1973 they presented dematerialized conceptual art practices side by side with computer art and constructive art.
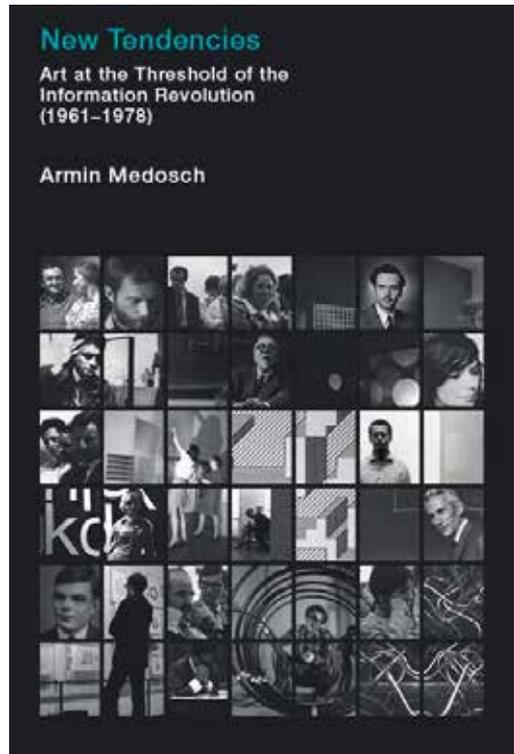
New Tendencies—Art at the Threshold of the Information Revolution (1961–1978), Leonardo Series, MIT Press, by Armin Medosch.

BIO AUSTRIA (AT)

Farmers' Market–the alchemy of food

The *Bio-Bauernmarkt* (organic farmers' market) launched in 2015 is back by popular demand! And the tremendous reception that led to a reprise this year also prompts the question: Could it be that high-quality foodstuffs are the real gold of the future and, thus, organic farmers are, in fact, our modern-day alchemists?

On Saturday, September 10, 2016, a select group of organic farmers will purvey their wares at the Farmers' Market of the Future in POSTCITY. They're among the 2,400 producers in the Province of Upper Austria alone who are members of BIO AUSTRIA, the largest association of its kind in Europe.

Thanks to regulations strictly enforced by BIO AUSTRIA, these men and women can provide healthy, nutritious foodstuffs, and thus help to ensure an intact environment for this generation and those to come, and a habitat that's suitable for human beings to live in. Right on site in POSTCITY, festivalgoers will be able to purchase a wide variety of foodstuffs that are products of organic agriculture direct from the farmers who raised them.

Festivalgoers are also cordially invited to a celebration of all the senses—a tasting of organic delicacies in POSTCITY on Saturday from 10 am. to 5 pm. This is also a great opportunity to chat about culinary practices and to get information about organic agriculture as well as innovative marketing concepts for locally produced foodstuffs.

http://www.bio-austria.at

Supported by BIO AUSTRIA Upper Austria

Theurl, Sonja Fuchs / BIO AUSTRIA
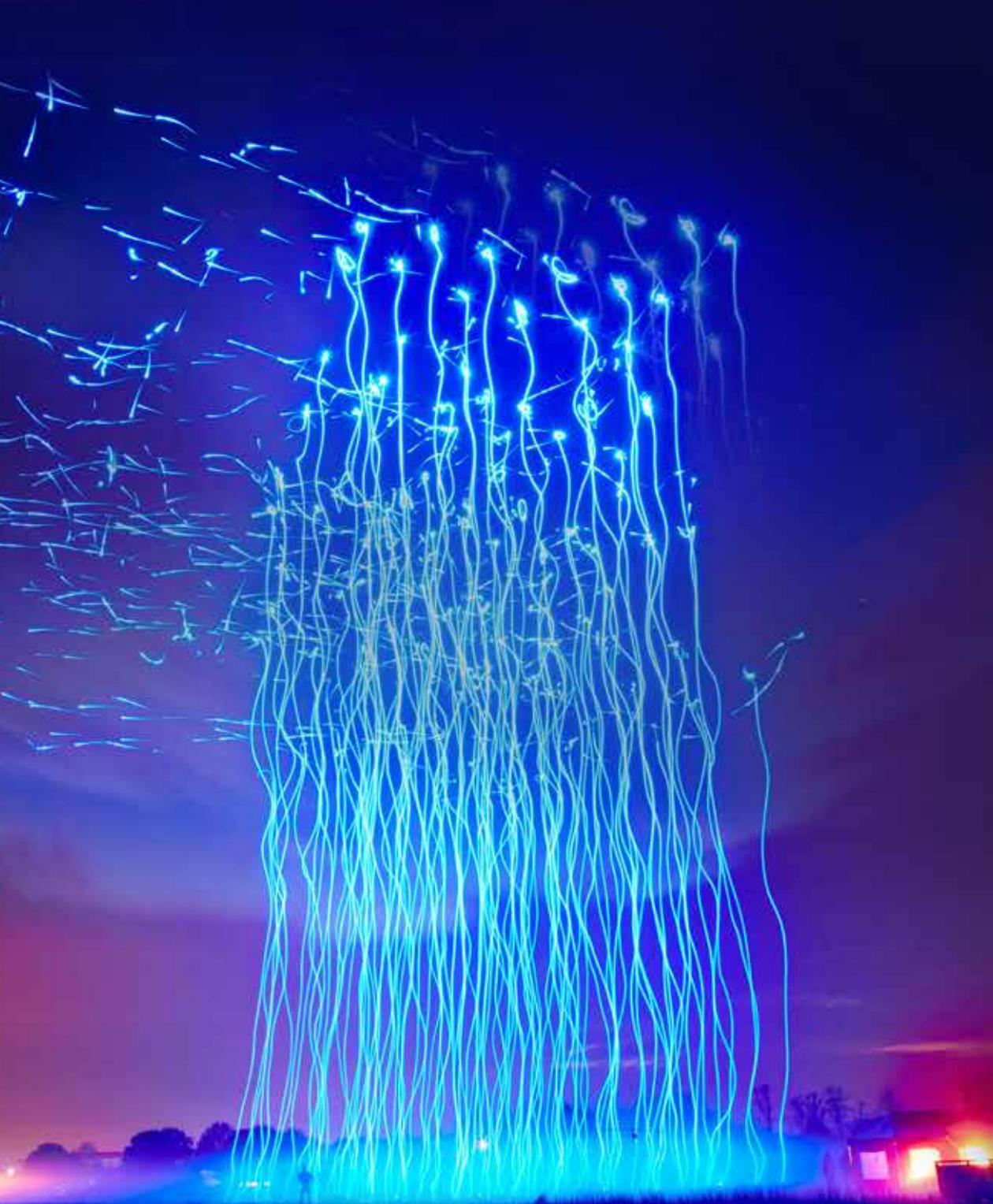
Drone 100 – Intel in collaboration with Ars Electronica Futurelab holds the world record in the category Most Unmanned Aerial Vehicles (UAVs) Airborne Simultaneously. *Photo credit: Intel Corporation*

EVENTS, CONCERTS & PERFORMANCES

Martin Hieslmair

FM Einheit (DE)

מנא מנא תקל ופרסין

Mene, Mene, Tekel, upharsin

Numbered, weighed and found wanting.

Blinded by his unbounded power, Babylonian King Belshazzar hosted a great feast. At the height of the gala celebration, he commanded that the gold and silver vessels stolen from the Jewish Temple be brought forth so the revelers could drink from them in honor of Baal, the god of Babylon.

No sooner were they desecrated than a disembodied hand appeared and wrote the following words in flaming letters on the palace wall: *Mene, Mene, Tekel, upharsin*.

Thus began the downfall of Babylon.

The decommissioned postal service logistics center's spiral packet chutes—custom-made for the facility in the 1980s—invite festivalgoers to decipher the mysterious inscription.

The construction—made to vibrate in its distinctive resonance—sorts materials hidden beneath the skin of their packaging, packets encircling the globe millions of times daily.

And once again we pay homage to the gods of consumption.

The results of this acquisitive frenzy are spewed out by the spiral packet chutes, and festivalgoers can number and weigh them for themselves and perhaps find them wanting.

Sam Auinger (AT/DE)

GLEISHALLE, A Concert Cycle

"Imagine, a space starts to talk to you, but not with words and strings of meaning instead in changing states and moods (by sound), you can sit, lie down or walk in it."

The space is the instrument is the space. Its specific idiosyncrasy, its tonal, vocal and acoustic qualities constitute the object of attention of this concert cycle. A series of concerts of varying duration and staged at different times during the festival's run engenders on site a tonal space that plays with visitors' perception of space and time, and the emotional perceptibility of the space.

The Instrument / The Space

The spatial configuration of the Gleishalle makes it an extraordinary setting for sensory perceptions within the context of everyday experience. This indoor space is a former railroad freight–car loading/unloading dock for the transshipment of letters and parcels. The form and materiality of the architecture follows its function (logistics operations). The space's dimensions—more than 200 meters long, about 50 meters wide, less than 8 meters high—determine two of its fundamental auditory traits: a resonance time of approximately six seconds, and an audible topography.

The Cycle

In music, a cycle is a multi-part composition with a shared context of meaning. The parts normally represent variations on a theme. The Gleishalle with its specific auditory qualities is the theme of this concert cycle. The space's specific quality is primarily the result of its unusual spatial proportions. Here, a sound (acoustic event) fades away in the width and length of the space and not in its height too, as we're familiar with in comparably vast spaces such as cathedrals—for example, St. Mary's (Mariendom) in Linz.

The Composition

The space's extraordinary characteristics with respect to architecture and materiality will be interrelated to a loudspeaker system so as to bring about the development of a compositional language. This will create the possibility of organizing acoustic events in such a way that audience members can partake of various auditory experiences: spatial coloration, spatial density, spatial depth, spatial movements and spatial states, both stable and unstable.

Gerd Thaller

Idea / Concept: Sam Auinger
Composed and performed by: Sam Auinger & Hannes Strobl aka tamtam
Including the compositional element of a tuning tube by: Bruce Odland & Sam Auinger aka O + A
Artistic support: Katrinem and Stefan Weissenberger
Technical support: Thomas Koch and Gerd Thaller

The Big Concert Night 2016

The Big Concert Night is played out according to a most unusual format. Ars Electronica and Linz's Bruckner Orchestra with conductor Dennis Russell Davies (US) have collaborated on this production since 2002. The "Big" in the title is no exaggeration—the program kicks off at 7 pm and usually lasts until well after midnight, and thus takes concertgoers on extraordinary artistic expeditions ranging from classical orchestral music to industrial noise and granular synthesis. Thus Ars Electronica is probably the world's only media art festival with access to the services of a full-fledged orchestra and, what's more, one that's amenable to trying out new things. As always, the program includes world premieres of works by young composers as well as performances of the masterpieces of the 20th-century avant-garde. Orchestral concerts alternate with displays of artistry by digital composers and musicians. Artistic visualizations accompany all the works.

Once again this year, the Train Hall in the former Austrian Post Office logistics facility makes a venue available that is both acoustically and visually spectacular—a superb setting for a diverse assortment of music and sounds. Sam Auinger (AT/DE) has been commissioned to create a cycle of eight spatial concerts especially for the Train Hall and to premiere them together with Hannes Strobl (AT/DE) over the course of the festival (also see page 217). *Raumkonzert #7* is on the Big Concert Night program. Ars Electronica has also commissioned FM Einheit to give a concert performance created especially for POSTCITY's slides, a bank of 32 spiral, almost 15-meter-high chutes that were previously used to sort parcels.

Ma Mère l'Oye by Maurice Ravel and Igor Stravinsky's *Le sacre du printemps* will fill the huge Train Hall with fine sound paintings and monumental orchestrations composed on the cusp of modernism in the early 20th century. Seven jumbo-format projection surfaces, 3D cameras and kinetic elements are being used for the real-time visualizations of these two major orchestral pieces.

The Ars Electronica Futurelab's real-time visualization of *Ma Mère l'Oye* was originally commissioned by the Los Angeles Philharmonic for the Walt Disney Music Hall; conductor Esa-Pekka Salonen (FI) presided over the world premiere in Los Angeles in February 2016. The sequence of projections created especially for the Walt Disney Music Hall is being reconfigured for the Train Hall (also see page 346). The visualization of *Le Sacre du Printemps* is also the work of the Ars Electronica Futurelab. In

Simone Zaunmair (AT)
La Lucha

La Lucha—entre dos hombres celosos y la mujer describes two jealous men fighting over a woman. A fervent, pompous duel in the profuse Mariachi-Macho style—compassionate trombone solos alternate with demanding trumpet passages and powerful orchestral crescendos. Furious, quick and rousing! A story full of passion, pain, pride and melancholy, set amidst Mexico—or wherever it might come to such a clash.

Performed by the Bruckner Orchestra Linz /
Dennis Russell Davies

Maurice Ravel (FR)
Ma Mère l'Oye

Ma Mère l'Oye is a five-piece suite inspired by the works and fairytales of Charles Perrault, Marie-Catherine d'Aulnoy and Jeanne Marie Leprince de Beaumont. The French composer Maurice Ravel originally dedicated *Ma Mère l'Oye (Mother Goose)*, a piano piece for four hands, to Mimi and Jean Godebski, six and seven years old. The piano duet premiered at the first concert of the Société Musicale Indépendante on April 20, 1910. In 1911 Ravel adapted and extended the piano duet to a suite for orchestra. It then was first performed at the Aeolean Hall by the New York Symphony Orchestra on November 8, 1912, and in this form *Ma Mère l'Oye* is most frequently heard.

Performed by the Bruckner Orchestra Linz /
Dennis Russell Davies

addition to projection surfaces that capture the orchestra laterally, kinetic elements and special LED lighting fixtures are being used in order to adapt the spatial, physical effect of the visualization to the very dominant presence of the Train Hall. The real-time visualization conceived by Cori O'lan derives its live parameters from an FFT analysis of the orchestra's intonations and uses them to produce abstract visuals. It also works with actual historical images from the Jesup North Pacific Expedition, which did anthropological field work in far-eastern Russia from 1897 to 1902 to document the peoples living there and their customs. Also serving as the basis of various scenes in the visualization are close-ups of murals in the Villa Poppaea in Torre Annunziata, the home of the Emperor Nero's second wife, which was destroyed by the eruption of Vesuvius in AD 79. The Bruckner Orchestra's brass section kicks off the Big Concert Night with a performance of Simone Zaunmair's (AT) *La Lucha*, a piece that takes good advantage of the Train Hall's architecture both as scenic backdrop and resonating space.

Rendez-vous avec Claude, Marc Reibel's (DE/AT) jazzy homage to Debussy, is being visualized by Akiko Nakayama (JP). Totally in the spirit of the alchemists of our time, she doesn't produce her visuals on the computer but rather by creating a live mixture of colors and fluids under a powerfully enlarging camera. Artistic duo AROTIN & SERGHEI (AT/RU) and pianist Mikhail Rudy (RU/FR) will perform *Light Impulse– Radical Atoms 2016 / Vers la Flamme 1914*, a real-time sound and video animation with a performance of late piano works (Op. 72-74) by Alexander Scriabin. Sound artist and composer AGF (Antye Greie-Ripatti) (DE/FI) will contribute a site-specific performance to the program.

The 2016 Big Concert Night lineup:
· Sam Auinger and Hanns Strobl aka tamtam (AT/DE)
· FM Einheit (DE)
· Bruckner Orchestra Linz (AT) conducted by Dennis Russell Davies (US) performing compositions by Simone Zaunmair (AT), Marc Reibel (DE/AT), Maurice Ravel (FR) and Igor Stravinsky (RU/FR/US)
· AGF (Antye Greie-Ripatti) (DE/FI)
· AROTIN & SERGHEI (AT/RU)
· Mikhail Rudy (RU/FR) performing Alexander Scriabin
· Akiko Nakayama (JP)
· The Ars Electronica Futurelab (AT)
· Cori O'lan (AT)

Tom Mesic

Roland Aigner

Igor Stravinsky (RU/FR/US)
Le Sacre du Printemps

Le Sacre du Printemps (The Rite of Spring) was composed by Igor Stravinsky in 1913. The main theme is suggested by its subtitle, *Pictures of Pagan Russia in Two Parts*: to please the god of spring a young girl is chosen as a sacrificial victim and dances herself to death. *Le Sacre du Printemps* was written for the 1913 Paris season of Sergei Diaghilev's Ballets Russes company with an original choreography by Vaslav Nijinsky. Despite nowadays being one of the best-known orchestra pieces of all time, at the time its premiere at the Théâtre des Champs-Élysées caused a scandal. The sharp dissonances and peculiar rhythms of Stravinsky's piece were not what the listeners expected. Only later reception saw *Le Sacre du Printemps* as the visionary and highly influential masterpiece that it is.

Performed by the Bruckner Orchestra Linz /
Dennis Russell Davies

Marc Reibel (DE/AT)

Rendez-vous avec Claude

My composition took shape 20 years ago, written under the powerful influence of Wolfgang Dauner, to whom it is dedicated. It combines a single theme in the style of Claude Debussy with elements from the jazz, rock and funk genres. Over the course of what is tantamount to a musical journey with Claude through the 1970s and '80s, the theme is constantly cast in a new light. Embedded in between are improvised instrumental solos that are additionally enriched by the personality of the respective musicians performing them.

Performed by the Bruckner Orchestra Linz /
Dennis Russell Davies

AROTIN & SERGHEI (AT/RU), Mikhail Rudy (RU/FR)

Light Impulse–Radical Atoms 2016 / Vers la Flamme 1914
Real-time sound and video animation with a performance of late piano works Op. 72-74 by Alexander Scriabin.

Light Impulse is based on the radical innovative concept of the composer Alexander Scriabin (1872-1915), creator of a light notation system for a fictitious "Light Piano" and inventor of a "synthetic mystic hexachord" origin of all possible sounds. Together with Mikhail Rudy, a pianist and specialist in Scriabin's oeuvre and Russian avant-gardes, AROTIN & SERGHEI bring this vision to the future, showing the visual impulses and transmutation of radiant atomized sounds and light particles in the subliminal cell structures of "Infinite Screen".

In cooperation with the Museum in Progress, Klangforum Wien, Wiener Konzerthaus, Ars Electronica, Biennale di Venezia, Fondation Beyeler Basel and the Kunsthistorisches Museum Vienna. Installation and Performance: AROTIN & SERGHEI; Piano: Mikhail Rudy
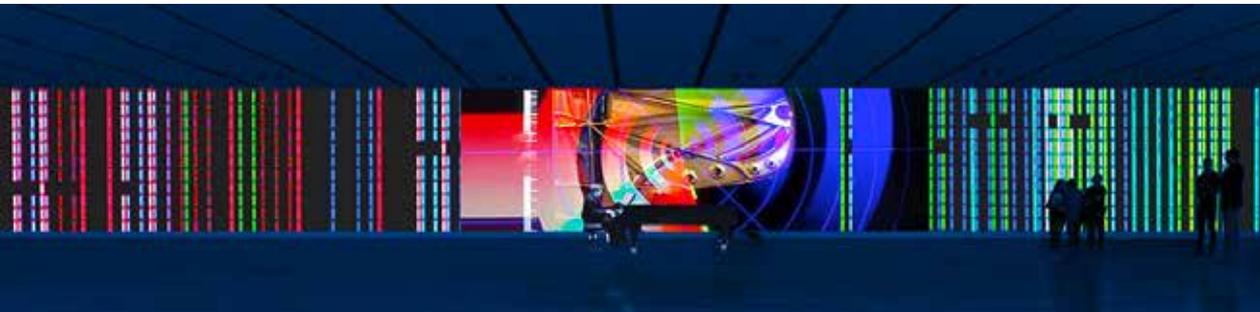
Pao-Chang Tsai (TW)
Solo Date

At the earliest stage of its creation, *Solo Date* asks: how do you live without someone you love? This solo performance is set in the near future and explores the interaction between human beings and artificial intelligence.

Unlike most cross-sector collaboration, where technology is merely applied for aesthetic purposes, *Solo Date* makes technology an active character and an integral component of this work.

Throughout history, people have turned to science when religion fails to offer answers, and vice-versa. *Solo Date* raises philosophical questions about human emotion, existence and solitude. As we move towards the era of AI, *Solo Date* raises important issues that redefine the relationship between human and machine. Like a guinea pig under observation, the performer is enclosed in a modern, transparent, LED-lit cube centered on a proscenium stage, which is enveloped in black scrims. The audience will be taken on a journey in search of a past romance through ancient eastern ritual and artificial intelligence.

http://qaring.tw/solodatedoc

You-Wei Chen

Sparkasse OÖ Klangwolke 2016

50th Anniversary of JKU–River of Knowledge

by Salvatore Vanasco

"Only what we dream is what we truly are, because all the rest, having been realized, belongs to the world and to everyone."
Fernando Pessoa

Linz's Johannes Kepler University, which is celebrating its 50th anniversary this year, provides the theme for the 2016 Linzer Klangwolke. *River of Knowledge* treats the importance of education and the social significance of lifelong learning. Current and historical events will be depicted as imposing scenic images on the Danube and aloft above Donaupark along its south bank, and thus span a dramatic arc from the past to the future. Spectators will be able to experience and feel technological developments the likes of which manifest themselves on a daily basis at JKU. The aim is to show how universities can nurture society, and what impact the visions of science have on our lives.

The *River of Knowledge* is also meant to register current feelings and moods—nothing less than society's emotional state—and express in terms of tonal colors social and individual everyday life in which people see themselves as being increasingly confronted by fundamental changes. These raise big questions as to our identity, our sense of self and our relations with strangers, how we deal with one another, and how and what we want to learn. These are questions having to do with the complex structures and interrelationships that make up our world and are now summoning us to go forth into the unknown, into strange, uncharted territory. In plural societies, education opens up a broad horizon of possibilities. Measures to prepare for this open horizon are already being taken by the university, whose mission is to endow students with the capacity to make decisions in accordance with their own interests while always remaining cognizant of the fact that the recognition of others constitutes a precondition for the possibility of fully realizing ones own possibilities.

Artists: Michael Saup, Rica Blunk, Salvatore Vanasco, F.M.Einheit, Uwe Buhrdorf, Stephanie Geiger, Claudius Brodmann, Björn Herrmann, Georg Bochow, Cornelia Wunderlich, Jens Berte, Madeleine Dewald, Oliver Lammert, Christian Czech et al.

In cooperation with Brucknerhaus Linz, LIVA, Johannes Kepler University Linz, Sparkasse Oberösterreich, Meinhard Lukas, Hajo Frey, Ralph Fischer / BUKS, Sevim Belli, Laszlo Puskas, xailabs Gmbh, Die Wellenmaschine Gmbh and Pyrovision

Magdalena Leitner
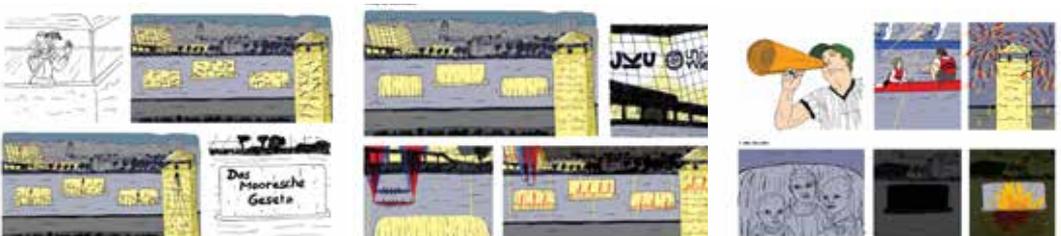
University of Arts Linz (AT), Michael Fakesch (DE) and Chris De Luca (DE)

Funkstörung & Lightstorm

Lightstorm—two meters high, three meters in diameter, and spinning at 35 kph—is an oversized, rotating tube with LED strips embedded all around the outside. While the cylinder is in motion, the installation visitors' visual faculties interpret the rapidly blinking LEDs as a drawing in midair. Impressions of pulsating images in space occur on the retina.

The artists mean *Lightstorm* to symbolize the individual amid the maelstrom of big-city life. The 21st-century cityscape is characterized by the proliferation of light sources. The pervasive illumination engulfs people; it suffuses them and their lives; its pulses impart the beat to their personal rhythm. The individual is trapped within a tornado of sensory overload and has to go with the rhythm of the city lights to avoid drowning in them.

Funkstörung is an electronic music project founded by Michael Fakesch and Chris De Luca in 1994. They have now teamed up with the creators of the *Lightstorm* project to create a unique audiovisual performance.

Credits: *Lightstorm*: Katharina Gruber, Laurin Döpfner, Gregor Woschitz, University of Arts Linz, Time-Based and Interactive Media Course
Funkstörung: Michael Fakesch and Chris De Luca

SILK Fluegge (AT)

MYGRATION–beget

Migration as a form of multiple affiliation to and identification with life cannot be reduced to a transcultural identity problem. Rather, in a virtual age there is an emergence of complex (dis)information networks, which extend from the virtual into real space and vice versa. The performance piece *MYGRATION–beget* involves a corporeal dispute on this topic: the body and the soul, which remains in generations throughout its existence and which influences, departs from and invests itself into people's identities and which repeatedly pours itself into new forms. *beget* is the first part of the *MYGRA-TION* series by SILK Fluegge, which examines the heritage and the aim of places to compress information that needs to be organized in order to create a feeling of security. The fanned out construct of the heritage of four personalities is condensed into a performance using parachute silk to build a pictorial form of the haptic perception of the here and now, which creates a tension between blind flight and down-to-earthness. The venue is a railway station platform: the arrivals and departures; the lingering in the waiting room. It is the snapshot of a thousand possible strings converging by chance that creates a person, their reactions, decisions and the ways in which they act.

Concept and choreography: Silke Grabinger; Production management and choreographic assistant: Olga Swietlicka; Dramaturgical advisor: Angela Vadori; Light design/ video projection: Peter Thalhamer; Costumes: Bianca Fladerer; Video: Magdalena Schlesinger
Dance and performance: Veronika Cimborova, Gergely Dudas, Boglarka Heim, Matej Kubuš

Patrick Proier

Playful Interactive Environments (AT)

PIEdeck

PIEdeck is an experimental interactive installation created for playful activities with multiple participants. Developed by the research group Playful Interactive Environments (PIE), it consists of a laser-tracking system, a public display and mobile virtual reality headsets.

PIEdeck serves as an experimental environment to explore novel game concepts and other forms of co-located interaction in a hybrid-reality context, combining real physical movement with virtual content in a large-scale setting. The *PIEdeck* proto-type allows virtual reality (VR) participants to walk through an immersive, abstract audiovisual world and interact with the environment. Passers-by also leave their own mark on the virtual world, creating traces that are visible to VR users and on the public display.

Credits: Playful Interactive Environments, University of Applied Sciences Upper Austria; Team: Georgi Kostov, Andrea Aschauer, Philip Sonnleitner, Jürgen Hagler, Jeremiah Diephuis, Michael Lankes

ZoopTEK (US)

Knight Light

Knight Light is ZoopTEK's vision for the next generation of e-sports, as an immersive live gaming event. In an abstract futuristic arena heavily inspired by Roman gladiator contests, it combines the skill of sword-wielding avatars and the chaos of animal-themed minions with the influence of the crowd. Players choose to play the game in the way that suits them best. Avatars are played by those who crave the thick of battle, using traditional first-person shooter controls. Summoners are played by more strategic players, unleashing the right minion at the right time by using their mobile device. Last but not least, spectators may sway the tide of battle by providing various bonuses to their favored team by playing quick mobile games. The experience is all tied together by live music synchronized to the events unfolding on the big screen, with an announcer calling the shots.

ZoopTEK LLC, Chicago: Alan C. Reck (president, lecturer MA course in Music for Applied Media, Danube University Krems); Rishu Mandolia (CEO); Miguel Kertsman (composer, director MA courses, Center for Contemporary Music, Danube University Krems); Jonathan Mazur (artist); Andy Urquiaga (designer); Ernie Adams (drummer, University Faculty)
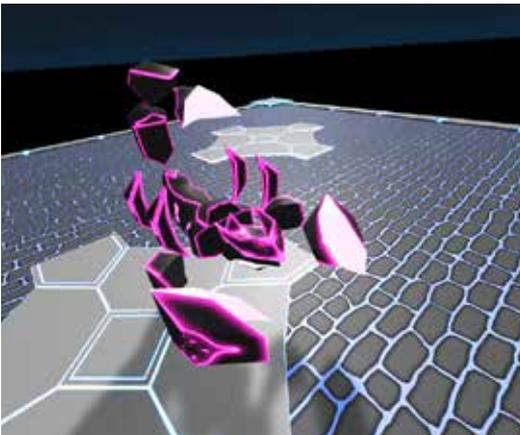
Navid Navab (CA)

Practices of Everyday Life | Cooking
Culinary concert for chef and enchanted kitchenette

A culinary concert orchestrated around a chef, an enchanted kitchenette and sonified ingredients. As the chef prepares a meal, sections emerge from culinary tasks to form multisensory tableaus. Each tableau is a unique gestural sound composition undertaking phenomenological reconsideration of notions such as instrument, performer, computation, and the musical event as a whole. Interactive instruments carefully embedded into the scenography symbolically charge everyday actions and objects in ways that combine the composer's design with the performer's contingent nuance. Within the enchanted kitchenette, gestures mimicking sonic affordances and audiovisual events shaped under gestural contours feed back one into the other, breaking dualities such as analog-digital, performer-performed, instrument-score, or intention-noise. The act of performing music then emerges freely from open engagement with matter, borrowing elements from "play", day to day living, and the movement arts.

http://www.practicesofeverydaylife.com

The 19th Japan Media Arts Festival

Ukawa Naohiro (JP)

DOMMUNE

Social Media Project
Art Division Jury Recommended Work

A multi-talented artist Ukawa Naohiro founded the live streaming channel *DOMMUNE* on March 1, 2010. "Commune and the next step" is the motto. With *The Final Media DOMMUNE* he has created something like a commune in the digital age. As a mixture of live talk show and club night, *DOMMUNE* has been broadcast via livestream from a little studio in Shibuya, Tokyo on weeknights from 19:00 to 24:00 since March 2010. The studio, with attached bar and dance floor, accommodates a maximum of 50 people; at the same time, an infinite number of other guests around the world can join the event from their homes, in trains and even from behind their desks via the website *http://www.dommune. com*. With the microblogging site Twitter, remote viewers can send in their thoughts and comments live. It is an interactive project where people at different places share in a party with the same music at the same time.

http://www.dommune.com

Credit: Ukawa Naohiro (MOM/N/DAD Productions)

Ars Electronica Opening

Numbered, Weighed and Found Wanting—the packet chutes left over from the former postal service logistics facility invite festivalgoers to reinterpret an ancient biblical warning: *Mene, Mene, Tekel, upharsin*. Sound artist FM Einheit (DE) will impart energy to these spiral constructions to bring out their characteristic resonation and sort out the materials that otherwise remain secreted within their respective packaging. Meanwhile, a pendulum installed among the chutes keeps the beat ...

In *Practices of Everyday Life | Cooking,* festivalgoers will then imbibe a synaesthetic performance about a cook and an enchanted kitchen that artist Navid Navab (CA), gesturally invoking spatial sounds and picturesque visualizations, embeds in a virtuoso scenography.

The *Kankisenthisizer* is an instrument that uses fans to generate both sounds and light. In this performance, Ei Wada (JP) demonstrates the unconventional musical production possibilities offered by the device he came up with. In *Roboactive (n) A1 K1*, the artist Dragan Illic (SRU/US) has himself strapped to a robot arm and creates graphic compositions while on the move. This performance is said to be an example of post-media practice combining drawing, movement, sound and video.

Solo Date by Pao-Chang Tsai (TW) scrutinizes the relationship between human emotion and artificial intelligence, and a dance performance entitled *MYGRATION—beget* by an artists' collective named SILK Fluegge (AT) deals with origins, affiliation, identity and other relevant topics.

Florian Voggeneder

Tom Mesic

Impressions Ars Electronica Opening 2015

Ars Electronica Nightline

Among music-loving night owls, Nightline is an annual highlight of the Ars Electronica Festival program. POSTCITY, the site of the opening event on Thursday, hosts this late Friday lineup of electronics and performances.

Force Field by Evelina Domnitch (BY) and Dmitry Gelfand (RU) is a sound performance that harnesses sonic pressure to make water droplets float. Next up is the audiovisual artist Jerobeam Fenderson (AT) and the duo Pulsinger & Irl (AT).

Lightstorm, a walk-through LED installation by Linz Art University (AT) students Katharina Gruber, Laurin Döpfner and Gregor Woschitz, creates an extraordinary audiovisual experience together with the electronic music pioneers Funkstörung (DE). Finally, *Print a Drink*, a project by Benjamin Greimel (AT), features an innovative 3D printing process that serves up drinkable "cocktails" in which various forms float as if by magic. At the OK Night on Saturday, the OK Deck will serve as the stage for the musicians attending the Modular Music Days taking place during the festival at the OK Center for Contemporary Art. Here, the spotlight is on the modular synthesizer scene and the technology that powers it.

Florian Voggeneder

Impressions Ars Electronica Nightline 2015

Stadtwerkstatt (AT)

STWST48x2

Following *STWST48* in 2015, Stadtwerkstatt, the nerve center of Linz's free/open culture, hosts *STWST48x2*, 48 hours of non-stop happenings along the Danube. The programs for *STWST48x2* aim to showcase many of Stadtwerkstatt's cultural initiatives, including the information lab, the Eleonore artist residency, radio FRO, Café Strom and STWST club.

The information lab takes up "the nature of information" as a matter of inquiry, investigating the interplay between reality and information, with installations by Taro *the mushroom project*, KARKATAG *rehearsal*, Franz Xaver *Inform the Water*, Tanja Brandmayr *f.o.g. Ballett* and Pamela Neuwirth *Purple Haze*. The Vienna-based Technopolitics is invited to present its *Tracing Information Society—a Timeline*.

Since 2009, the Messschiff Eleonore radio station has gathered local and international temporary residents for meetings, debates, research and lab works. This summer, the Eleonore residency *RADIO ACTIVE—SINK and SWIM* pays homage to radioart pioneer Tetsuo Kogawa and brings together nine radio broadcast projects—Xavier Faltot *La Chambre à Air*, Elaine W.Ho & Ming Lin *Widow Radio Ching*, Eva Ursprung *courtship sound of piranha*, Sarah Grant & Danja Vasiliev *QFM*, Rasa Smite & Raitis Smits *Pond Radio*, Nicolas Montgermont *Axis Mvndi*, Magmadam *Prototipa*, Enrique Tomas *SDR Music*, and Ryan Jordan *Currents Below The System*.

Other programs include freq:club, with oscillating frequencies that suspend the night till daybreak; Radio FRO's 105.0 MHz broadcast and Café Strom holding court. With a special radio jam session in collaboration with the MS Stubnitz in Hamburg, *STWST48x2* launches Eleonore's Beacon radio project, *7067 khz—it's not a test*, calling for a daily radio signal broadcast on 7067 khz from the earthbound inhabitants.
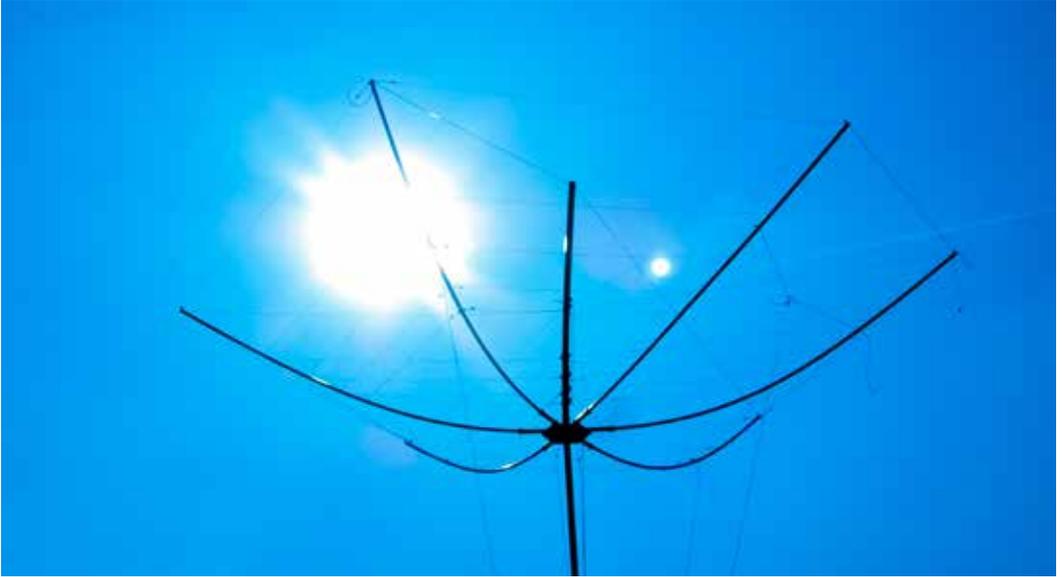
Eleonore

The Mobile Ö1 Atelier

Through the intense cooperation with Ars Electronica *The Mobile Ö1 Atelier* staged by Austria's cultural public radio station has been a festival fixture for many years now. It has become an important living art space and comfortable lounge, so this year, 2016, *The Mobile Ö1 Atelier* is located at the entrance to the festival's main quarter, POSTCITY.

In 2016 *The Ö1 Mobile Atelier* is once again designed by *pneumocell*, by the Vienna-based architect Thomas Herzig (AT). *pneumocell* is an assembly kit consisting of inflatable building elements which can be quickly connected in numerous combinations to form complete constructions. Facing the bright, semi-transparent pavilion reminiscent of biological cell structures.

On the inside *The Mobile Ö1 Atelier* is both an information point and a project exhibition venue throughout the festival. An acoustic project can be experienced in *The Mobile Ö1 Atelier*: *Expansion of the Universe* by composer Rudolf Wakolbinger (AT). By converting scientific data into music, Wakolbinger

Katharina Edlmair

acoustically illustrates the history of the universe. The composition's duration of 13.8 minutes reflects the 13.8 billion years from the Big Bang until now. The corresponding sound-installation for *Expansion of the Universe* is built as a maker project using 216 loudspeakers.

http://oe1.ORF.at/mobilesatelier
http://www.expansionoftheuniverse.net/
http://www.pneumocell.com/

The Mobile Ö1 Atelier is produced jointly by Radio Österreich 1 and Ars Electronica 2016.

Tom Mesic

Rudolf Wakolbinger (AT)

Expansion of the Universe

In his opus *Expansion of the Universe* composer Rudolf Wakolbinger illustrates the history of the universe acoustically.

The relation between mathematics and music has fascinated the composer since his studies in Vienna. In particular, he focused on converting light frequencies (colors) into pitch levels. In *Expansion of the Universe*, Rudolf Wakolbinger used microwave recordings collected by the US space agency NASA, where different colors represent the electromagnetic radiation corresponding to the formation of planets and galaxies. Rudolf Wakolbinger converts these colors into perceptible sounds, which serves as the composition's formal framework.

Artist: Rudolf Wakolbinger; Coordination: Martin Schlögl/ LIQUIDCENTER (AT); Technical concept and implementation: Anton Bachmayr & Martin Bachmayr/NETZTEIL (AT); Developing: Nicole Scheiber, Peter Schlögl, Stefan Schlögl, Stefanie Schlögl; Supporter: ARTEX Museum Services, Ministry for Europe Integration and Foreign Affairs

http://www.expansionoftheuniverse.net

Andreas Pikal
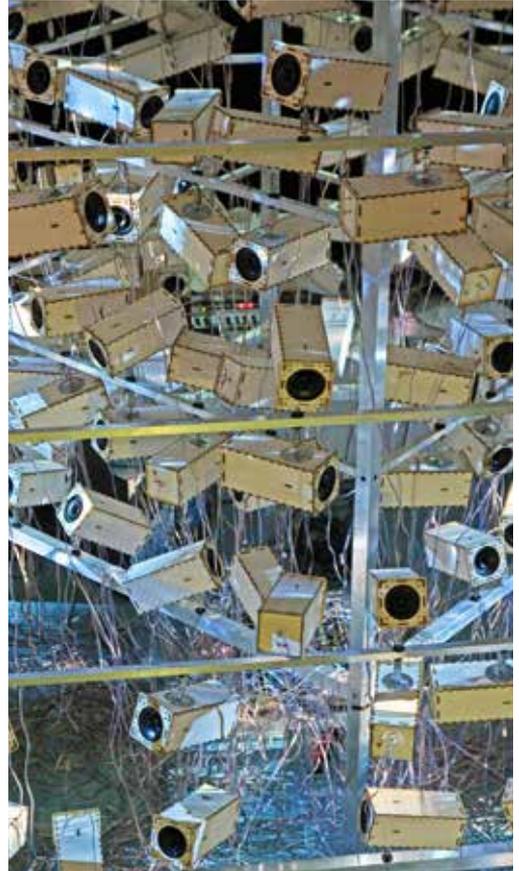
Stefan Schlögl

Volkmar Klien (AT)

Music and Media Art / Music as Media Art

Symposium and Concerts at Anton Bruckner Private University, the Ars Electronica Festival's Newest Partner

In October 2015, Anton Bruckner Private University (ABPU) moved to its new campus at the foot of Pöstlingberg overlooking Linz. These impressive premises are equipped with state-of-the-art media technology and infrastructure superbly suited to the production and presentation of electronic music. The university simultaneously initiated a new program of study in computer music and media composition, and appointed Volkmar Klien as professor in charge of it.

This restart—based on a long tradition of electronic music at ABPU—delivered the impetus to expand the extent of the school's collaboration with the Festival Ars Electronica and strive to make this an intensive long-term relationship.

The declared aim is to provide a new primary venue for projects in musical and sound art genres staged in conjunction with the Ars Electronica Festival, and to take full advantage of the university's Computer Music Studios (CMS) that offer perfect acoustic conditions for the presentation of music and sound art as well as possibilities to engage in substantive analytical discussions of them. Accordingly, there will be concerts (curated by Volkmar Klien, Se-Lien Chuang and Andreas Weixler) staged in the Sonic Lab and other halls in that building, which will also serve, within the framework of a symposium, as the setting for an intensive exchange of views and experiences among festivalgoers and specially invited guests representing various approaches to musical

theory and practice. Plus, the Music Monday series already successfully established at ABPU by Werner Jauk will be offering an overview of and detailed insights into the works of sound art presented at the Festival.

In this collaboration between a conservatory and the Ars Electronica Festival, it is essential to bear in mind that—throughout the many millennia that preceded the contemporary technical possibilities of digital production and distribution—music has always been a highly efficacious form of social media. Since time immemorial, music has been an interactive, participative communications technique used by people in society. Obviously, the invention of musical notation, the printing of sheet music, audio recording and processing, etc. have added many new options to partake of music-making ensembles (e.g. via headphones and streaming services); nevertheless, it is beneficial and worthwhile to never lose sight of the fact that not only the music that is defined as "electronic" or "computer music" makes fundamental references to the issues that are elaborated on in the context of electronic & media art.

Electronic forms of music constitute the most obvious nexus of possible collaboration among musicians and media artists. Nevertheless, such exchanges are interesting not only for computer music and media art; they are also relevant to genres far beyond those that would initially seem

Simon Bauer

to constitute the core zone. In a world in which it seems that even a concrete composition is accepted as such only in the form of a sufficiently derivative simulacrum of an original (Filter Preset No.7 "vintage wholesome"), exchange among artists across the media practice spectrum is of decisive importance. After all, computer music as well as art that deals with networks and robots have more things in common with choral music (which, after all, has also always been a communal creation of virtual worlds) than things that set them apart, and it is especially the process of artistic exchange on emerging differences that brings out ideas worthy of consideration. In recent decades, electronic & computer music has often dealt primarily with the expansion of tonal possibilities of expression, and in this respect there definitely are certain parallels to so-called art music.

In computer music, this has frequently manifested itself as the attempt to heighten potential complexity. Today, any cell phone makes available more computational capacity than the largest research & media centers for electronic music did 25 years ago. At a time in which everyone who acquires such a cell phone also receives, at no additional charge, a confrontation with complexity to a fundamentally unmanageable extent (and without the inclusion of an option to avoid such an encounter), it is tantamount to a foregone conclusion that the primary motive for holding a symposium at which musicians and artists have their say on the subject of the computer as a means of production can no longer be to acquire information about algorithms to produce ever finer, "more complex" tonal structures. Accordingly, the objective of the events hosted by ABPU in

conjunction with the Festival Ars Electronica will not be to furnish a setting for coteries of specialists to discuss the latest trends in the technical feasibility of digital sound production, but rather to stage concerts and talks that are takes on issues raised by the changing roles and functions of music in a world that is increasingly pervaded by technology and, as a result, is becoming progressively more standardized.

The symposium kicks off this year by focusing on *Sound Arts & Music—Music & Sound Arts* and thus on the curious relationship between these two forms of artistic dealings with the auditory world. Although both art forms seem at first glance to have to do with associated areas and certainly do make use of the same medial techniques in doing so, they are nevertheless embedded in highly dissimilar contexts—namely, those of music and the visual arts, each with its own particular traditions of presentation, distribution, curation and theory formation. And it is precisely the unique, individual position that this relationship assumes which enables it to provide the ideal theme for the first Ars Electronica Symposium at the ABPU in its role as interface between music and other media arts.

Christian Herzenberger

Christian Herzenberger

Andreas Weixler (AT)

CMS and Sonic Lab

The Sonic Lab is a multimedia computer music concert hall equipped with a periphonic loudspeaker system. It was set up for the University of Linz from 2005 to 2015 by Andreas Weixler in cooperation with the CMS computer music studio. In it, the audience is situated in an acoustic dome consisting of 20 full-range loudspeakers with four subwoofers for the base tones. The movement of the sounds is unimpeded both horizontally and vertically. CMS studios are set up to be compatible with each other and with the computer music concert hall. A double projection in the Sonic Lab enables it to serve as a performance venue for audiovisual works as well as to host conferences and symposia. Among the CMS's fortés are interactive audio-visual performances, jazz and improvised music (and especially percussive and electro-acoustically amplified sounds), contemporary compositions, musical theater and media art. Not least of all due to its strong pedagogical orientation, the Sonic Lab is indeed a setting for the music of the future.

The teaching studio, the production studio and the Sonic Lab are all equipped with compatible multi-channel systems based on a Digidesign C24 DAW controller and a 32-channel ProTools system that can perform digital mixing, playback and recording in multi-channel modes. The entire university building is set up with MADI hookups (digital interfaces to multichannel audio transmissions) that make it possible to interconnect the computer music studios, the sound studios, the Sonic Lab and other spaces via multichannel links. The Sonic Lab is a concert, production and teaching facility equipped with very sophisticated audio & acoustic technology. There's a circular configuration of 8 Genelecs and 4 Genelec 7070 sub-woofers, one on each wall. Twelve more speakers complete the acoustic dome arranged in three quadraphonic layers: 4 Genelec 8040As at a height of 3 meters; 4 Genelec 8040A ceiling speakers at a height of 5½ meters; and 4 KS Audio CPD 12M standing on the floor. For front-of-house applications, there's a high-end PA system: 2 Kling & Freitag CA1215-9SPs, 2 Kling & Freitag SW 115-E SPs, 4 KS Audio CPD 12M monitors, an analog 24-channel Soundcraft GB 4 mixing console and a digital Yamaha 01V mixing console. A shared infrastructure control room and a director's window connecting the Sonic Lab and the production studio make this facility suitable for big-time productions.

Thomas Gardner (UK)

Sound Art & Music–Music & Sound Art
Remarks on a Special Relationship

Sound art and music evolve in a shared world and the joint navigation of this common terrain would allow artists, curators, theorists and participants (listeners) to take new creative approaches. The current fervent debate concerning their togetherness or separation has many facets. Some of these, as suggested by my colleague Salomé Voegelin,[1] include the politics of their disciplinary boundaries and the aesthetic expectations which fund and label them, as well as the ideological and practical specifics of their transgressions, creating both fissures and forms of continuation. The post-postmodern world no longer seems to require hard boundaries between any discipline, which makes the fact of their on-going institutional ratification all the more bizarre: hinting at greater ideological, social and cultural separations of which sound art and music are but symptoms, but which their joint discussion might well help reveal and debate.

This brief introduction offers some thoughts about what identities are at stake within these moving boundaries, and why they matter.

Sound art, whether it warrants such a name or not, gives rise to the possibility of hearing and noticing what may otherwise remain unheard, or has been unacknowledged or excluded, and entails an investigation into the processes through which something becomes audible.

The site of sound arts practice is thus at the margins, at the border with the visual, the linguistic, the environmental and the social. The activity of listening does not, in principle, discriminate against or exclude any sound, our ears do not have lids, although nor does sound art have any prescribed method through which the inaudible becomes audible. Rather it performs a kind of critical borrowing of practices which both engage with and resist other disciplines. For example, against a background culture in which the visual is dominant, sound art offers a resistance to the self-certainty of seeing and to the apparently clear demarcation between object and subject that the visual can give rise to.

Sound art is in a very special position, both because it is a subject which gains strength from its work at the margins of many disciplines, but also because it is at risk of being marginalized for the very same reason: it may not thrive in relationship to a single disciplinary hierarchy. For example, some of the areas to which our practice has been specifically linked are: performance, writing, fine art, improvisation, radio, photography, environmental recording, installations, software, instrument design, and the moving image.

The relationship with music is particularly complex, since the risk of being overwhelmed or judged by musical ways of hearing presents an almost existential risk to these looser and plural liaisons formed through sound.

Certainly, it was a comprehensible need amongst early sound-arts practitioners to attempt a differentiation and distancing from musical sensibility and listening habits. For example, the idea of listening to a soundscape as if it were a tune or song presents an unacceptable mixing of categories, which at some level betrays the intentions of listening. The purging or letting go of these musical thoughts needed to be possible. This might, in some instances, happen by becoming conscious of musical tropes and thought habits, and letting them go when they enter our minds: hearing something getting louder as a "crescendo" is a mental structuring that may inadvertently pop into our heads even when the increase is non-intentional, and brings with it a history of musical crescendos, Baroque echo effects or a Wagnerian heroic immolation, which need to be let go.

However, the need to establish this kind of protective distance between sound art and music has lost

Matthias Seyfert

Michael Hierner

its initial raison d'être, and a more fluid engagement in the depths of this difference is now becoming possible. The term "inclusive disjunction" is gratefully borrowed from Allen S. Weiss and is used here to indicate the situation in which sound art and music can occur simultaneously, together, but that it remains possible to distinguish between their operations. How close this inclusivity is, and how likely the identity of the protagonists is to destabilize each other, however, is still very much at issue. Each of us will have very particular experiences of how this is worked out within our own histories and disciplinary skills. For me, the current issues concern mimesis and musical measurement.

Mimesis refers not only to the processes of representation of the material world (everyday sounds, environmental sounds, animal sounds) but also the mimetic entrainment that happens between people and is an immediate part of sociality of musical experience. Thus how one should distinguish between these two "kinds" of mimesis seems important, both from a music and sound-arts point of view, and from a social and environmental one.

The same holds true for the questions of musical measurement, in which the incommensurable differences between hierarchy and equality present themselves. While the overtone series embodies a hierarchical experience of space, and metronomic time suggests an equality between different moments, the reverse is also true: measures of equality exist within pitch (i.e. does an augmented 4th divide an octave in two equal parts?) and other hierarchic measures exist for time (for a one-year-old their first year is their entirety, whilst for a 40-year-old it is only a fortieth)

Specific musical practices inhabit and exploit these paradoxical incompatibilities and offer a more than mathematical interpolation. They are, none the less, culturally specific (maquam, claves, raga, equal-temperament) ways of working. If generalizable, they would be like some kind of universal justice, which they are not. The translation between this musical politics of hierarchy and equality and actual politics thus represents a powerful incision between the hermetic space of "musical measurement" and an active political engagement with the world. It seems to me that the relation between sound art and music is not an esoteric concern, but offers ways of thinking about some of the intractable problems around us. Musical measurement provides ways of engaging with and exploring the politics of hierarchy and equality, whilst mimesis explores the parity and interchange between human sociality and environmental context. Both of these are central to the relationship between sound art and music, and central to the world that we live in.

1 In a joint editorial introducing a special issue of the journal *Organised Sound*: Thomas Gardner and Salomé Voegelin, "Editorial: Historical continuum, mimetic fissures." *Organised Sound*, vol. 20 (Special Issue 02, 2015), p. 141–147. http://doi.org/10.1017/S1355771815000023

Werner Jauk (AT)

Music, making music & sound installation– the media is the difference

Theories of the origin of music, which draw on studies in the field of anthropology as well as evolutionary psychology and combine them with media theory, assume that music is the cultural transmutation of emotional sounds/behavior. This is the physical reaction to the perception of a situation, which results in a bodily state of excitation, which leads to sound produced by the body itself through breathing and the vocal cords, accompanied by the instrumentation of the correlating physical movements, manifested as mediatized sound.

Sound is thus an artifact of movement in an environment, which provides information to a perceiving body and thereby induces within it a state of excitation depending on the meaning of the movement to the body, which in turn leads to the production of more sound and therefore the communication of the importance of this movement to others. Both of these processes are adaptations that serve survival. Expressed through sound gestures (cf. Clynes 1980; Carmiaux, 2011; Godoy 2006; Jauk 2014; Piana 2012; Volpe 2010), sound is a vital medium of information and communication that uses movement in space to convey information and thus collectivize sensing bodies (Jauk 2014).

Music is a formalization of the imagination of physical movement and of human excitation through sound, as well as the resulting generation of sound with its communicative function. Melodic movements are perceived spatially and are projected by notation onto a single plane; excitation serves the production of sounds varying in "sharpness", it is caused by its perception and mediatized in the time- and frequency-domain of the melody contour by being noted down and pre-scribing generation of sound (Jauk 2014). The communication of excitation

occurs as a chorus of voices, and polyphony is deemed the objectification of the "we" (Adorno 1947).

With the development of media for the storage of sound, its basic functional aspects faded into the background and the idea was ultimately established of music as a work of purely relational conceptualization, as opposed to animated music-making based on the excitation and communication properties of sound. Sound relations are no longer sensed as excitation currents but thought of as relations of time and intervals. Notation brought about this aesthetic turn, made possible by a media turn: notation is a product of the mediatization of auditory perception. In the form of a sound gesture, this perception is the concentrated expression of the imagination of sound movement and its significance as bodily stimulus, an instructive cue from the choral conductor since the Late Middle Ages, as well as the projection of such a cue in writing in the iconic neumes, the first notation pre-scribing human sound as musical production. The arrangement of time and frequency into grids led to discrete notation. Composition theories liberated them from the naturalness of the sound gesture and made them into a medium for the intentional forming of compositions. Notation brings about the turn from the immediate physical communication of movement to the media composition of imaginary relationships in the movements. This code system enables the composition of communicative sensations of movement in a musical work (Jauk 2013).

In returning these performatively defined and understood aesthetics of sonority to their origins, the functional elements of sound come to life: high tones are perceived as small in "volume" and high in "density", low tones as large in "volume" and low

in "density". As a "conceptual metaphor" (Lakoff 1993) for the general experience of gravity, different tones are understood as being "above" or "below" each other in terms of their perception, and recorded as notation accordingly. A similar effect can be observed in thematic work, which ultimately can be thought to have emerged from embodiments of the physical (under)scoring that goes hand in hand with emotional (under)scoring: small "figures" are addressed by the rapid movements of high sounds etc.

It is therefore the autonomy of notation as a medium for transcribing sound that has led to thinking about these codes in absolute terms, and allowed the functional materiality of this code to be culturally forgotten.

The storage of sound itself, and finally the generation of sound apart from physical oscillations and thus beyond any physical limitations by way of digital synthesis, brought with it a shift in our way of thinking over the past century. The semiotic linguistic turn associated with notation as the prescribed way of communicating sound (after initial overestimation of the feasibility of creating electronic music with machines and algorithms in the early computer music) was in turn overcome through a sonic performative turn—music and sound studies became auditory studies (Jauk 2009). The possibility of handling sound directly created a new awareness of its function in the intentional interaction between the body and the environment (Gibson 1982).

Concrete sound—although abstracted by the absolute musical aesthetics of the composition process—related back in sound studies to the consciousness of sound itself as environmental information about dynamic events of a physical and social nature/

culture. Hi-fi and lo-fi soundscapes indicate the relationships between the basic noises / keynote sounds and individual (sound) movements, or signals/sound marks (Schafer 1977)—and hence between perpetual movements of low intensity in nature and those constant movements caused culturally by mechanization, and hence sounds and individual movements, the sound of which allows their position to the perceiving body to be determined in order to act in a way relevant to survival. Soundscapes are not just artifacts of movement, but, the other way round, the generation of sound-shaped dynamic landscapes (Truax 1992).

Sound installations raise awareness for these fundamental exploratory forms of interaction. Digital media art explores these in a kind of aesthetic experiment, by allowing us to experience variations in conditions of listening and its mediatization and their impact on the construction of reality/ virtuality. McLuhan, with his theory of the dynamization of culture through any extension of men (McLuhan, 1964), and hence through instrumentation and media, already described media culture as one of hearing. The all-at-onceness of electronic culture (McLuhan 1995), today Net culture, would allow us to select from the information all around us in accordance with our hedonic experience: this is the situation of listening.

Dynamization and encoding in the digital culture have rendered these experiences musical (Jauk 2009). The storage of dynamic and thus transient sound in the codes of notation and composition, in accordance with (hedonic) conditions of sound and its meaning as an excitation value for the body, are the basis of music and are transferable to the dynamic virtuality created from codes. Although

primarily negotiated as visual culture, which is limited, as a culture of making an image of itself and thus of rational thought, to algorithmic and cybernetically mechanistic series, this culture is actually a hedonic one of listening, of the whole-body experience of movement in space, which in turn leads to the body's own movement and communication of excitation–to interaction through sound gestures. Herein lies as well the paradigm of the materialization of digital information in the new digital culture. However, beyond the writing down of information in terms that adhere to material thinking, beyond the telematic expression of terms that are no longer symbolic, this materialization is about perceiving what is signified as a tangible object in an auditory sonic world in which the physical excitation value harbors the potential for intuitive control of digital information as well as information divorced from any materiality. And it is this very immateriality that now allows for the transformation of this material hedonic interaction into the experiential form of materiality. The new paradigm is the perception of sound as a stimulus that is always experienced physically. Sound installations enable the experimental experience and exploration of this performative quality–they seek to gather knowledge and are thus experiments taking place between science and art, studying the physical, mental, social and cultural interactions with the environments/ virtualities they generate. What was reduced to the level of the clear rationality of performable codes in music becomes in sound installations a physical experience in new environments: in music in the form of "works" and in the sound installation in the form of virtuality. While on different steps of mediatization of body-environment-interaction, both are media productions of the sound interactions of the body with the environment, of its hedonic performative sonic behavior and creation.

The technological feasibility of the sound-gesture interaction in the context of a body-affirmative culture enables this bodily experience to be reflected on directly, beyond any mental conceptualization.

Adorno, T. W. (1958): *Philosophie der Neuen Musik* [1947]. Frankfurt am Main: Suhrkamp.

Carmiaux B. et al. (2011): "Gestural Embodiment of Environmental Sounds: an Experimental Study." *NIME´* 11, Oslo.

Clynes, M. (1980): "The Communication of Emotion–Theory of Scentics," *Theories of Emotion: 1. Emotion-Theory, Research and Experience*. R. Plutchik and H. Kellerman (eds.), New York: Academic Press, pp. 271–301.

Gibson, J. J. (1982): *Wahrnehmung und Umwelt*. Munich: Urban & Schwarzenberg.

Godoy, R. I. et al. (2006): "Exploring music-related gestures by sound-tracking: A preliminary study." *Proceedings of the COST287-ConGAS* (GIMS2006).

Jauk, W. (2009): "pop/music+medien/kunst. Der musikalisierte Alltag der digital culture." *Osnabrücker Beiträge zur Systematischen Musikwissenschaft,* 13. Bernd Enders (ed.), Osnabruck: ePos.

Jauk, W. (2012): "Musik & Medienkunst. Medien der Erkenntnis und Gestaltung von Erlebniswelten zwischen embodiments und Metaphern."*Die Metapher als Medium des Musikverstehens: Osnabrücker Beiträge zur Systematischen Musikwissenschaft.* Bernd Enders (ed.), Osnabrück: epOs, pp. 173–186.

Jauk, W. (2013): "Beyond semiotics? Music–a phenomenon of mediatization: The extension of the hedonistic body and its communicative aspects." *New unknown music. Essays in Honour of Niksa Gligo*, Dalibor Davidovic & Nada Bezic (eds.), DAF: Zagreb, pp. 407–421.

Jauk, W. (2014): "Intuitive gestural interfaces/adaptive environments and mobile devices/apps: Playing music and the musical work as a role model for personalized gestural interaction in social environments." ICMWT International Conference on Mobile & Wireless Technology Congress Book. Beijing, pp. 280–284.

Lakoff, G. (1993): "The Contemporary Theory of Metaphor." Andrew Ortony (ed.), *Metaphor and Thought*. Cambridge, MA: Cambridge University Press, pp. 202–251.

McLuhan, M. (1994): *Understanding Media: The Extensions of Man* [1964]. Cambridge, MA: MIT Press.

McLuhan, M. (1995): The *Global Village: der Weg der Mediengesellschaft ins 21. Jahrhundert.* Paderborn: Junfermann.

Schafer, M. (1977). *The Tuning of the World*. New York: Knopf.

Truax, B. (1992). "Electroacoustic Music and the Soundscape: The Inner and the Outer World." John Paynter (ed.) *Companion to Contemporary Musical Thought*. Routledge: 374.

Piana, S., Mancini, M., Camurri, A. (2012): "Automated analysis of non-verbal expressive gesture." *Atlantis Press Review* 9, pp. 1–11.

Volpe, G.; Camurri, A.; Dutoit, Th.; Mancini, M. (2010): "Cross-disciplinary approaches to multimodal user interfaces." *Multimodal User Interfaces* 4, pp. 1–2.

Wallbott, H. G. (1998): "Bodily expression of emotion." *European Journal of Social Psychology 28*: pp. 879–896.

Translation: Jennifer Taylor

Werner Jauk (AT)

Materialization of virtualities in the bodily/physical interaction process— music as a paradigm for the media-induced transformation of materiality

Immateriality is not something that—pursuant to the dominant visual culture—eludes sight as a reflection of light off of matter. Immateriality is the bodily not to be experienced intangible, the physically and therefore mentally inexperienced; immateriality is in no way bound to materiality, and finally, immateriality is free of cognitions, which are in turn embodied cognitions. It is free of systems of thought that result from physical experience. The digital code is immaterial, free of any ties with materiality (Lyotard 1985).

It is physicality that leads to "being trapped" in material thinking, to the notion that nature behaves in "shocks and spurts" (Lévy 2000). We impose this notion on observations of nature, to which we ascribe the causality of the construction even of culture. Digital culture, potentially a culture of immateriality, becomes a material culture in the body's interaction with virtualities. This applies to the "logic" of how this culture is organized, which manifests itself mainly at the body's interfaces with it. Whereas interfaces in accordance with the semiotic linguistic turn were first symbols, formal languages in the form of logically sequenced commands, and then the activation of categorical representations, icons, through instrumentally mediated handling, today they are increasingly becoming data of a material world or human actions as intentional, and therefore stimulation-based, interactions of the body (Gibson 1982) with the now virtual environment. The interaction came to be dominant over the body by way of comprehensible symbolic languages expressing the depiction of a "reaction," and now is increasingly responding to the material environment through physically tangible experience—integrated into a communication process that is distinguished from the process of transmitting information by virtue of the interacting body our bodies get together with/in their environment forming a social/cultural environment. What differentiates the previous interactions from those of the future is that the physical body will not merely perform instrumental actions by touching icons for materiality, but that the focus will be on the intentionality of these interactions—the intentionality displayed in the correlation between "emotion" and "motion." Gesture is a communicative non-verbal interaction within the paradigm of the sound gesture as a compressed form of bodily communication of the imagined behavior of physical sound (artifacts of movement) in space and its significance for the body as its immediate reaction, performed as a (compressed) stimulation-based bodily action (Wallbott 1998; Jauk).

Music as a formalization of forming by sound gestures, as experience of sound and its mediatization, is the shifting process between the experience of materiality, its dematerialization, and the subsequent materialization of the dematerialized form that has been newly created.

The sound gesture as an expression of material, physical experience of sound (cf. Clynes 1980;

Carmiaux 2011; Godoy 2006; Piana 2012; Volpe 2010), its mediatization in the code system of notation, which enables the deliberate execution as a composition of virtually interacting and partially dematerialized "sound gestures," as well as the return of the "work" thus created to the level of material perceptibility through the communicative physical cooperative establishment of the sonic figure, now makes music the paradigm of the constitutive interaction of the body with virtualities. Music is that excitation-inducing perception of physical material qualities that are experienced and expressed materially to the physical and human world. In "intermedial transposition" at the level of code closest to the immaterial code, these qualities are given in the notation. This allows the organization of deliberate processes in the "work" as well as processes beyond the conception that arises from material experience by the body. The final step is the return to the level of audibility, a process of materialization that ultimately does not address a single sensory apparatus alone but affects the entire body—now, however, in a material form, which as a virtuality is organized at least in part beyond the laws of materiality. The "work," deliberately composed of codes for sounds and not organized using natural sounds themselves, stands as a paradigm for this process (Jauk 2014).

Overcoming the transience of sound has, in the process of the mediatization of sound as an artifact of movement and stimulation-based reaction (the emotional outburst or emotional behavior instrumentalized in sound-gestures being e-motion-amplifiers), led to a storage medium: notation. As a code of materiality, this is fundamentally bound to the notion of physical tone duration and pitches. If the coding of duration as an experience of materiality is linked to the formation of embodied cognitions, then the coding of pitches is a "conceptual metaphor" (Lakoff 1993). The encoded representation of the experience of pitch is the transference

of the concept of general gravitational experiences onto the idea of deep tones as voluminous and vague, and high tones as small and compact. They are therefore imagined as being "low" or "high" in the space, although such material situations almost never occur in natural settings and accordingly cannot become embodied cognition. The encoding of pitch is hence a metaphorical transposition of a material concept onto one that is beyond at least these kinds of material conditions (Jauk 2014).

Although not immaterial itself, the autonomy of this code enables constructions of virtualities partly beyond materiality or the laws of specific materialities—for example, their mutual interaction in intermediality.

Now it is the transience of sound, its momentary intangibility, its presence that can neither be touched nor experienced this way, that inveigles us to take on immateriality. This has merely led to the formation of storage code systems that ultimately were only able to generate immateriality through composition theory. Nonetheless, music in particular can, as the deliberate forming of virtuality, also serve as the paradigm of its materialization—using the near-immaterial code and its material handling. Here, the forming of codes in music exceeds the visuals that always depict something and which, in dynamized form as an abstract interplay of forms, from abstract film to digital visuals, themselves borrowed from music to take shape. These visuals can be viewed as an intermedial transposition. The same is true of exceeding the forming as design through the word, a symbolic form that signifies meaning that is always derived from bodily experience and is therefore material.

Interaction as a control system is subject to materiality. Transmission of information in order to realize material products is used in fields such as robotics, telematics, recently telematic robotics; vital here is the transfer of codes for assembly plans so that

the right material conditions can be constructed in other locations. Ultimately not far removed from postal systems for transferring information to the place of manufacture, such systems have the advantage of their logistics and also in the partial bypassing of material circumstances: the transference of information and the on-site materialization are more economical/ecological than the transportation of material. After all, this materialization can compensate even for the implications of the transport of material objects if, for example, the use and construction in low-gravity conditions make the production in Earth gravity and overcoming the same during transportation into space obsolete through the fabrication of outer space tools on site. This could be made possible by the expansion of the printing process as materialization of symbols into 3D printing as materialization of the object itself. If the first case is comparable to telegraphy or the analog imagery technology of the fax, then the second case can be compared to the transfer of the information that is elsewhere synthesized as sound and thus materialized as digital information—already made by telematic midi-interactions triggering sounds early on.

Immateriality allows product mixes to be made from various materialities through the common digit. Although the immateriality of digital codes pursues a transmediality—that is, the code is independent of the coding of certain material properties/ existences—arts of the common digit can be called multisensory, they ultimately pursue the intermedial transposition of musical forming by tension-resolution. According to the arousal value of stimuli on other stimuli, that which is generally referred to as multimedia can now be called multisensory transmaterial art (Jauk 2005).

An early paradigm of such art is in part the synesthetic arts, in which the musical code—bound to the notion of physical duration and frequencies—is transposed into color values. The assumption of synesthesia is a construct of materialization that eludes any empirical research and ultimately is to be regarded as originating from codes and their transmateriality, almost as a precursor to immateriality. Telematic concerts represent a transition between the materialization of objects according to codes to be put together (composed) elsewhere, and communicative processes as a paradigm of interaction according to material reactions. Implicit here, however, is the experience of social materiality, that is to say the physical presence, demonstrated in the communication process, as well as the scrutiny of reactive and interactive systems; following material laws, the degree of freedom in reactive systems is limited (Jauk 1995).

The most recent materialization technologies interlace those mentioned above and provide a key expansion: although bound to materiality and thus to rational mechanistic thinking, sprung from sight as an active bodily function and therefore physical synthesis of fields of vision, they deviate from the generating mechanism according to this material principle and instead hedonically process and shape the quantity of information to be handled. Only after the stimulation-based reaction of the social and cultural "body" does any cognitive "afterthought" occur (Maturana 1987). This hedonic interaction pursues a market strategy, but one that orients itself on a form of interaction for "every body," that is, one that is general and accessible. Intuitive interfaces as hedonic, expressive physical forms of interaction use gestures—which in turn create physical objects that can be described and explained according to material laws, but also social situations and their connection—that are generated collectively and in a collectivizing way using communicative processes (Kerckhove 1995) beyond writing. With their cultural implications writings perform not only the recording but also the forming of pre-scribed "content" by

dominant systems, through the material rules of gouvernementality (Foucault 2004).

Playing music is the paradigm for materialization according to hedonic experience: the extension of the hedonic body through "instruments" and "media", whose material form is determined by this expressive quality and its social interaction, but equally by the bodily perception, the material sensation of material sound. Materialization therefore implies a cultural shift: it no longer follows the rational thinking of relationships but is rather the collective and collectivizing materialization of physical interaction processes, transposed into bodily experience by tension-resolution. It is connected with the turn from mechanistic thinking to hedonic experiencing, and it thus transcends telematic concepts of materialization to become the materialization of experiential values into a hedonic culture of experience, a musicalized digital culture (Jauk 2009). This form of materialization leads "back" to the bodily physicality of virtualities, from the cybernetic mechanical de-scription of physicality to one that is performatively and hedonically determined—one that focuses the holistic bodily experience of materiality. The linguistic semiotic "sight" of things turns over to the hedonic performative behavior of "sonic" processes. Nevertheless sound-studies auditory-studies, focusing on the bodily perception of sound, open up this paradigm of materialization shifting between material and immaterial "existences" as a process of body-environment-interaction and its mediatization. It appears paradoxical, but: it is immateriality as independence from (a) materiality that allows for this deliberate transformation into any sort of materiality—by the hedonic body.

Carmiaux B. et al.(2011): "Gestural Embodiment of Environmental Sounds: an Experimental Study." *NIME´ 11*, Oslo.
Clynes, M. (1980): "The Communication of Emotion—Theory of Scentics." *Theories of Emotion: 1. Emotion-Theory, Research and Experience*, R. Plutchik and H. Kellerman (eds.), New York: Academic Press, pp. 271–301.

Foucault, M. (2004): *Geschichte der Gouvernementalität* (I, II). Frankfurt am Main: Suhrkamp.
Gibson, J. J. (1982): *Wahrnehmung und Umwelt.* Munich: Urban & Schwarzenberg.
Godoy, R. I. et al. (2006): "Exploring music-related gestures by sound-tracking: A preliminary study." *Proceedings of the COST287-ConGAS* (GIMS2006).
Jauk, W. (1995): "Interactivity instead of Reactivity." *Prix Ars Electronica 95*. H. Leopoldseder, C. Schöpf (eds), Vienna: Österreichischer Rundfunk, pp. 23-27.
Jauk, W. (2005): "Multisensorische Künste. Musikalisierung der Künste des 'common digit' und der 're-defined body.'" S. Droschl, C. Höller & H. A. Wiltsche (eds.), *Techno-Visionen. Neue Sounds, neue Bildräume* (pp. 94–111). Vienna: Folio-Verlag.
Jauk, W. (2009): pop/music+medien/kunst. Der musikalisierte Alltag der digital culture. *Osnabrücker Beiträge zur Systematischen Musikwissenschaft 13*. Ed. Bernd Enders. Osnabruck: Universität Osnabrück.
Jauk, W. (2012): "Musik & Medienkunst. Medien der Erkenntnis und Gestaltung von Erlebniswelten zwischen embodiments und Metaphern." *Die Metapher als Medium des Musikverstehens. Osnabrücker Beiträge zur Systematischen Musikwissenschaft.* B. Enders (ed.), epOs: Osnabrück, pp. 173–186.
Jauk, W. (2014): "Intuitive gestural interfaces/adaptive environments and mobile devices/apps. Playing music and the musical work as a role model for personalized gestural interaction in social environments." *ICMWT International Conference on Mobile & Wireless Technology Congress Book,* Beijing, pp. 280–284.
Kerckhove, D. de (1995): "Kunst im World Wide Web." *Prix Ars Electronica 95*. H. Leopoldseder, C. Schöpf (eds), Vienna: Österreichischer Rundfunk, pp. 37–49.
Lakoff, George (1993): "The Contemporary Theory of Metaphor." A. Ortony (ed.), *Metaphor and Thought,* Cambridge: Cambridge University Press, pp. 202–251.
Lévy, P. (2000): "Die Metapher des Hypertextes [1990]." C. Pias et al. (eds.), *Kursbuch Medienkultur. Die maßgeblichen Theorien von Brecht bis Baudrillard,* Stuttgart, pp. 525–528.
Lyotard J.-F. (1985): *Immaterialität und Postmoderne.* Berlin: Merve.
Maturana, H. & Varela, F. J. (1987): *The Tree of Knowledge: The Biological Roots of Human Understanding.* Boston: New Science Library.
Piana, S., Mancini, M., Camurri, A. (2012): "Automated analysis of non-verbal expressive gesture." *Atlantis Press Review 9*, pp. 1–11.
Volpe, G.; Camurri, A.; Dutoit, Th.; Mancini, M. (2010): "Cross-disciplinary approaches to multimodal user interfaces." *J. Multimodal User Interfaces 4*, pp. 1–2.
Wallbott, H. G. (1998): "Bodily expression of emotion." *European Journal of Social Psychology 28*, pp. 879–896.

Translation: Jennifer Taylor

Werner Jauk (AT)

sound-sculpting/ touch the sound… 2.0

Sound is considered intangible, yet it is perceptible … Sound is regarded as ephemeral and yet it surrounds us constantly …

Sound is movement–because of its generally low intensity and ubiquity, it only becomes "distinct" when it is different–if the soundscape is "hi-fi", when specific tones/ "marker sounds" stand out as "signals" from the noise, the stationary sound resulting from continuous movement–or if this noise is highly intense or is broken up into "lo-fi" soundscapes (Schafer 1977).

Hearing allows us to passively analyze these movements as the source of sound through their impact on our body by "intensity" when listening. The phylogenetically dominant sense of sight is linked to the active physical handling of the environment, its conscious synthesis.

Following "touch my sound" (Jauk/Jauk 2011), sound-sculpting/touch the sound … 2.0 is now attempting to vary these two forms of perception systematically by connecting the mechanically passive analysis of listening to ephemeral sounds with active mechanical interaction, thereby mapping the synthesizing act of seeing stationary figures to the analyzing process of hearing the fluidity of sound. Sound is shaped by hand to form stationary figures based on the model of physically tangible materialization–material–scapes are (cognitively) created through shaping sound (Truax 1982).

It may seem paradoxical at this point–but, this materialization is made possible by the immateriality of digital code (Lyotard 1985): because there is no bound to any materiality, its transformation into a material form at will is possible!

However, the process of materialization does not occur via the algorithmic processes of a hardware interface but is instead a psychological process of transference of embodied cognition–of physical knowledge gained through the body's experience of the environment, transmitted from one sensory apparatus to another.

What people experience as a mental feat, as the transmission of "volume" and "density" as empirical values of materiality from the other senses, is transferred to the "materiality" of sound, giving its transience a stationary form–the "volume" and "density" of which can be grasped and manipulated as digital information. The paradigms of the visual experience of the manipulation of matter are applied to sound, thereby overcoming the auditory analysis of ephemeral tones that take on form through extraneous movements and allowing the hedonic, corporeal formation of sound (Jauk 2007) to be experienced by adopting sound-gestures as paradigms (Jauk 2014).

This experimental setting is a method used in media arts to explore extended perception and its virtual constructions, thus operating at the interface of science and art (Jauk 2009). At the same time, this work mediates between performative sound installation and music, formalizing the focus of sound installations: the perception of and through sound as an adaptive behavior enabling survival in reality, as a form of bodily interaction that is becoming increasingly necessary for survival within virtual worlds.

Schafer, M. (1977): The Tuning of the World. New York: Knopf.

Truax, B. (1992): "Electroacoustic Music and the Soundscape: The Inner and the Outer World." Paynter, John (ed.) *Companion to Contemporary Musical Thought.* Routledge: 374

Jauk, W. (2007): "Der Sound des hedonisch-performativen Körpers und das Spiel der Elektrogitarre." *Jazzforschung / jazz research 39*, pp. 273–289.

Jauk, W. (2009): "pop/music+medien/kunst." *Der musikalisierte Alltag der digital culture. Osnabrücker Beiträge zur Systematischen Musikwissenschaft,* 13th ed. B. Enders. Osnabruck: Universität Osnabrück.

Jauk, W. / Jauk-Hinz, D. (2011): "touch my sound," exhibition of the project "Longing for". Biennale di Venezia 2010, kunsthaus muerz.

Jauk, W. (2014): "Intuitive gestural interfaces/adaptive environments and mobile devices/apps. Playing music and the musical work as a role model for personalized gestural interaction in social environments." *ICMWT International Conference on Mobile & Wireless Technology Congress Book.* Beijing, pp. 280–284.

Lyotard J.-F. (1985): *Immaterialität und Postmoderne.* Berlin: Merve.

Translation: Jennifer Taylor
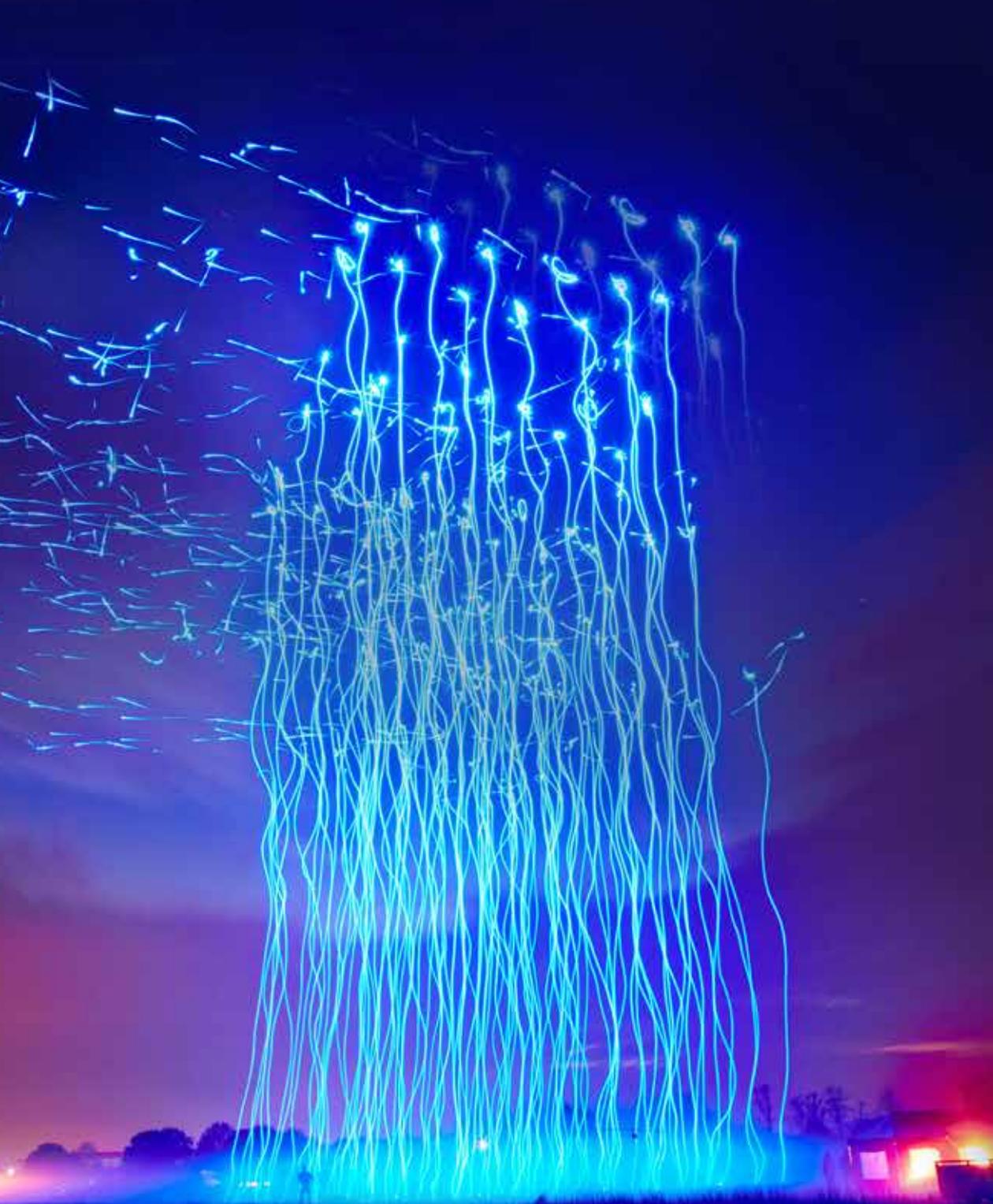
249

Drone 100 – Intel in collaboration with Ars Electronica Futurelab holds the world record in the category Most Unmanned Aerial Vehicles (UAVs) Airborne Simultaneously. *Photo credit: Intel Corporation*

CAMPUS

Campus Exhibition
Spirits of Everything
Tsinghua University, Beijing

Faculty for Creative New Media and Performing Art, Department of Information Art & Design at Tsinghua University

Amidst the iterative process of technological innovation that humankind drives forward, electronics, machines, information and media are incessantly engendering new "life forms." In our work, we attempt to capture such brilliant bursts of creativity and, via indeterminacy and contingency, to breathe into our art & design projects an extraordinary vitality, a charm all their own. The works have never been so closely associated with the time, the processes and the places in which they originate, and with their audience. In this exhibition, we, proceeding from an academic point of view, aim to shed light on the complex interrelationships operative nowadays between the "things in the world" and human beings, and,

against the backdrop of a multicultural culture, elaborate on China's past present and future.

This exhibition showcases the results of scholarly research done and instruction given in recent years at the Department of Information Art & Design of the Academy of Arts and Design at Tsinghua University. The show includes works by students and faculty members in the Information Art & Design, Animation, Photography and Digital Entertainment Design departments. It consists of three main subdivisions: digital conservation and innovation in the field of traditional Chinese cultural heritage, works of interactive media art, and a screening of more than 20 works of animation.

Wu Shizhong, Guan Yan, Wu Qiong, Wang Zhigang, Zhang Mangmang, Xiang Feng
Narrow Streets Dating Back to the Ming and Qing Dynasties

Yiyang's old inner-city lanes, which date back to the Ming (1368–1644) and Qing (1644–1911) dynasties, are typical of classic southern Chinese urban planning. Still very well preserved, these narrow streets are lined with buildings in a unique architectural style. The edifices enable us to understand the construction techniques used in those days, the spatial concepts the planners implemented, which customs and ways of life prevailed then, and how the city developed. The ancient lanes of Yiyang are now considered the most beautiful in southern China.
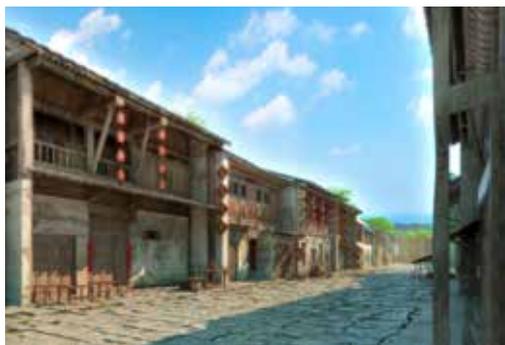
Wu Shizhong, Guan Yan, Wu Qiong, Wang Zhigang, Zhang Mangmang, Xian Feng

The Ceramic Kilns of Yangwuling

The ceramic kilns of Yangwuling in Yiyang, Hunan Province are almost a thousand years old and an essential part of southern China's cultural heritage of peasant ceramic craftsmanship. The wares produced there were influenced by the delicate ceramic style of the Southern Song Dynasty (960–1279) as well as the coarser, more audacious style of the Yuan Dynasty (1279–1368). These ceramics give us insights into how the society of Hunan Province developed over various historical periods.

Lu Xiaobo, Wu Qiong, Zhang Lie, Chen Lei, et al.

Dunhuang's Digital Conservation– Virtual Exhibition Platform

This research project was conducted in conjunction with the National Basic Research Program of the People's Republic of China. It is a multimodal platform for the presentation of digitized cultural heritage. It brings together visual and auditory elements, and shows murals from the Buddhist grottoes of Dunhuang from various perspectives. This presentation combines virtual reality and augmented reality, lives up even the most demanding artistic criteria, and offers both the general public and Dunhuang specialists an immersive experience that complies with both scientific and artistic standards.

Lu Xiaobo, Ma Lijun

Dunhuang–VR Exhibition (Encounter with the Tang Dynasty, Dunhuang)

This work is part of a VR platform for the presentation of the digitized cultural heritage of Dunhuang, a Buddhist center on the ancient Silk Road famous for its cave temple. It is based on a high-definition virtual reconstruction of the current state of Cave 159 of the Buddhist Mogao Grottoes of Dunhuang. This work employs VR methods to put the presentation visitor right into the middle of this cave. The visitor can move about freely and, in an impressive immersive experience, get close-up looks at the details of the sculptures and murals inside.

Shi Danqing, Xian Feng, Wang Zhigang, Dai Dai

Land of Hope

Land of Hope is a major multimedia installation which was the centerpiece of the China Pavilion at Expo 2015. Set up on an approximately 450-square-meter space, it consisted of 20-30,000 luminous artificial rice stalks that constituted an imposing "field" designed to serve as a medium for the presentation of dynamic images. Pavilion visitors could walk through this field and then up a ramp to an observation platform, which provided an impressive overview of the entire field.

Wang Chao, Xu Yingqing, Su Yi, Tao Ji, Wang Meng, Sun Zhuang, Huang Xiangyang, Fang Ke, Wang Yu, Gu Jiawei, Yan Suosuo, Zhang Lei, Mi Haipeng, Yu Kai

DuBike

DuBike is a smart bicycle developed by X-Studio at Tsinghua University together with the Deep Learning division of Baidu, an Internet services provider. While DuBike is in motion, sensors mounted on its frame collect information about the cyclist's physical condition as well as the environment though which s/he's cycling. Via voice output and a display system, DuBike gives the cyclist real-time feedback about his/her performance. And it can simultaneously analyze various factors—physiological indicators, cycling habits, location, bike path condition, environmental quality—and deliver real-time routing suggestions, smart tips and other biking-related services to the user.

Zhang Lie, Wang Zhigang, Yao Jijun, Cui Xiaosheng et al.

China National Sinology Center, Exhibition Design of the Zhouyi Pavilion

The China National Sinology Center is an exhibition venue dedicated to traditional Chinese culture. *Zhouyi* (known in the West as *Yi jing* or *I Ching*) has always been regarded as the most important work among the classics, as the origin of the so-called Great Path. The exhibition design's metaphor consists of a thousand LED columns representing a stereographic forest of yarrow (*achillea*) stalks that allow installation visitors to experience the esoteric wisdom of the *Zhouyi*.

Wu Qiong

The Rhythm of the City
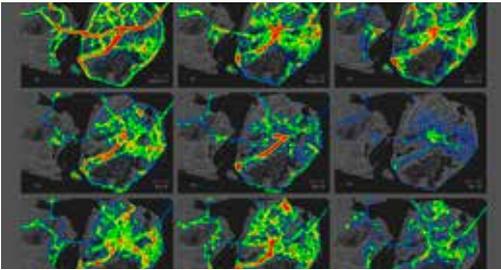
The work was a data visualization of Xiamen residents' journeys. It visualized real-time data on Xiamen residents' journeys at various times of the day, such as positions, directions and distances. These visualizations described Xiamen residents' points of departure, destinations, duration of journey and general rules, shown on a real-time mobility map of the dynamic flow of Xiamen city residents, reflecting the distribution of the districts and the characteristic connections of the city. The landscape described by the data visualization resembled rhythmic pulses of the city, by which people can observe and analyze their familiar city from a different perspective, the rules and characteristics of which are available for transport and urban planning in the rapidly developing city.

Zhu Hui

Mu Mu—A New AR Interaction

Mu Mu amalgamates animation art and cutting-edge technologies including state-of-the-art augmented—reality technologies. The project, which was selected for a joint venture with Disney, offers an advertising platform for several international firms. Installation visitors can try out innovative new VR interaction and take part in the creative process themselves. In this way, the project imparts a powerful experience of live interaction.

Wang Zhigang
To Live

The video works used in this play give theater-goers a visual experience of the pain that the chief protagonist feels when she is separated from those she loves. As a result, viewers are touched directly in a way that is utterly unprecedented. The videos further strengthen the extraordinary atmosphere on stage, as they impart a powerfully moving experience.

Deng Yan
culture weakness

culture weakness is video installation consisting of a fan, a cloth curtain and projected videos. It describes a traditional Chinese vessel that cannot be smashed, and thus represents the current state of traditional Chinese culture—fragile but nevertheless strong.

Zhang Yinghan
Camera Obscura

As a forerunner of the camera, a camera obscura is a primitive painting tool. With the help of a ray of light and a viewing aperture, the painter can use it to render a clear, realistic picture of an object. Taking the technical principle of the camera obscura—which yields an upside-down and laterally reversed image—as my point of departure, I produced a simple apparatus that I applied to the video medium as a means of scrutinizing society's relationship with groups of people who have different sexual orientations.

An Ji'er
Uncertain Substance

This uncertain substance emerged from the deconstruction and reassembly of pictorial artifacts into a strange new image that evokes a state of indeterminacy. As the upshot of mistrust towards experience and judgment, *Uncertain Substance* lets us see things in a way this is impartial and free of bias. This is perhaps the primordial state of things.

Lai Weiwei
Waiting

the film back in slow motion radically decelerates the sequence of images and thereby expresses the feelings people experience while they wait and wait and wait.

Li Tong
The Pit

In a state of absentmindedness, all sorts of fragmentary images insinuate themselves into our consciousness. We're powerless to prevent this. It's not until we consciously dredge up these images that we become aware of how much they influence us, and we begin to take an interest in them, these pictures that conform to no stringent logic.

When we bury things and commemorate them, it's as if we can keep in mind what has been lost. As for me—my remembrance of things, both before and after they were lost, consists of precisely such image fragments. That which was buried doesn't exist in reality; nevertheless, everything is there.

Zhou Qiannan

Mermaid Can

Reality and constructed truth have always been the discourse that the artist has been drawn to through her life. The artwork is constructed involving different media: video projections of footage shot in multiple states in the US and some in France, handcrafted clear casts from small antiques, a cabinet holding the casts onto which videos are projected, and a mythical time. It presents semi-living specimens resembling the mermaid's body parts from P.T. Barnum's *Fiji Mermaid Show*, a big hoax in the 19th-century US. It shows the juxtaposition of kitsch and ornament, morbidity and beauty, disgust

and fascination. It probes the manipulative use of media and anthropologically rich phenomenon of animal exhibits in various forms from earlier times, but also reflects on our modern visual experiences.

Li Qingyu

Untitled

All will disappear. Regardless of how long you live in this world, you'll eventually vanish. Experiencing how something disappears or is reborn is a feeling that can't be expressed in words. The artist attempts to manifest this feeling and make it possible to experience the process of departure and return by letting these processes run side by side in slow motion.

Liu Yushan

Illusion

Truth and falsehood, reality and fantasy are interdependent. If you pause and reflect in contemplation of a landscape, only time can tell you if it's real or unreal. If you dissect images and rearrange them, repeatedly take them apart and put them back together again, it's only at the moment of reassembly that you're able to recognize the subtle difference between "reality" and the "true countenance" of what you behold. What we see isn't truly the world, but rather a small world that we create from a still-life. But when the images are isolated,

one can only hope that those viewing them judge the content of a particular image on the basis of their own individual visual experience. This is also a process of the construction of perception.

Liu Silin
Sirens

I invited people from a wide range of social backgrounds to perform a lip-synch number with me and to imitate the sound of a police car's siren.

Tian Li, Fu Zhiyong, SeeekLab
Sand Letter

There's a saying in China: "Show me your handwriting and I know who you are." Writing Chinese characters, stroke by stroke–this is a source of fascination that electronically generated scripts or symbols can't even come close to achieving. *Sand Letter* and its appurtenant app transform the installation visitor's handwriting into a calligraphic line in the sand drawn by smart hardware. Even over a considerable distance in the sand, similar brush strokes and styles of forming characters can be represented.

Fu Zhiyong, Qiu Bixuan, Niu Siyue
Creative City

Creative City provides insights into a complete Making process, an innovative collaborative model that ranges from the space itself to the depiction of a Makerspace with its lively setting. In this work, a stereoscopic book is linked to projections. When a user browses through this book, his/her act of touching the installation's chip triggers the projection mode. Videos and animated sequences then appear in the book, and thus launch a process of
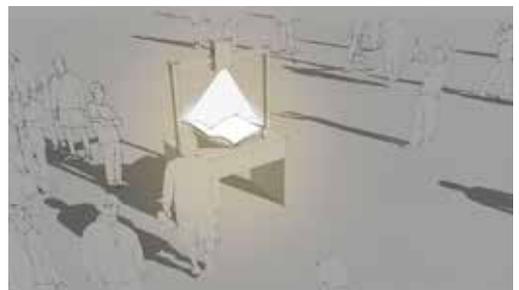
interaction that enables the user to discover the possibilities of a Makerspace.

Fu Zhiyong, Tian Li, SeeekLab
Sightseeing Elevator

This sightseeing elevator commutes between the real world and the digital one. Inside, numerous videos are available. Installation visitors can ride a "phony" lift that simulates the experience of riding a real elevator from one floor to the next. Passengers can peer out of the cabin's window and thereby perceive a strange yet familiar space/time and experience a completely different world.

Fu Zhiyong, Guo Jiajing, Ge Sihang
InstaBooth

InstaBooth visualizes a link-up between two cities. Beijing and Linz, two cities that can each look back on a long, rich cultural tradition, teamed up to produce this exhibition. *InstaBooth* transposes locations on the city maps of Linz and Beijing. Installation visitors can position cubes on both maps; the animated sequences that then appear provide a means of comparing and contrasting the two cities.

Zhang Lie, Tan Xingdong et al.
VR Terracotta Army

The terracotta army of Emperor Qin Shihuangdi, one of the most important manifestations of China's extraordinary classical culture, is a World Cultural Heritage treasure. Thanks to the latest VR technologies, spectators can stand face-to-face with the soldiers and get a close-up look at the impressive dimensions of the imperial tomb and the lifelike appearance of its terracotta warriors.

Shi Danqing, Shi Qingyuan, Chen Congxin, Feng Shuangni, Wang Zhigang

Interactive Version of the *Night Revels of Han Xizai*

This is a digital interactive version of the *Night Revels of Han Xizai,* a classical 10th-century scroll containing painting and calligraphy. New media technologies have been used to create an interactive, animated narrative design based on details of the original, and to stage it in three-dimensional scenery. By interacting with the imagery, an installation visitor can experience the fascination of Chinese painting.

Wang Zhigang, Jia Shan, Mei Jing, Wang Yingqi, Hao Mingzhu, Ye Dong

Outing into the Mountains and Streams

This work, based on the classical painting *Outing into the Mountains and Streams*, uses the methods of classical Chinese garden art to imitate the landscape in the painting. It emphasizes the aspect of

mediatization and the immersive experience, and thus realizes a contemporary interpretation of the original work, the earliest traditional landscape painting of which the West ever took note. The work consists of three parts: *Fascination of the Mountains*, *Climbing the Mountains* and *Venerating the Mountains*. It carries spectators into the mountains and is thus an extension of a three-dimensional abstract image of the landscape.

Wang Zhigang, Ruan Jianan, Zhang Jieye, Chen Xiaoyu, Tang Muyuan

Spirit Wandering in the Dark

Water and mist billow and surge; ghosts perform their dances. These nature spirits are projected onto a carrier medium, fog, in a miniature landscape that is typical of Chinese gardens. Many elements—real and unreal, kinetic and stationary, hidden and visible—dovetail to create a mysterious, oriental atmosphere.

Wang Zhigang, Jiang Yuntao, Chen Kaixi,
Xu Benyi, Feng Lei, Wang Linfeng

Tribe of Demons

This amusing ecosystem set up on a tabletop enables several participants to interact. It is populated by odd little figures with a wide range of traits—they differ in appearance, character, modes of locomotion, and kinship forms. Installation visitors can use various hand movements to engage in a rather natural form of interaction with these peculiar creatures. If the circumstances and the internal equilibrium of the system are modified, visitors can track the ensuing developments and the changes that the individual figures and the group as a whole undergo.

Wang Zhigang, Luo Wei, Hao Mingzhu,
Yang Pengtao

Magic Mirror—
Invisible World

The "I" that an installation visitor sees in the mirror is immersed in a mysterious world. Several spirits—some cheeky, some shy—gather round the visitor and engage in spooky interaction with her/him as the visitor descends into a realm of enchanted interplay somewhere between illusion and reality.

Ma Yanlin, Zhu Jiahui

Spacial Gears

Spacial Gears works in terms of two- and three-dimensional optical illusions, and goes beyond conventional conceptions of interlocking cogwheels. Viewed head-on, the gears mesh with each other and move together. But actually, they're offset and there's a certain gap between them. Thus, each gear moves at its own predetermined pace.
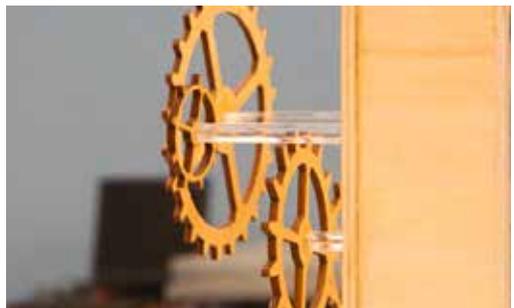
Lu Qiuyi, Wang Liyuan, Mi Haipeng,
Shi Danqing, Xu Yingqing, Guo Jiajing,
Xie Chenrui, Jiang Meijia, Liang Jie, Liu Jing

MetaLife

What is life? When a drop of fluid metal can hunt for game, digest its prey and move about, can it be said to be alive? *MetaLife* is an interactive installation that consists of a mollusk that feeds on fluid metal. The fluid metal that inhabits the installation seems to be sentient. When interacting with installation visitors, it exhibits shy, curious or even slightly inso-

lent behavior, and prompts its human interlocutor to give some thought to what life actually is.

Lu Qiuyu, Mao Chengpeng, Zhong Qiuheqi,
Liu Yejun

ZOOO

The installation's software simplifies adjusting the puppets' motion settings and arrangements. The flexible backdrop makes this DIY stage ideal for customized performances.

Xu Chutong, Zheng Wei, Li Zhi, Li Jiawei,
Gao Jing, Ma Anqi

Angry

Perhaps human nature is what makes people want to explore mysterious spaces and peculiar objects. And even if curiosity is the driving force behind progress and innovation, it nevertheless also sometimes violates the private sphere of others or even causes them harm. In thrilling films, a cabinet often seems to conceal a secret, and it's sometimes even the place in which the solution to a veritable enigma is hidden. What people don't know, however, is whether their curiosity incites suspicion, aversion or even rage on the part of others. The negative

feelings that accompany these reactions might even arouse an interpersonal phobia between strangers and thus bring forth a vicious circle that's hard for those involved to break out of.

Zhang Yang, Liang Yuyun, Wang Han, Guo Jiajing, Zhou Xueyi, Wang Li, Zhang Fengjie, Wang Yue

There's always somebody who's nice enough to shoot the souvenir photo …

Nine emoticons with human facial expressions represent nine classmates. You take out your cell phone, activate the flash and take a snapshot, only to realize that some classmates were making funny faces. Out of curiosity, you take another picture, and lo and behold—now two others are making faces! … So who knows if you'll ever succeed in taking a perfect souvenir photo?

Zhang Su

Mr. Monster

The most striking features of *Mr. Monster* are the eyes. A control option makes it possible to simulate and "animate" its eye movements. This endows fruits and vegetables with a new life. The installation consists of nine "images." When an installation visitor approaches, the eyes concealed in the image open slightly and interact with the visitor. When s/he moves away, the eyes close and the installation returns to stand-by mode.

Wang Han

Fish Feast

Various fish are hidden in this installation's multiple place settings. These fish usually remain cool, calm and collected, but if you don't watch out, they suddenly start to flounder! And if you touch them, their original reaction changes—they either start to wriggle even more violently or they just lay there like a dead fish!

Liang Yuyun

Music Reyalp

Music Reyalp is a box that can play back music in two directions. If the box is positioned upright like an hourglass, the music is played normally. But when you flip the box, the music is played from the end to the beginning.

Sun Yuehui

Marching Matrix

Marching Matrix was an offshoot of observations and analyses of military parades and similar spectacles. The basic element of the work is a simple rectangular matrix that changes constantly as it moves forward. The observer can use gestures and verbal commands to create various formations seen from a third-person perspective. When s/he comes to understand the rules or reorganizes them, the outcome can be a fascinating experience that also provides food for thought.

Gong Ziyi

Feather

A feather is suspended in a transparent acrylic box on display in the exhibition space. Three of the box's sides have an opening, which prompts the installation visitor to blow on the feather in the box. When that occurs, the feather registers the change in air pressure and in its own range of motion and it begins to move back and forth. Not far away, a feather that's 10 times larger than the one in the box is suspended from the ceiling of the exhibition space. When a visitor blows on the feather in the box, an electrical motor makes the larger suspended feather move the same way as the little one. Thus,

the installation enlarges the visitor's impact on a tiny thing and thereby addresses the issue of the extent to which individuals' behaviors influence their wider environment.

265

Wang Ruocha

Wandering

Wandering was inspired by a fantasy theme: the migration of flying fish. This is a mechanical installation consisting of gears and connecting rods. In the installation, the mechanical construction is clearly visible; the design idiom was derived from industrial design. Most of the work was done by hand, which endows the inanimate machine with an organic feel and warmth. The installation, on one hand, displays the beauty of the machine and the handwork that went into it; on the other hand, it fulfills an educational purpose and propagates scientific insights and values.

Chen Lei, Wang Zhigang

Feitian—Dunhuang's Dance Animation

In Buddhist iconography *feitian* are female spirits that dance to a musical accompaniment. Thousands of beautiful *feitian* images were created a thousand years ago in the Buddhist grottoes of Dunhuang, a treasure trove of Chinese peasant art. This animated film uses motion capture to present research on the dance style depicted in Dunhuang, thus enabling viewers to get a vivid impression of the *feitian* and their mysterious, elegant dances.

Campus Exhibition
Speculative Materialities
Interface Cultures student exhibition in Ars Electronica 2016

University of Art and Design, Linz, Interface Cultures
Faculty: Christa Sommerer, Laurent Mignonneau, Martin Kaltenbrunner,
Michaela Ortner, Marlene Brandstätter, Fabrizio Lamoncha, Alessio Chierico

We have maintained that the economic driving force of innovation is not just derived from the internal power of the machines, but is also due to the persuasive power of their design, their nature as objects and their essential materiality. Our imagination has been captivated by the idea that technologies are moving toward the immateriality of software and into the abstraction of digitalization. At the same time, some of the most interesting experiences afforded by art promise to free us from the fetish of objects, to enrich the intangible value of the artistic process. All this is fundamental, but it should not serve to exclusively confine our perception to the oblivion of virtuality.

We are material, and we are surrounded by materials which have their own dignity and agency. They converge to form objects. The relation between the world and its users is mediated from remote data centers that store information on devices like smartphones or smart devices. In this generic sense we are talking about interfaces: material or immaterial, practical or conceptual elements which divide, relate and regulate the interaction between people and things. This is our theme. New speculations about possible future scenarios for such interfaces and about the dynamics that are currently taking place.

This year the Interface Culture department intends to celebrate the emergence of new sensibilities in respect to these themes. Projects range from the questioning of our relationship with time to the identitarian principles behind national symbols, from sculptural forms which remind us of the centrality of materials in art to improbable calculating machines and improbable sports for consumers. From critiques of a society which binds us to our habits and demonstrations of more literal constraints, to the needs for the exercise of power and control. From speculations on and materializations of processes and technological empowerment to retrospective reflections on our natural state, combined with environmental concerns. From interfaces that involve challenge and choice to the progressive sensing of the social interaction on the net.

All of these themes are explored in this Interface Cultures student exhibition. It emerges from practices involving the evolution of our contemporaneity. Here you will find neither screens displaying representations, nor pure virtual worlds with supposed abstractions, but rather agglomerations

of materials: objects that give rise to speculations. For example, Gabriela Gordillo asks herself what our days sound like. Her work *Arrhythmia* is a sound installation which consists of an ongoing composition made up of rhythms taken from everyday life. The collected data are transformed into an audible sequence that enables us to observe these patterns,

mix them and relate them to others. Another example is Or Wollf's *MusiCalendar*, which deals with a combination of the digital and the analog world based on the output of personal data. The project includes a digital interface that utilizes personal characteristics to create an individual calendar. These data are transformed into points on a paper

Gabriela Gordillo

Arrhythmia

Or Wollf

MusiCalendar
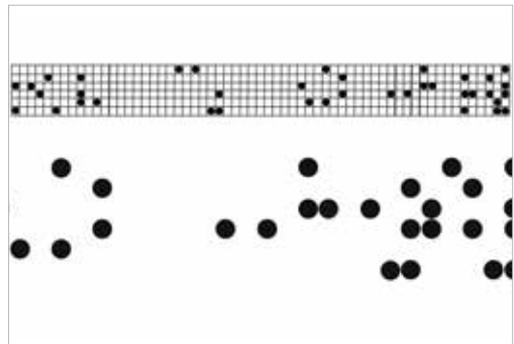
strip of a music box that will subsequently be translated into a melody and visuals.

Sound is also a very central key in Amaia Vicente García's installation *Is Europe a Utopia?* It shows a European flag hanging from the ceiling. The spectator can move around the artwork. By doing so he/she makes the fabric move and produces sounds. The specific nature of the sounds and motions depends upon how many people are present. The sounds are the voices of women who are reading facsimiles of passages of the European constitution concerning diversity, equality and gender opportunity.

Domes by Chiara Esposito are sound sculptures made with ceramics. Their metallic glaze, a traditional decoration technique, here serves as a sensing element. The sculpture senses the visitor's touch and reacts to it by resonating.

The sculptural form is also the focus of the installation *Sonolith* by Johannes Wernicke. He creates a seemingly solid monolith which hangs from the ceiling. Visitors trigger wave–like movements on its surface.

Media archeology served as the source of inspiration for several projects. Qian Xu uses an abacus in her artwork *Suan*. The visitor is invited to play with it,

thus generating various fractal images. The work elucidates the charm of mathematics from an unusual perspective.

Martín Nadal and Cesar Escudero Andaluz install an old calculating machine that has been hacked; it serves as a miner that validates the pending bitcoin transactions in a blockchain (online distributed database). *BitterCoin* combines the Internet of Things, media archeology and economics. The operations are displayed on the calculator screen and subsequently printed out.

Sound and media archeology also play a central role in Oliver Lehner's project *Shopping Mill*. In this installation walking on a treadmill simulates a shopping experience. Soothing background acoustics are provided by muzak, while the customer/visitor on the treadmill strolls down a 3 D–generated shopping aisle. This artwork constitutes a critical statement on de-realized labor and senseless consumption. These muzak products were developed to make people feel comfortable in uncomfortable architectural settings, to enhance productivity at the workplace.

Three different approaches to wearables are elucidated in the exhibition. *Homo Restis* by Jens

Amaia Vicente García

Is Europe a Utopia

Chiara Esposito

The Dome

Johannes Wernicke

Sonolith
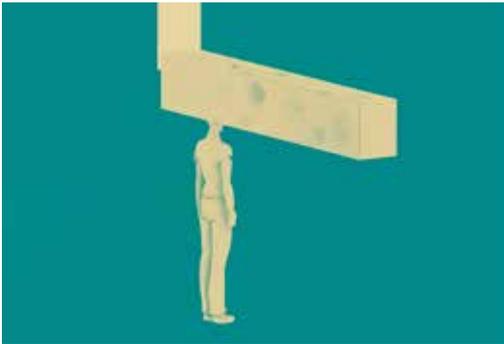
Martin Nadal, Cesar Escudero Andaluz

BitterCoin

Vetter and Sarah Leimcke is a live performance sonic installation. The two artists appear as "men on strings," marionettes, as designated by the Latin term *restis*. They attach themselves to the environment and to each other. The moment of "getting attached" is thereby transformed into sound.

The costumes are medieval–futuristic. *Homo Restis* interacts with its immediate environment and abstract space through the presence of both Vetter and Leimcke.

Alibi by Nathan Yao Guo is a speculative and interactive installation. It creates a spacesuit for a

Qian Xu
Suan
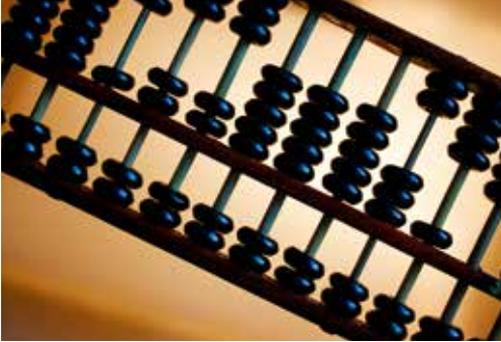
Oliver Lehner
Shopping Mill

Jens Vetter, Sarah Leimcke
Homo Restis

Julia Nüßlein, Irene Ródenas
Green Filter

fish that enables it to move around with the help of a robotic arm. Inspired by *Becoming Animal* by Deleuze and the approach of critical design, this project proposes an ecosystem and biosphere for animals. It provides a high-tech scenario which enables animals to explore their "outer-space."

At the same time, it gives people something to cogitate over.

Julia Nüßlein and Irene Ródenas have also chosen a speculative approach. In their project *Green Filter* they propose a symbiosis between humans and nature. It consists of wearable objects made of

plants and natural materials that filter the air we breathe. The objects challenge entrenched habits and assumptions, and encourage us to take a critical view of our position on planet Earth.

Patricia Cadavid's installation *#12OCT* can be seen as a critical statement on history and on the controversy involving different connotations. The date October 12 reminds us that in 1492, Christopher Columbus arrived in America. In the colonized countries this date is known as the Day of the Race. The project uses social networks as collective thinking sensors. As we see, this year's student projects in Interface Cultures are designed to free us from having to spend a large part of our lives hunched over desks. They aim to liberate us from seeing our lives pass by on monitors, illuminated by cold LED light. These projects and prototypes provide us with powerful, smart, physical objects. They show us speculative interfaces and some possible future potential of enhanced materials.

Nathan Yao Guo, Muchen Zhang
Alibi
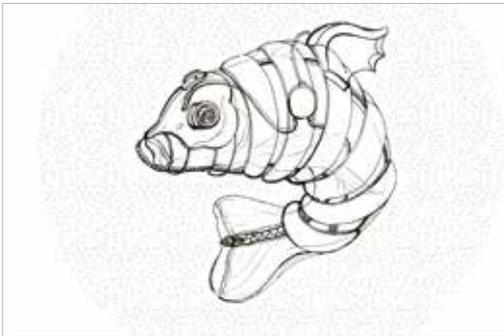
Patricia Cadavid
#12OCT

Campus Exhibition
MEDIA SPACES
BTK University of Art and Design Berlin
Exhibition of the Master's Course, Master of Media Space

The group exhibition *Media Spaces* contains media projects that research innovative conceptual solutions within the realm where real and virtual spaces come together. They include artworks created with a focus on spatial aspects of media installations, including their dimension and perception, to show art works by nine young individuals who came to Berlin a year ago to study, work, and last but not least to live in the city of Berlin.

The group exhibition contains digital reflections, projections, ephemeral traces of images, kinetic and traditional sculptures, whispering plates, interactive laser pointers, mixed-media installations and visual illusions, which all represent artistic uses of media in a spatial setup. The projects are partly motivated by individual views on Berlin's changing appearance, urban and intersocial phenomenon or the desire to heal "weather-sickness" (a term used here analogously to "homesickness") when thousands of kilometers away from home. Other works aim to create novel expressions of inner and outer personal states. Such expressions, for example, are generated by morphing verbal secrets into motions of hanging metal plates, which creates a metallic whispering sound. Other works use ephemeral images of dancing bodies or express the sadness about the deforestation and the changing environment using traditional and new media.

The projects were created by nine master's students from the Media Space program of the BTK– University of Art and Design in Berlin. The students–supervised by Prof. Dr.-Ing. Katrin Wolf, Prof. Thomas Noller, Florian Kühnle and Steffen Klaue– come from all over the world. The exhibition is both an international and interdisciplinary group work, which benefits from the excitement of nine young people who came to Berlin from Pakistan, Russia, Ireland, Mexico, Columbia, Italy, Thailand, Lebanon and Iran to by inspired by the city's free spirit and its unique pulse. This is what is currently attracting many creative people from all over the world to work and live between traces of the past, recent political changes and constantly appearing urban trends that from one day to the next are replaced by another.

Ad Achkar (LB)

Space Box

By studying their light we can understand the composition of stars that are light years away. The invention of the camera obscura was originally intended to stimulate philosophical reflection and speculation on the nature of perception and knowledge, the external world along with the eye and the brain (Jonathan Crary). Thus we can perceive light not only in the subject of a real space but also virtually as the illusion of space. The camera obscura never fails to present several possibilities for shaping reality, neither by producing images nor by creating a surreal illusion or effect and reflecting an outer space structure.

Supervision by Prof. Dr.-Ing. Katrin Wolf and Florian Kühnle

Chompunuch Vanichayanguranon (TH)

Raindrop Filter

Raindrop Filter is a mixed-media installation that aims to relieve the symptoms of weather sickness or yearning for particular weather conditions such as rain.

Supervision by Prof. Thomas Noller, Prof. Dr.-Ing. Katrin Wolf and Florian Kühnle

Claudia Livia (IT)

Whisper

The installation *Whisper* is based on a concept about spreading secrets by whispering. It creates a visualization of a whisper using a configuration of moving elements playing with light reflections. This project involves an experience mediated by a machine that enables an engagement with the public's most intimate secrets. In fact it gives them the opportunity to explore the role of secrets in human behavior.

Supervision by Prof. Dr.-Ing. Katrin Wolf and Steffen Klaue

Ad Achkar

Javier Gurza (MX)

Rattle

Rattle is a sound visualization of seismic waves. The project is intended to represent the sound that rattlesnakes make by shaking their rattles when they feel threatened.

Supervision by Prof. Dr.-Ing. Katrin Wolf, Prof. Thomas Noller and Florian Kühnle

Lydia Smolin (IE)
Altered Atmospheres

Altered Atmospheres is an immersive experience which aims to capture the multifaceted and transitory nature of contemporary Berlin life. Through real film footage together with still photographs to evoke familiar interiors and activities, the viewer is encouraged to engage with the piece by way of the senses of sight, sound, smell, touch and taste. It examines the intersection between model-making and film and how these can be used side-by-side to transform reality and to create an altered space in time.

Supervision by Prof. Thomas Noller, Prof. Dr.-Ing. Katrin Wolf and Florian Kühnle

Ad Achkar

Mahdieh Asadikachehbashi (IR)
Rhythm

Incorporating movement into art is definitely the main concern of kinetic art. The idea of this project is about movement, the clashing of different objects in order to create a sound or rhythm. It is like an instrument which produces its own song, with the notes produced by a small metal ball moving over different surfaces and through pipes.

Supervision by Prof. Dr.-Ing. Katrin Wolf and Steffen Klaue

Nilufer Zakirova (RU)
Post-Penetration

Post-Penetration is an installation showing the repercussions of human actions on the natural world. It combines both sculpture and documentary video. The video contains fragments of deforestation—carved, burning trees in a Moscow suburb. It was made under an emotional shock, while going from a suburb to the city center. The video represents human actions, while the sculpture represents their effect.

Supervision by Prof. Dr.-Ing. Katrin Wolf, Florian Kühnle and Prof. Thomas Noller

Sidra Ashraf (PK)

Sneak Peak

Sneak Peak realizes the idea of observing people without their knowledge in order to confuse the viewer as to the position of people coming view. As the view is indirect and conveyed through different mediums, it allows for playful interaction and enables people to distort their position in space, and relative reflection allows the viewer to see people colliding even when they are far apart.

Supervision by Prof. Thomas Noller, Prof. Dr.-Ing. Katrin Wolf and Florian Kühnle

Miguel Canal (CO)

Ephemeral Dancers

Movement, time and light are the key elements of this work in exploring the ephemerality of images. *Ephemeral Dancers* uses the idea of ephemerality to question our perception and to create an understanding of images as a transient result of the artistic process. Dance, video and phosphorescence are the essential tools used for the projection of images onto a photosensitive surface. They appear, merge and vanish, allowing the viewers to see the impermanent essence of images. Thanks to the phosphorescent paint, images are transformed from video to brief light radiation that re-emits the video projection and which creates a multilayered video painting where movement and time are just traces of light.

Supervision by Prof. Dr.-Ing. Katrin Wolf and Steffen Klaue

All projects with the financial support of the Institut für Gestalterisches Forschen

University of Tsukuba (JP)

PhD Program of Empowerment Informatics, School for Integrative and Global Majors

Future societies are expected to demand engineering systems capable of improving quality of life in terms of safety, convenience, a sense of fulfillment, etc. To this end, this program establishes "Empowerment Informatics" as a new branch of informatics that supplements and extends human functions and enables technology to work in harmony with people.

http://www.emp.tsukuba.ac.jp/

Alberto Boem (IT), Shori Kano (JP), Kai Sasaki (JP)

Vital+Morph

Vital+Morph is a prototype of an organic interface that proposes an unusual viewpoint of the relations between bodies, clinical data and future computational materials. *Vital+Morph* is intended to be used as a medium for remote physical connection and emotional awareness between people hospitalized in an intensive care unit and their relatives.

How to physically engage with clinical data? How can we make them alive again?

Signals coming from a vita–signs monitoring station are physicalized into a series reactive tangible objects. Through them a person can feel the internal state of a hospitalized patient, as a new form of co-monitoring. These elements are surrounded by a moldable interface that helps remote persons to share their physical presence.

By using today's available technologies we wanted to create a perceptual equivalent of novel computational materials and explore their social impact in complex contexts such as healthcare.

Alberto Boem

278
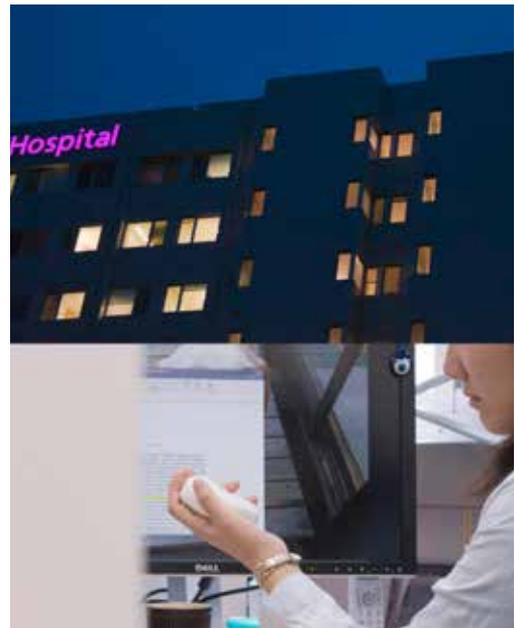
John Brumley (US), Joana Lobo (PT), Rintaro Takashima (JP)

Pitter Pata Pata / ピッタパタパタ

Pitter Pata Pata is a system that synthesizes external physical activity and internal biosignals into localized haptics and kinetic wearables. As our contemporary bodies become increasingly hybridized, with mobile, wearable and implanted technologies playing major roles in how we identify ourselves, existing methods and tools for biological awareness must expand to include device awareness. Likewise, personal devices need to better integrate with our own somatosensory feedback loops. *Pitter Pata Pata* seeks to create a tighter coupling between the biological and mechanical systems of blood flow (pitter patter) and air-powered haptic/kinetic exercise apparel (パタパタ, pa-ta pa-ta) by increasing the wearer's agency in how the device provides haptic and visual feedback.

Vienna University of Technology (AT)
Robots in Architecture

The International Association for Robots in Architecture is originally a spin off association of Vienna University of Technology. Its goal is to make industrial robots accessible for the creative industry, artists, designers and architects, by sharing ideas, research results and technological developments. Founded in December 2010 by Sigrid Brell-Cokcan and Johannes Braumann, *Robots in Architecture* is an open platform for everybody interested in the creative use of and innovative fabrication with industrial robots.

Robots in Architecture is engaged in applied research, soft- and hardware development, "robot pedagogics"–and in the question: how soon will robots revolutionize architecture?

http://www.robotsinarchitecture.org/

PRINT A DRINK

PRINT A DRINK combines methods from robotics, life sciences, and design to explore a completely new field of 3D printing. Rather than building up objects layer by layer, the process uses a high-end KUKA iiwa robot to accurately "inject" microliter drops of edible liquid into a cocktail. Within a minute, *PRINT A DRINK* can build up complex 3D structures in a wide range of drinks–creating fascinating augmented cocktails using only natural ingredients. The process was developed by Benjamin Greimel at the new laboratory for creative robotics of the University of Arts and Design Linz and will utilize the latest-generation KUKA LBR iiwa robot–a robot built for man-machine collaboration.

Credits: Benjamin Greimel; Philipp Hornung; Johannes Braumann; University of Arts and Industrial Design Linz

Philipp Moosbrugger

sonic Degrees of Freedom

sonic Degrees of Freedom is an audiovisual installation that brings together digital with analog, and physical with virtual. It links a collaborative KUKA LBR iiwa robotic arm with an analog synthesizer system, so that the highly complex kinematics of this robotic arm directly inform and generate soundscapes, turning kinematic movement into an electrical current.

The voltage thus generated acts as an interactive audio-input for the mapping installation that is projected onto the robotically fabricated, topo-graphic panels, showing seamlessly mapped live-modulated waveforms triggered by the sound input.

The collaborative robot allows haptic interaction and recording of movement samples, which are then triggered through an interface.

Credits: Johannes Braumann, Michael Schweiger, Maria Bramasole (University for Arts and Design Linz); Christopher Noelle (*http://www.metofa.com*); Sven Stumm (RWTH Aachen)
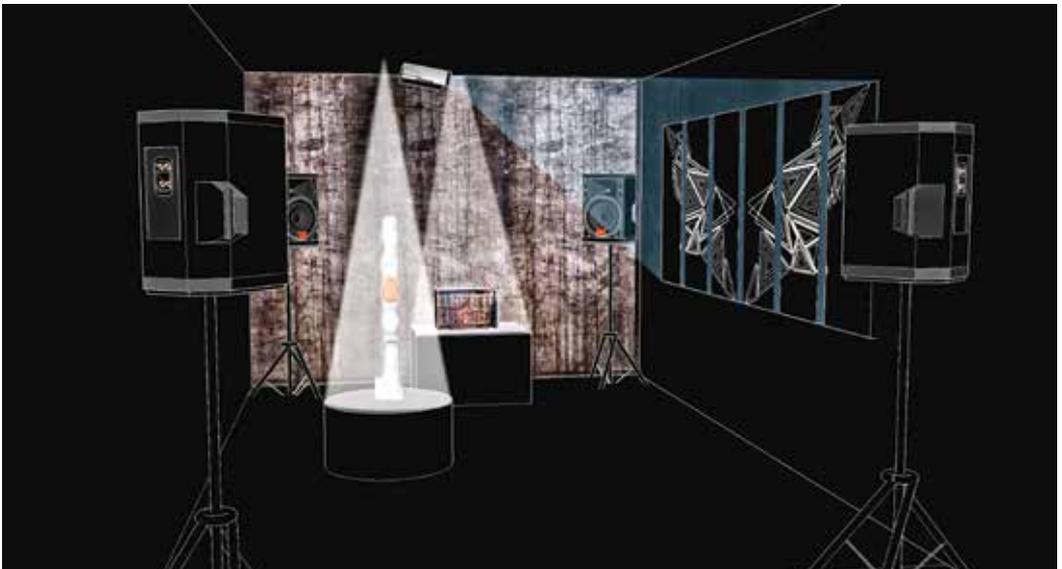
Christopher Noelle

CREATE YOUR WORLD

u19 – CREATE YOUR WORLD
Future Festival of the Next Generation 2016

Saving the World, Playfully

What does it mean to save the world? Saving the world means transforming what has become a place that is hostile to life into a thoroughly livable habitat. And saving the world also means conserving and caring for it as a place worth living in, where it's already Paradise on Earth.

Nothing less than contributing to saving the world was the mission assigned to u19 – CREATE YOUR WORLD when the Future Festival of the Next Generation was launched in 2011.

After all, we can succeed in saving the world—and we will succeed, make no mistake about that—if each and every one of us pitches in.

Play Instead of Being Afraid!

And consider this: the less grimness and solemnity we display and the less we are paralyzed by fear that the sky is falling, the easier it will be to achieve this! Playfully—that's our motto, and it's just what the doctor ordered! The more enjoyably we go about changing the world to make it better, more diverse and more sustainable, the more meaningful, more inspiring and more rewarding it is.

Meaningful, inspiring and rewarding are also the precise attributes to describe u19 – CREATE YOUR WORLD's 2016 program. The Future Festival of the Next Generation offers an up-close-and-personal introduction to lots of amazing stuff that's happening right now and what will be emerging in the near future.

As a visitor, you can join in, go for a test drive on the leading edge, get fired up, learn something new, or maybe just check out what your peers are up to.

We Global Villagers

Whatever you do, whatever someone else does—it works. Even if you don't do anything. Why? Because,

Tom Mesic
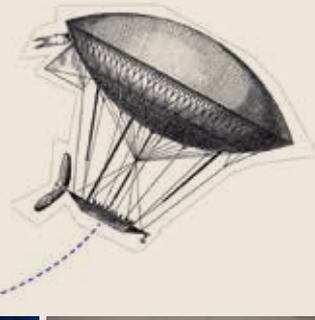
Tom Mesic

as we have come to realize, everything's interrelated. Welcome to Network Earth!

The Global Village at u19 – CREATE YOUR WORLD makes it clear to visitors of all age groups how tightly the global web is woven and the influence that you as an individual node can have on the entire configuration. Do you even realize how effective you are? In the Global Village, you find out what happens when you, here in Austria, eat a pineapple from Peru. You see who benefits and how, who gets short-changed, who uses far too much, and how we could all have enough. On the Village Square, you can learn how to solve this conundrum.

The way we see it, ideas need space for brainstorming, creativity and a lively exchange of views. And that's exactly where the Global Village comes in.

Imagine what it would be like if the world were a village and all of humankind were reduced to 100 inhabitants. Consider how coexistence would play out in such a small community. What language would be spoken, and how would these people provide for the necessities of everyday life? And what about political systems—and would it even makes sense for everyone to work together to jointly solve problems? How can we enjoy the good life without destroying Planet Earth in the process? And what does sustainability actually mean? All of these questions can be put to experts who will be on hand to work together with you on your ideas for a more sustainable world at an amazing array of hands-on stations and workshops. And one thing's for sure—extraordinary solutions are yours for the taking here!

Verbindung hergestellt (Connection Established) is a project in which 21 pupils from Vorchdorf Elementary School, asylum seekers living in that town, and the Ars Electronica Center Linz and Trotec Lasercutter jointly produced an exhibition. Working together, the participants got acquainted with one another as a way of reducing or eliminating fears or feelings of insecurity that might exist among them. Plus the resulting public exhibition is a great way to reach lots of other local residents and help them get to know asylum seekers living in their midst. At their first get-together, the pupils and asylum seekers interviewed each other and introduced their respective conversation partners to the entire group. The next step was a joint visit to the Ars Electronica Center for a workshop about the human body. In the final phase, all participants were photographed and the resulting images used to make anonymized cardboard cut-outs that, together with the audio recordings of the interviews, comprise the centerpiece of the exhibition. The aim is to establish an inspiring setting for interpersonal encounters taking place among equals.

Tom Mesic

Susi Windischbauer

Habits.wiki is a Wikipedia-like online platform at which country-specific habits of urban and/or rural people worldwide can be entered, described and accessed/queried. This reveals differences among people as well as showing what they have in common, and it thereby fosters intercultural transparency and understanding for other ways of life.

The Festival Ars Electronica attracts visitors from all over the world and thus provides fertile soil for *Habits.wiki's* seeds to germinate and take root worldwide. Every festivalgoer will have the opportunity to input new habits, to study the habits of strangers and to compose alternative entries.

The mission of *Habits.wiki* is, for the first time in human history, to collaboratively describe the diverse behavioral patterns of our species, to structure the material and make it available to users.

> "He only fears mankind who knows them not, and he will soon misjudge them who avoids." Johann Wolfgang von Goethe

The exhibition was produced between April and June 2016 as a cooperative effort by Peter Androsch, the Ars Electronica RefugeeLab and the Independent Province Volunteer Center. People who have fled from Pakistan, Afghanistan, Bangladesh, Ghana and Korea confront the subject of passion. What does passion mean in its classic sense—the suffering of Jesus Christ—and what does it mean figuratively in the sense of a traumatic experience—in connection with fleeing, for example?

Every story presents itself as a multidimensional image. Black on white, what people have gone through becomes visible. Language and alphabet are foreign to us; images fascinate, and we find them beautiful. In this way, "The Refugee" ceases to exist; behind every image, behind every story, there is an individual human being who thereby becomes visible.
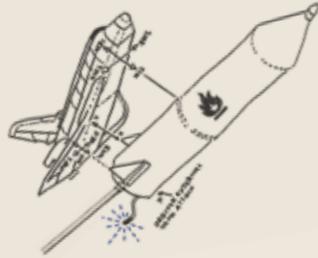
Florian Voggeneder

Martin HiesImair

Solutions, and make it quick!

Let's not underestimate the major challenges we are facing, which demand our courage and creativity! Nevertheless, the amazing things that productive energy and decisiveness can accomplish will be demonstrated at u19 – CREATE YOUR WORLD by several projects focusing on production methods of the future. Here, the focus is on two emerging currents that have already begun to reshape our economy: fabrication as the do-it-yourself movement of the 21st century, and rapid prototyping as the turbocharged approach to problem solving. Our motto: cut the blah-blah; get busy and try it out. In FabricationLab Extended, you can transform your idea into a prototype on the double—in a simple, user-friendly, playful way.

Fabrication Lab Extended

A healthy dose of ingenuity is called for here, since the job at hand is processing out-of-the-ordinary materials with a wide variety of methods and tools. A laser cutter and a 3D printer are mainstays of the infrastructure in such a multifunctional lab, offering equipment to turn all sorts of ideas into real prototypes. But there is lots more to discover, and you can get all kinds of tips and pointers from artists who have already gotten into the swing of things. They set pictures in motion, advance filament, cause solder meltdowns, saw stuff apart only to stitch it back together again, get hammers a-swingin' and the CNC machine a-buzzin'. Meanwhile, the coders among them will be occupied with the apparently invisible driving force behind this machinery, the programming language.

Among them as well the watchwords are: "open it up, peer inside, take it apart and put it back together again." That encapsulates the can-do spirit of the MAKER FAIRE®, which originated in the USA. The Americans call it "The Greatest Show (& Tell) on Earth," by which they mean that a Maker Faire is, for one thing, a science fair; for another, a sort of carnival; and, at the same time, something altogether new—a family-friendly festival for inspiration, creativity and innovation. On one day of the festival, the Linz Mini Maker Faire will contribute, in collaboration with Make: magazine, yet another facet to this colorful jamboree of lateral thinkers.

Make:
make-magazin.de

Ars Electronica 2016
Mini Maker Faire
POST CITY, 11.09.16
Linz

RIC

Tom Mesic

Tom Mesic

Kristóf Fenyvesi

287

Gamification is the Key

Gaming is the gateway to a positive future—not the only route, but it will get you there for sure. A key to this gateway is Gamification. Gamification doesn't declare play as strictly a reward for completed labor; instead, work and play are blended into a holistic experience of utilitarian acts and stuff done for fun, purposeful exertion and effortlessness. Thus, in 2016, u19 – CREATE YOUR WORLD is dedicated to game playing: from unbridled exuberance to curiosity, the mechanisms that games trigger and the inner logic on which play is based. u19 – CREATE YOUR WORLD is convinced that saving the world is not a dirty job that somebody has to do. If it is as much fun as a computer game, more players will gladly come along for the ride.

This setting is designed to showcase new dimensions of play—from the exploration of strange virtual worlds to interactive live gaming events.

One thing is certain—there are lots of opportunities

for discovery and hands-on experience. Let yourself be teleported to scorching deserts, frigid mountains or a bottomless swamp, and explore these strange domains with all your senses. You will have the chance to immerse yourself in new worlds and galaxies, and if you've got the nerve, you can even encounter talkative guests from other galaxies, and make politicians shut up and listen for a change. Regardless of your preference—classic first-person shooter, application of strategy, or quickie pastime on a mobile device—you will get your fill. At a live gaming event, the principles of Roman gladiatorial combat will be redefined in an abstract futuristic arena in which participants determine their own level of engagement and precisely how to go about partaking of this extraordinary experience.

And as if that weren't enough, you can also take part in a game set in the real world, surmount obstacles, and draw inspiration from live synchronized music.

u19 Agency–Networking Is What's Happening!

Year after year, jurors in the Prix Ars Electronica's u19 – CREATE YOUR WORLD category are astounded by the entries young people submit. These projects manifest youngsters' ingenuity and the diversity of the methods, media and tools they use to express themselves today: films, pieces of music, electronic and electromechanical gadgets, graphics, board games, drawings, websites, apps and–like this year's Golden Nica recipient–games. It's a big batch of knowhow that's brewed up each year at the Prix, which is why we've set up the u19 Agency to facilitate our role as mediator. We interconnect creative thinkers and doers, get up-and-coming alchemists hooked up with their peers and, at the same time, show them, based on our experience, what it takes for someone with a project or an idea to convince others of just how awesome it is. In this spirit, we've invited the 15 winners in the Prix's u19 – CREATE YOUR WORLD category to plan and produce this year's u19 Exhibit together with us. Selected u19 Guides will even be conducting the tours of the exhibition, so they can see for themselves how audiences react to their ideas, what people comprehend and where they need some conceptual support. The prizewinners will be on the receiving end of the recognition they are due at the u19 Ceremony, where their honors will be bestowed upon them in the presence of leading artists, officials, scientists and dignitaries in the worlds of culture and commerce.

But that's not all, folks!

We know–there are lots of submissions that deserve recognition but came away empty-handed this time around. These are projects that display plenty of potential, but maybe the concept was not thought all the way through or the presentation could have been a bit niftier. At u19 Agency Labs, we get the kids who created them together with artists and mediators who are seasoned pros at imparting the right design to an idea and thus letting it speak volumes on its own behalf. And we also have just the thing for those who have already mastered this fine art–an open round conducted according to the u19 Fishbowl principle. Here, u19 – CREATE YOUR WORLD entrants can present their projects, discuss them, and, in the spirit of open source, invite others to team up and develop them further.
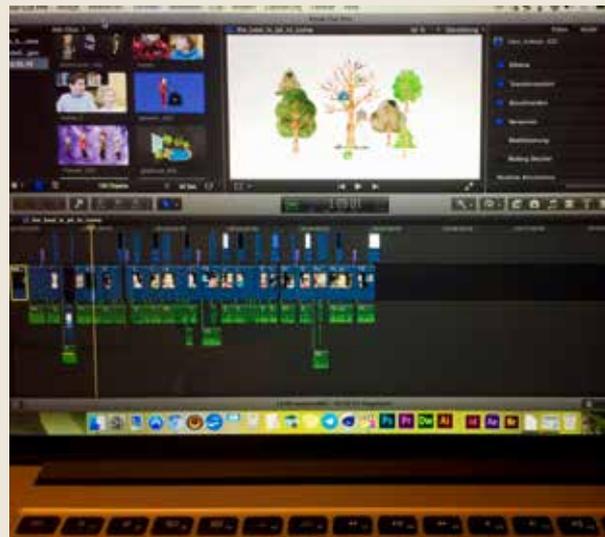
Ars Electronica EducationLab
Education for the Present and the Future

One premiere is already a definite fixture on the festival line-up. The brand-new Ars Electronica EducationLab makes its debut at the 2016 festival. This open house throughout the festival will introduce a lavishly furnished space for reflection in which protagonists may, can and should think aloud (!) about the future of education. u19 – CREATE YOUR WORLD could not hope for a lovelier setting or a more fertile environment for these considerations. While u19 – CREATE YOUR WORLD showcases inspiring examples for the application of humanism and intelligence to the job of configuring the future, the Ars Electronica EducationLab's job is to give a lot of thought to learning and benefiting as much as possible from these ideas. How do we take ingenious practical concepts and implement them in schools? How do we make teachers our accomplices as we go about saving the world?

A network of universities, technical colleges, high schools, artists and extramural educational institutions is working together here to maximize quality. The Ars Electronica EducationLab's guidelines are the 17 sustainability goals of the United Nations. They are to be implemented by 2030, which is a major challenge. Schools can make a big contribution to achieving them.

On Thursday, the EducationLab focuses on participation and political socialization; on Friday, on health; on Saturday, the spotlight is on integration and inclusion; Sunday's theme is future production; on Monday, digital fluency and technology and education are the day's topics.

Emiko Ogawa

Ars Electronica EducationLab

The prevailing facts and circumstances are familiar to all: we live in a global information society in which digital media and science are taken just as much for granted as eating with a fork and brushing your teeth.

A Question of Speed

Everybody has also heard about the dark side of the information age: chronic stress due to information's speed and volume, new forms of gaming and other addictions, a general tendency towards sociopolitical hysteria. This is due in no small measure to the fact that technology and media are developing much faster than human competence in dealing with the incessant flow of new tools and applications. The speed of these trends poses big questions and problems in many areas.

What to Do? Develop 21st-Century Education!

In light of the fact that traditional educational structures cannot be adapted to the speed of social and technological development, we need new locations to create and test educational, pedagogical and learning formats fit for the digital age. They must serve the global goal of generating finding that can be applied, in turn, to other educational structures.

Dealing in a productive way with technology and science is, first and foremost, a matter of education. And it is also to a great extent a social question, and one that constitutes a substantial challenge to the rather static educational system as we know it, and puts it under pressure to take action. Rapid developments of a social and technological nature seem to be too much for most educational institutions to handle. What they still lack are didactics fit for the 21st century. And there is still no open facility in which to develop and test these teaching methods in a flexible structure of scholarly disciplines and institutions.

A Brief Intro: Ars Electronica and Education

Scrutinizing the basic principles of the issue enunciated at the outset—how society and technology influence, shape and determine each other—has been the core of Ars Electronica's mission since its inception in 1979. Ars Electronica stands for an open, often playful and usually experimental mode of dealing with technologies and media in ways that are in tune with the times.

Ars Electronica's interest as an institution is always on fostering a critical confrontation with what current developments and emerging trends bode for humankind's everyday life in the near future.

As the festival producer, museum operator and R&D lab host, Ars Electronica has amassed tremendous knowhow in pedagogy and didactics in conjunction with media and science, and gained extensive experience as an extramural teaching institution designed to implement informal approaches to educational experiences without strictly prescribed learning goals. Accordingly, nurturing our clientele's creativity is a top-priority item on Ars Electronica's agenda. The declared aim of this educational facility on the banks of the Danube is the empowerment of visitors—supporting them in adjusting to the changing media and technical realities and enabling them to derive benefits from these constantly upgrading technologies. Ars Electronica has come up with a one-of-a-kind Infotrainer system as a method of mediating visitors' encounters with content in the Museum of the Future and has also successfully developed formats and programs for target audiences ranging from kindergarten classes to senior groups. Intensive, long-term collaboration with universities and research institutions throughout the world are also characteristic of Ars Electronica. The Ars Electronica EducationLab is conceived as an open facility—on the intellectual level as the educational and educational research division of Ars Electronica and its partners, in which to take advantage of skills and combine capabilities to create new knowledge and develop new solutions; and on a material level as a concrete laboratory space to experiment with new formats, applications and installations.

Ars Electronica as a Place of Learning

Ars Electronica is one of the few institutions in the educational field that does not reject or take a standoffish approach to new technologies or social changes. Quite the contrary—we actively integrate them as core elements of our programs and employ them as versatile tools. This makes a dialog possible where, elsewhere, there is often a lack of communication. We cultivate an open approach to all means at our disposal and keep our eyes open to the opportunities and risks they entail.

As an extramural educational facility, Ars Electronica sees itself as complementing rather than competing with existing institutions. This holds true especially since the museum's redesign to enable visitors to experience science in a totally new way. Infrastructure such as the BioLab and the FabLab offer unprecedented new forms of competence enhancement. More than 35,000 students annually take advantage of this infrastructure in conjunction with group tours and workshops.

Mission Statement of the EducationLab

Amid the ongoing discussions surrounding the school of the future, Ars Electronica has taken action in the form of an EducationLab as a site for developing, testing, investigating and disseminating teaching models for the present and the future. The mission is simply stated: ways and means of learning to deal with the speed of social change without being constantly overwhelmed. On one hand, this means educational tools designed for 21st-century teaching; on the other hand, this is a matter of empowerment, especially for members of society who have previously had little opportunity to learn to deal with digital media in ways that are productive and that foster their personality development. And this shifts the focus to those who lack access to higher education.

This means new forms of science education and digital fluency—imparting knowledge and acquiring the capability to exploit digital tools instead of just being a pawn of the technology. Thus this is also a matter of ensuring equal opportunity and people developing their personal potential.

Networking in the EducationLab

There are several higher education institutions in Upper Austria that offer programs designed to foster innovation–in technology, art and science, as well as in teaching. The EducationLab can and should also be a place where these various experts can convene to collaborate on interdisciplinary projects. In addition to networking, Ars Electronica can also host courses in which the knowhow developed here is shared and developed further.

Vanessa Graf

EducationLab as a Real Place

As a physical location, the EducationLab is a proving ground for experiments in media pedagogy and science education. A secure setting and competent supervision make it possible, for example, for test subjects to immerse themselves in virtual gaming worlds for 24 hours at a time and then reflect on what they have just been through. Only those who have personally experienced what it's like in young people's media-based everyday reality can work with them in a suitable way.

EducationLab at the Focal Point

Modeled on the likes of Chicago's Urban Lab, Ars Electronica's EducationLab is conceived as a sort of Municipal Library 2.0–a pop-up lab that can be flexibly deployed where educational programs are in short supply in order to provide playful new approaches to digital media and the natural sciences.

Commissioning the EducationLab to Carry Out Assignments

The EducationLab is meant to serve parents and teachers, schools and universities, institutes, firms and educational institutions that are struggling with the rapid pace of social developments. The EducationLab creates new educational formats and programs. One of the services the lab offers is Ars Electronica's specific knowledge in the field of education. The EducationLab also looks forward to working with companies that want to upgrade their apprentice training program and the continuing professional education they provide to employees.

Tom Mesic

Projects and Programs in the EducationLab

My FutureWorkshop

Sometimes, young people have to take detours, gain experience and get a second chance in order to find their way in this complex world. Upper Austria and Austria's federal unemployment office offer various courses for youngsters who are currently out of school and/or have yet to find an apprenticeship. This program began offering something new in 2015: a few course participants could take a one-week FutureWorkshop at the Ars Electronica Center.

The aim is to impart key skills, to help them recognize previously undiscovered talent, and to get experience working as part of a team.

Nine My FutureWorkshops have already been held at the Ars Electronica Center. Their success speaks for itself: several of those who completed the course got internships, summer jobs and even full-time employment as Infotrainers at the Ars Electronica Center and thus have bright future prospects.

A few former participants will be working together with an interdisciplinary documentation team at the festival to gain insights into the production field.

Participation and Political Socialization in the Age of New Media

An event produced jointly by the Upper Austria Teacher-Training College, Upper Austria Chamber of Labor and the Ars Electronica EducationLab

New social media have been changing our daily lives and how we communicate for some time now. Especially for young people, these media constitute a central element of their lifestyle. Even the political discourse in increasingly conducted via Facebook, Twitter and similar platforms, and this has opened up new channels for sociopolitical participation and socialization. The purpose of this conference is to come to terms with this challenging new reality and to ascertain its impact on political education. The scheduled events include a briefing on recent social developments and market research on methodological-educational exchange and game modules, as well as a round-table discussion with prominent participants.

The collaborative production of this event is kicking off more intensive cooperation between the Teacher-Training College Hochschule and Ars Electronica that will focus on education for the present and future at the interface of digital competence, creativity, the culture of innovation, and participation. The key issues participants will be discussing are:

• How can classroom instruction be configured so that conveying digital competence is not seen as an additional challenge?

• How can digitization foster individualization?

• How can media be used in classroom instruction so as to implement equal opportunity and help to develop people's personal potential?

• How are these new participation possibilities changing democracy, and where does political discourse among young people take place?

The aim of this joint venture is clear: on the one hand, coming up with ways and means of learning to deal with the speed of social change without being constantly overwhelmed; on the other hand, developing educational tools designed for 21st-century teaching.

This is a matter of new forms of science education and imparting digital fluency—the ability to utilize digital tools instead of just being a pawn of the technology. Thus this is also a matter of ensuring

Tom Mesic

equal opportunity, of helping people to be all they can be and to accept responsibility, and of new online participation possibilities and how democracy is being changed by them.

Das Erkenntnisspiel
(The Insight Game)

Produced jointly by Otelo eGen, the Upper Austria Department of Health and the Ars Electronica EducationLab

"Virtual reality (VR), also known as immersive multimedia or computer-simulated reality, is a computer technology that replicates an environment, real or imagined, and simulates a user's physical presence and environment to allow for user interaction. Virtual realities artificially create sensory experience, which can include sight, touch, hearing, and smell."* VR is hot; it's a blockbuster hit, and not only among young people and gamers. Otelo eGen, Ars Electronica Linz and the Upper Austria Department of Health have launched an initiative for the early detection of trendy new consumer products like VR glasses and, by way of response, development of appropriate educational programs to protect future users from abuse.

* Source: https://en.wikipedia.org/wiki/Virtual_reality

The working group is getting support from experts in the fields of addiction prevention, technology research and education (province school director and teacher-training college). Since autumn 2013, the members of this interdisciplinary group have been exchanging visions and ideas of what it actually means to use technology in a healthy way, what steps are necessary to make these insights available—especially to individuals and institutions that can exert an influence on consumer and media behavior—and their effects on the health of young people.

The first joint project is currently undergoing testing in various contexts. Das Erkenntnisspiel (Insight Game) is played out in a mixed reality, a hybrid of virtual and real space. It attempts to integrate a process of reflection by users right into the gaming experience and to provide a basis for a postgame session about the users' online, gaming and media behavior.

Technology is omnipresent; it expands our senses, gives us feedback, motivates and supports us, and keeps us under surveillance. But what body of rules governs it as it does so? Who is controlling the technology, and who is it controlling?

Through the use of virtual-reality glasses in *Das Erkenntnisspiel*, the boundary between reality and fiction comes close to being suspended. It is played by three teams simultaneously; up to 25 players can take part. Each team has

- a client, who sees the world "through" his/her smartphone, which serves as VR glasses; the client is also equipped with a smartwatch to collect data and determine the current location; the client must carry out missions;
- a mission controller who has access to the client's data glasses and smartwatch and thereby controls the client's activities from a command post via the telecommunications link;
- a healthcare and monitoring manager who is responsible for the health check at the start of play and has constant oversight of all data gathered;
- and at least one observer, the so-called ghost, the protective escort during missions.

Three potential missions are available:

1. Cooperation (10 minutes, play mode: Capture the Flag, at least two participants)
2. Empathy (30 minutes, fictitious research scenario, all participants undertake a shared mission)
3. Bullying (50 minutes, three teams play simultaneously, sociogram of the class as point of departure)

Although everything takes place in a real space, participants get the impression they are in a virtual gaming world. The effect of this game setting is to prompt participants to reflect on what they are doing. Topics such as data security and virtual personality can be dealt with in very vivid terms at the group's postgame session.

As an accompaniment to the game's current and future use in schools and at other events, a symposium is being held on September 9, 2016, in cooperation with Linz Teacher-Training College as a means of providing continuing professional education for teachers, physicians, therapists, et al., and as a scholarly point of departure for broader and deeper research on health-related issues attributable to the use of new technologies.

Harald Prochaska

Otelo eGen–Learning Spaces

Creating new play spaces for active, self-paced learning

In conventional educational and training courses, learning is perceived by many as an unpleasant task to be avoided whenever possible. We support the development and testing of new learning formats and cultures. Our learning spaces offer

- participative methods
- at open locations
- concrete results (that go beyond the experience gained here).

In addition to the art-of-hosting and other participative methods, we utilize media technologies for online collaboration, audio and video production, blogging/social media, 3D printing and virtual worlds. The result is to intensify experience values and to produce tangible, noticeable results.

Otelo Learning Spaces develops specific educational programs in cooperation with companies, intermediary organizations, research facilities and educational institutions:

- Kids Experience Technology
- Virtual Real Spaces
- Experience worlds for companies
- Coding dojos
- 3D printing labs in schools and firms
- Video as reflection; video interventions

References

- Kinder Experience Technology
- Virtual Real Spaces
- Andritz AG, Stiwa Holding, Miba AG, Upper Austria Chamber of Labor
- ISK–Institute for Social Competence
- Institute for Addiction Prevention
- Otelo–Open Technology Labs

Tom Mesic

Province of Upper Austria / Department of Health

The emergence of new media and technology is a milestone in humankind's history, especially the latest technological developments such as the computer, the Internet and smartphones. On one hand, every new technology opens up new possibilities and expands people's latitude for action; on the other hand, it takes time, concerted efforts and learning processes to integrate the latest technology into the existing culture. Every expansion of our latitude for action creates a new opportunity to act out and channel behavior for which, in the absence of the new technology, there would have been no equivalent. There are many positive aspects of this, but it also entails risks such as insufficient self-control in taking advantage of these new possibilities. In the past, it has already been possible to observe disturbing behavioral phenomena and problematic patterns of use associated with the introduction of new technologies. For example, the spread of radio and TV resulted in warnings and outpourings of fear about their negative impact on culture in general and the social development of young people in particular.

To foster public health and prevent ill effects in this context, it is important to imbue skills conducive to a constructive, competent mode of dealing with these new technologies. Learning social and personal skills like coming to grips with feelings, critical thinking and steadfastness, the development of productive strategies in response to challenges and stress, and building up strong self-esteem have been identified as key protective factors that deter the emergence of problematic behavioral patterns (in dealing with new technologies as well). *Das Erkenntnisspiel* makes an important contribution to this.

At the Ars Electronica Festival, *Das Erkenntnisspiel* will be a featured attraction in the u19 – CREATE YOUR WORLD's VR Lab, where 15 youngsters from Germany, Hungary, Switzerland and Austria will work on developing this idea further. It will also be one of the focal-point topics at a symposium entitled "Virtual Reality in the Educational, Social Welfare and Health Care Fields."

Harald Prochaska
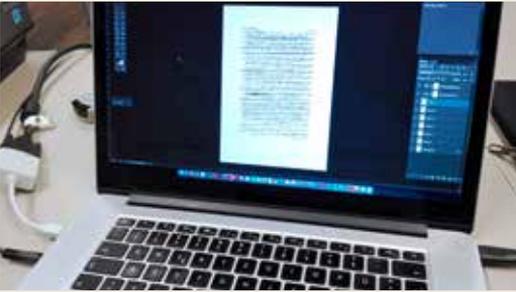
Susi Windischbauer

Second Conference for People Providing Aid to Refugees

Initiative ZusammenHelfen (Helping Together) in Upper Austria

The Festival Ars Electronica will host the Second Conference of People Providing Aid to Refugees in the Province of Upper Austria in order to offer part-time volunteers and full-time staffers a setting in which to network, acquire information, inspiration and motivation, and exchange views. Wide-ranging input from experts and various workshops on subjects such as language, cultural understanding, work and training are intended to strengthen and motivate helpers in their efforts on behalf of refugees.

Education and Technology Summit

The Festival Ars Electronica is hosting the event kicking off an Upper Austrian competence network in the field of media education. All local experts in this field are cordially invited to attend a round-table discussion of potential projects, the directions of future development, and the individuals' own initiatives. The aim is to bundle resources and to communicate insights in the field of media education to the general public.
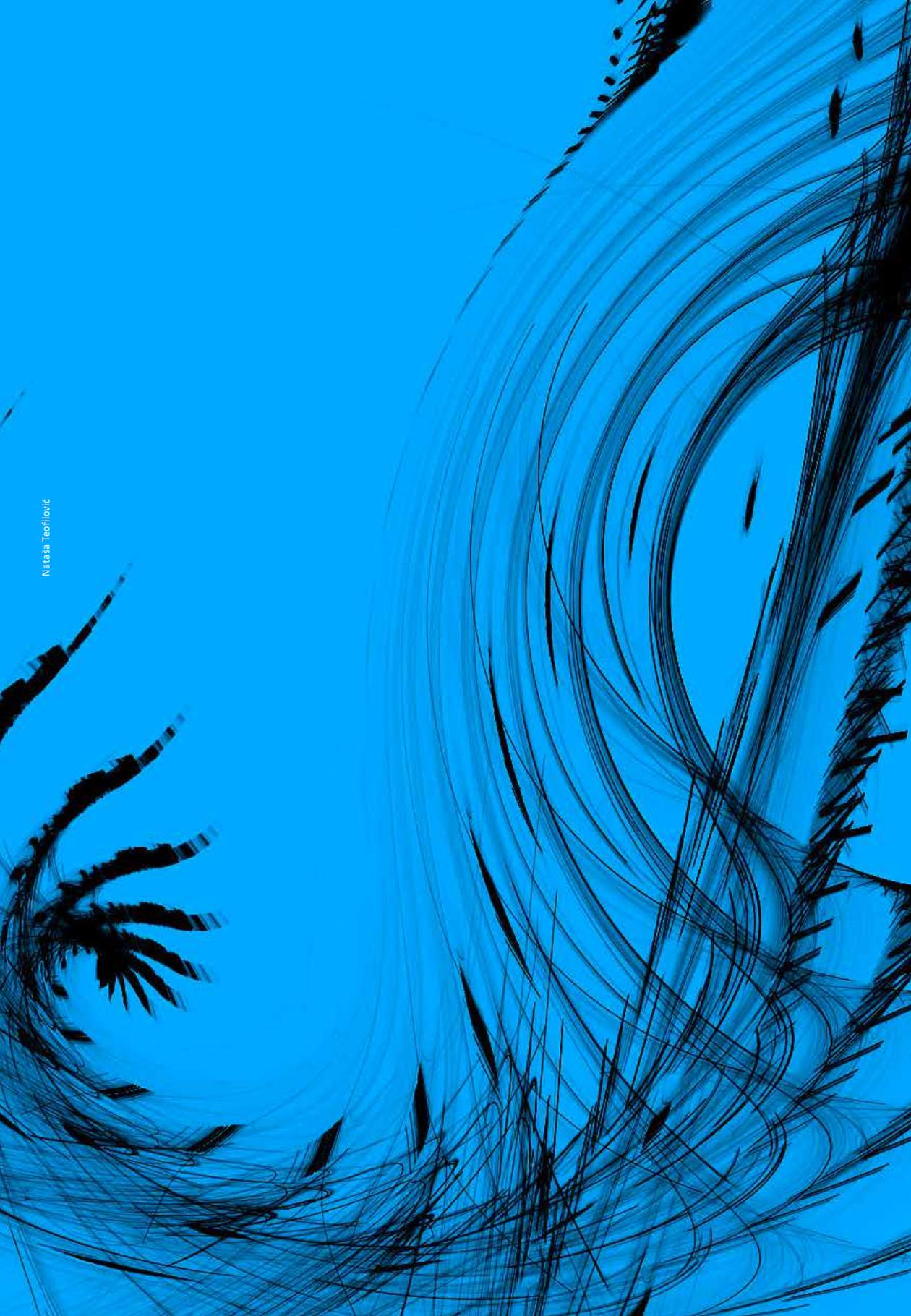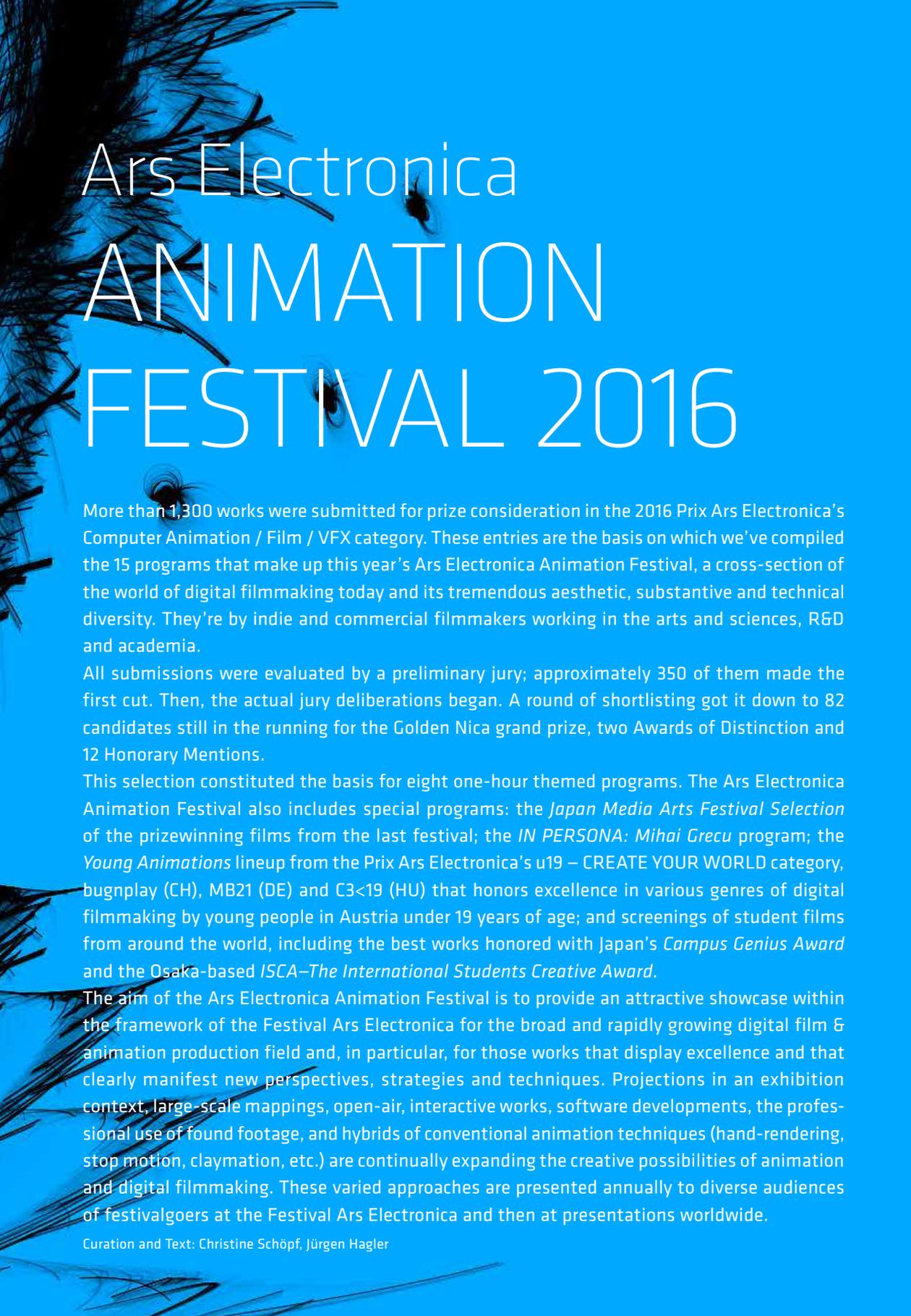
Ars Electronica
ANIMATION
FESTIVAL 2016

More than 1,300 works were submitted for prize consideration in the 2016 Prix Ars Electronica's Computer Animation / Film / VFX category. These entries are the basis on which we've compiled the 15 programs that make up this year's Ars Electronica Animation Festival, a cross-section of the world of digital filmmaking today and its tremendous aesthetic, substantive and technical diversity. They're by indie and commercial filmmakers working in the arts and sciences, R&D and academia.

All submissions were evaluated by a preliminary jury; approximately 350 of them made the first cut. Then, the actual jury deliberations began. A round of shortlisting got it down to 82 candidates still in the running for the Golden Nica grand prize, two Awards of Distinction and 12 Honorary Mentions.

This selection constituted the basis for eight one-hour themed programs. The Ars Electronica Animation Festival also includes special programs: the *Japan Media Arts Festival Selection* of the prizewinning films from the last festival; the *IN PERSONA: Mihai Grecu* program; the *Young Animations* lineup from the Prix Ars Electronica's u19 – CREATE YOUR WORLD category, bugnplay (CH), MB21 (DE) and C3<19 (HU) that honors excellence in various genres of digital filmmaking by young people in Austria under 19 years of age; and screenings of student films from around the world, including the best works honored with Japan's *Campus Genius Award* and the Osaka-based *ISCA—The International Students Creative Award*.

The aim of the Ars Electronica Animation Festival is to provide an attractive showcase within the framework of the Festival Ars Electronica for the broad and rapidly growing digital film & animation production field and, in particular, for those works that display excellence and that clearly manifest new perspectives, strategies and techniques. Projections in an exhibition context, large-scale mappings, open-air, interactive works, software developments, the professional use of found footage, and hybrids of conventional animation techniques (hand-rendering, stop motion, claymation, etc.) are continually expanding the creative possibilities of animation and digital filmmaking. These varied approaches are presented annually to diverse audiences of festivalgoers at the Festival Ars Electronica and then at presentations worldwide.

Curation and Text: Christine Schöpf, Jürgen Hagler

Deconstructed Realities

Deconstruction in a philosophical sense means breaking down literary or philosophical texts into their component parts and then assembling them anew. And that's exactly what the filmmakers on this lineup do with architecture, everyday events or urban life: a Los Angeles studded with colorful neon signs in Arabic; a stereoscopic leap into the entrails of Paris; the surrealistic reversal of everyday acts; and microscopic investigations leading into the inner domains of the outer world.

Seed, Manuel Casasola Merkle (Aixsponza)

Hide, Christian Stangl, Strange Freedom

Visuals & Sound

This program features music videos and works of sound art that demonstrate diverse ways of blending imagery and music. The spectrum includes classical music videos, software developments and dancing robots. What they all have in common is the successful interplay of acoustic and visual elements. Come and see/hear for yourself!

Statement

The filmmakers on this lineup take a stance on the big issues of our times—for instance, the current sociopolitical situation in Europe and the refugee problem, global warming, and using resources sustainably. Some of these takes might come across as comical at first, but they'll soon wipe that smirk off your face and replace it with a pensive look.

The Race, Michael Le Meur

Abstract

Abstraction—that is, the reduction of what's cinematically depicted to its essence or to certain aspects of it—can make use of a wide array of techniques. They range from abstract sculpture and painting onto film with a laser to mapping and generative art. The result is impressive visual complexity.

Rhizome, Boris Labbé (Sacrebleu Productions)

Coordinated Movement, Mike Pelletier

Expanded & Experimental

Experimental modes of animation are on display here. Real and virtual dance performance is seamlessly combined with quadcopter-mounted cameras that expand the space; macro shots shift the point of view inwards; light painting is technologically expanded; fluid bodies are animated via motion capture; and hybrids of game and reality trigger an impressive shift of perspective.

Narration

The plots on this classic narrative program include the tragic life story of a young girl in Saigon and tales of friendship and remembrance. A series of touching, poetic encounters.

MOOM, Robert Kondo, Daisuke Tsutsumi (Tonko House, CRAFTAR, Marza Animation Planet)

Comedy & Black Humor

Lots of dark humor is packed into this program: A 12-year-old boy dissects a frog in biology class and speculates about what he would do if he were God; the bedtime story of Father Opossum is an inane alphabet of death; and the Sisyphus-like saga of two mountain climbers in the Alps is a stone-cold stunner.

WINNER

Accidents, Blunders and Calamities, James Cunningham (Media Design School)

Jungle of Desire, Ping Wong

Late Nite

When darkness falls, it's time for tales of monsters, zombies, cat-eating wolves, trash as 1980s reminiscence, and sex. This might not be right for our underage friends, but grown-ups are sure to get a kick out of it!

IN PERSONA: Mihai Grecu

Mihai Grecu's visual and poetic trips mix several techniques and styles and may be seen as propositions for a new, dream-oriented technology. After studying art and design in Romania and France, he has been pursuing his artistic research at the Fresnoy Studio of Contemporary Arts. Recurring topics such as distress, cloning, hallucination, city life and war articulate the whole of his exploration of mysterious and subconscious beginnings.

Coagulate, Mihai Grecu, produced by Le Fresnoy

Young Animations

Witty, off-beat, subtle, tragic and serious animated work produced by young filmmakers will be screened during the Festival Ars Electronica. Every year, gifted young filmmakers submit their movies to u19 – CREATE YOUR WORLD (AT), bugnplay (CH), MB21 (DE) and C3<19 (HU). The greatest hits will be featured in Young Animations.

Kim's Life, Lena Krautinger, Safia El Maataoui

I am alone, walking on the straight road, Masanori Okamoto, Tokyo University of the Arts

Japan Media Arts Festival Selection

This program introduces eight video works which reflect everyday life in contemporary Japan through very Japanese depictions of the human emotions. *The House of Small Cubes,* the first Japanese film to win the Academy Award for Best Animated Short Film, conveys an important, moving awareness through its precise, nostalgic world view. Other works in this program use minimalist techniques to excite the viewer's imagination.

Campus Genius Award

The Campus Genius Award (Gakusei CG Contest) honors digital artworks created by students. The continuity of this contest, which has been held for 21 years, underpins its important role in Japanese media arts. Incorporating new media and technology forms of expression that change with the times, the contest forms a gateway not only for computer graphic artworks, but for a wide range of diverse genres.

Sushi, Asami Nakamura

ISCA–The International Students Creative Award

The International Students Creative Award is an international arts and information media competition sponsored by the Knowledge Capital Association. It is for Japanese and international university, graduate school and vocational school students.

slight fever, Saho Nanjo

Jazz Orgie, Irina Rubina

Filmakademie Baden Württemberg Anniversary Screening

The prestigious Filmakademie Baden-Württemberg celebrates its 25th anniversary in 2016. The Institute of Animation, Visual Effects and Digital Postproduction is integral to the Filmakademie's international acclaim: founded in 2002, the Institute offers hands-on training in animation and interactive media. Its award-winning student projects cover the whole range of animation and explore transmedia aspects–from drawn animation to 3D projects and fully-fledged VFX productions. This screening features a hand-picked selection of outstanding student projects from the last 25 years.

Tsinghua University

This program features selected works of animation art by students at the Academy of Arts and Design of Tsinghua University in Beijing (CN). Tsinghua is considered one of China's best universities for engineering and the natural sciences. It's a member of the C9 League, an association of the country's nine most prestigious institutions of higher learning.

A Miner´s Story, Ju Li

Jürgen Hagler (AT)

Expanded Animation
The Alchemy of Animation

The fourth annual Expanded Animation symposium is entitled The Alchemy of Animation in keeping with the 2016 Festival theme, RADICAL ATOMS and the alchemists of our time. The focus is once again on the fringes of the computer animation field as well as on the reciprocal interaction of animation and technology. This year's three featured topics are science, society and industry, which will be discussed from a variety of perspectives by three panels made up of animation filmmakers, curators, scientists, VFX artists and prizewinners in the Prix Ars Electronica's Computer Animation/Film/VFX category.

Kicking off the symposium is the Prix Forum in which the 2016 Prix Ars Electronica prizewinners present their work and discuss current trends and future developments in computer animation. The Art & Science panel will scrutinize various areas at which animation, art and science intersect and overlap. Producer/curator Abigail Addison presents *Silent Signal,* a collaborative project by six animation filmmakers and six scientists in the field of biomedicine. This form of cooperation gave rise to experimental works that explored questions concerning new ways of thinking about the human body. Animated visualizations in science and fiction will be treated by Erwin Feyersinger, a scholar of film and media. Scholar/software developer Diana Arellano presents interdisciplinary research projects carried out at the Baden-Württemberg Film Academy's Institute of Animation—among them, *The Muses of Poetry* and *SARA—Stylized Animation for Research in Autism*. An artistic take on the subject of art and science is provided by Markos R. Kay, an animation filmmaker who's known for abstract experiments on scientific data.

Three artistic positions occupy the focal point of the Art & Society panel. Mihai Grecu, who was honored with an Award of Distinction in the Computer Animation/Film/VFX category last year for *The Reflection of Power,* an animated short film with a political theme, will offer insights into his surreal, metaphorical world of imagery, and personally preside over a screening of some of his recent work. His fellow panelists include experimental filmmaker/media artist Reinhold Bidner and designer/artist Jonas Hansen, who'll go into interactive installations and experimental games. The Art & Industry panel will demonstrate how art and industry can influence and inspire one another. Representatives of a London-based studio called ManvsMachine and Aixsponza, a 3D motion design studio in Munich, will present their latest artistic and commercial work.

The Expanded Animation symposium has been a part of the Ars Electronica Animation Festival since 2015. Dates: September 9-10, 2016; Venue: CENTRAL Linz. In addition to the two-day symposium, the Animation Festival also includes screenings of award-winning works, presentations by prizewinning filmmakers and guests, as well as exhibitions and performances having to do with computer animation.

ARS ELECTRONICA

In addition to annually producing and staging a major festival—its extensive program is described in this volume—Ars Electronica is involved in a wide range of activities at the nexus of art, technology and society. These include the exhibitions and educational programs offered by the Ars Electronica Center in fulfillment of its public mandate, as well as Ars Electronica Futurelab's R&D work, product development by Ars Electronica Solutions, and the international exhibitions, workshops and events produced by Ars Electronica Export. The revenues generated by these activities make a substantial contribution to Ars Electronica's whole budget and thus support this organization in carrying out its public service mission in art and education. The following section gives an overview of the activities and projects conducted over the past year.
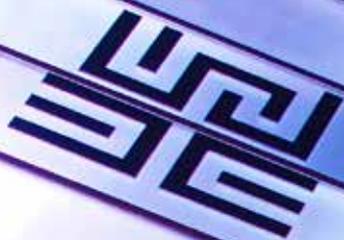
Martin Hiesmair

Ars Electronica Center

This is a time of transition for the institution known as a museum. Since its very inception in 1996, the Ars Electronica Center has been addressing the question of what a Museum of the Future ought to be like. Right from the start, the Ars Electronica Center has considered itself an experimental laboratory to learn how imparting educational material can function in an information-based society.

Since its architectural makeover and reopening on January 1, 2009, more than a million people have visited the exhibitions and attended the events held in Linz's Ars Electronica Center. A key component of its success has been the concept of situating open labs among the exhibits, and of creating a museum that makes carrying on a dialog with people the core of its mission.

Change is another essential element of the Museum of the Future, an institution that reinvents itself on an ongoing basis while remaining true to its basic principles of dealing with the interplay of art, technology and society, and establishing a public setting for participation, conversation and fascinating discussions. Leading protagonists in this interactive process are the Infotrainers, who regard the exhibitions as their instruments and use stimulating stories and flashes of inspiration to get visitors involved in what they are looking at and to link it up to their everyday lives, local surroundings and personal experiences. Infotrainers get into a conversation with the members of the tour groups they guide, help them to formulate questions related to our shared future and offer them potential answers to consider on their own. In doing this, Infotrainers can reference current trends and configure the interaction with laypeople as a form of give-and-take among peers—after all, the Infotrainers themselves come from a wide variety of backgrounds and have acquired their expertise from a broad spectrum of fields including biotechnology, sociology, art, design, teaching, and psychology. The Museum of the Future is one of the cornerstones of Linz's cultural landscape. It is a museum that pays attention to what people are saying.

Cinematic Rendering

The opening of the new Ars Electronica Center in 2009 gave birth to the idea of also using the new facility to present medical themes to the public. Ever since, they have been showcased in the center's Main Gallery, as in the RoboLab, BrainLab and Bio-Lab. And now, since the premiere of Deep Space 8K in August 2015, the Ars Electronica Center boasts an internationally unique venue for speeches and presentations that is also superbly suited to depicting and communicating medical content. And right from the outset, visitors were so enthused by these presentations that we developed a regular series of events in Deep Space 8K dedicated to medical topics.

Deep Space 8K is not only a setting for high-definition projections on dual 16×9-meter surfaces on the venue's wall and floor; additional viewing options include stereoscopic 3D images, 3D films and interactive 3D real-time graphics. 3D shutter glasses enable visitors to enjoy an impressive three-dimensional experience. Now, in the wake of an across-the-board upgrade of all hardware components in summer 2015, state-of-the-art projectors, high-performance processors and fiber-optic cables conjure up breathtaking worlds of imagery in amazing 8K resolution.

These technical enhancements now make it possible to also apply highly complex programs in Deep Space 8K. One is the *Cinematic Rendering* app for the presentation of photorealistic images of the human body in 3D and jumbo-format dimensions.

Taking a look into the human body has until now produced only unreal representations of a skeleton, organs or blood vessels. Even 3D pictures from CT or MR lack contrast and sufficient depth. Thus really interesting facts for surgeons, such as the distance between veins and tendons, have been hidden. By developing the process of *Cinematic Rendering*, Siemens Healthineers is opening a new chapter in the realistic representation of the living example. Inspired by films like *Lord of the Rings*, the researchers managed to transfer the animation-performance from the world of cinema to the realms of medicine. Thin-sliced data from CT and MR examinations is the basis for modeling the showpiece. Only "image-based lighting calculation" yields a realistic representation of living bodies. Before this revolutionary technique finds its way into routine medicine, it will have to undergo several tests. Until then, it fits perfectly well into Deep Space 8K—the virtual anatomy lecture theater of the future.

Dr. Franz Fellner's brilliant insight was that it is already possible to utilize this technique to display human anatomy more realistically than ever before. At regular intervals Deep Space 8K immerses visitors into the human body—from the surface of the skin to the innermost reaches of the blood vessels, the organs and the bones.

Dr. Franz Fellner, director of the Department of Radiology at Kepler University Hospital in Linz, presents impressive new methods for teaching human anatomy. For the first time, cinematic rendering makes possible an anatomy of the living instead of an anatomy of the dead. There is probably no place else on earth in which anatomy can be experienced so impressively.

313

ESERO Austria—Inspiration Outer Space

The *European Space Education Resource Office (ESERO)* is a project of the European Space Agency (ESA) and its educational partners in various European countries. Its mission is to integrate space research into the classroom as a means of encouraging kids' and young people's interest in the so-called STEM academic disciplines (science, technology, engineering and mathematics). To achieve this, teachers are provided with knowhow and instructional materials that are tailored to the specific curriculum requirements in the respective country. The job of each country's *ESERO* is to offer teachers continuing professional education and to administer the material.

Art and science are often motivated by the same reasons: the investigation of nature and our existence on Earth—to expand the limits of our knowledge, to advance our technologies, and to explore the unknown. This mental attitude—one deeply rooted in the Ars Electronica Center's philosophy—was one of the reasons why, in 2016, the tenth year of *ESERO*'s existence, and in the wake of an intensive selection process, the Ars Electronica Center was chosen to serve as Europe's tenth *ESERO*. This means that the Ars Electronica Center is embedded in a network of educational institutions to which the Linz-based facility will be able to contribute its unique combination of educational, scientific and technical expertise in order to support teachers providing classroom instruction in conjunction with the Inspiration Outer Space program.

This project is subsidized by the ESA and Austria's Research Promotion Agency (FFG).

http://www.aec.at/esero
http://www.esa.int/ESA

Florian Voggeneder, Martin Hieslmair

Fashion & Technology

Let's not kid ourselves—Linz isn't a capital of the world of fashion. No glitzy catwalk shows are staged here; we are not a hotbed of identity-shaping street styles publicized by fashionista blogs. Compared to other cities worldwide, Linz just isn't particularly fashionable. But Linz is quite in fashion, regarding the innovative high tech sector, the world-class heavy industry and the emmashment with the impressive creative scene, Linz is hosting. Linz Art University, an academy of artistic and industrial design, is emblematic of this.

Ars Electronica Curriculum @ FAT: "emerging technologies—sparks of Ars Electronica"

Technologies and their innovative applications in artistic and scientific fields are essentially what Ars Electronica is all about. In carrying out this institution's mission, thought is always given to the impact on society; after all, considered in a vacuum, these cultural phenomena do not even exist. This course offers an overview of and insights into Ars Electronica as an apparatus for reflecting on the future, but, even more importantly, it is a setting

Nina Wenhart

Günter Parth

for students to try out methods for exploring and understanding the world. The aim is to get young people to see the big picture, to act outside the box, and to develop curiosity for what is happening in other fields. And who, if not Ars Electronica, the prototype of a transdisciplinary cultural-technological platform, is better suited to triggering such "undisciplined" behavior?! The desired effect: students taking inspired approaches to their university projects. The quality of their semester work is indicative of this fruitful cooperation.

Creative Robotics

Opening on February 3, 2016

Robert Bauernhansel
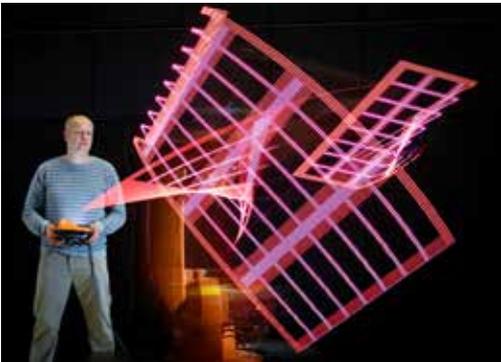
Robots have become an integral part of modern everyday life. But this has now progressed beyond the typical forms of factory automation to completely new applications. In creative industries, robotic arms are not being deployed for mass manufacturing but rather in innovative new processes that make it possible to turn out customized products. Meanwhile, robotics engineers are also doing

R&D on totally new areas for utilizing robots that go far beyond conventional machinery.

This exhibition was produced in collaboration with the Department of Robotics at Johannes Kepler University Linz, Linz Art University's Robot Lab, the Association for Robots in Architecture, the University of Applied Arts Vienna, the RWTH Aachen University and Linz-based KUKA CEE GmbH.

Works

Self-Stabilizing Balancing Cube, Johannes Kepler University Linz
Robotic Calligraphy/KUKA IIWA, Linz Art University, Association for Robots in Architecture, RWTH Aachen University and KUKA CEE GmbH
Robotic Woodcraft, Philipp Hornung, University of Applied Arts Vienna and Association for Robots in Architecture
Lightpainting/ KUKA KR16, Chris Noelle, Linz Art University and KUKA CEE GmbH

School Program

That Ars Electronica's Museum of the Future is a center for opinion formation, and cultural participation is convincingly demonstrated by the lively interest on the part of visitors over many years. Creating an experimental learning environment in which the younger generation can get hands-on experience with cutting-edge technologies and get acquainted with highly topical issues is a big part of our mission and a challenge we face every day. The strong attendance at our educational courses by school classes throughout the academic year shows that our educational program is not simply juxtaposed to classroom instruction; they complement each other and truly enrich these students' learning experience. The Ars Electronica Center's programs at the interface of art, technology and society are designed to appeal to young people across the educational spectrum—from elementary school pupils to students at universities and technical colleges. Familiarizing our youngest visitors with the technological instruments of our time is particularly important to us, since we regard this as a great opportunity to teach them to deal with these devices responsibly as well as creatively. Plus, as an educational institution strongly committed to lifelong learning, passing on our skills and values to those who are completing their career training and preparing for life in the adult world is also high on our agenda.

In order to carry on providing educational programs that contribute to an open, informed society, we have established the Ars Electronica Education Lab to strategically conceive, effectively administer and efficiently coordinate all of our divisions' educational activities.

Fully Plastic!
Grades 1-4, 2,5h

Much of what we see is two-dimensional, that is, flat—pictures in a book, alphabet characters on a piece of paper. But most things in our world are three-dimensional, that is, spatial—with a front and back, top and bottom, left and right side. In this workshop, participants come to terms with what dimensions actually are, and experiment with analog techniques and materials from 0D to 3D.

Martin Hieslmair

Magdalena Leitner

Hack the Robot
Grade 6 and up, 3h

We are all familiar with industrial robots—used in assembly plants, they do hard work and do it reliably. Now, take that boring, dirty job and shove it! In this workshop, participants use electronic components, *littleBits*, to build a new remote-control unit and hack the robot system. So let's just see what kind of tasks the robot arm can perform when you're done pimping it!

A Little Bit of Electronics for you?
Grade 5 and up, 2h

littleBits do away with technical devices being a black box. They are tiny electronic components, pre-installed printed circuit boards that you can mix and match and connect up to do just what you want. These colorful little switches enable you to emulate the functions of machines without any previous electronics skills. They are as user-friendly as Lego-bricks and as sophisticated as an electronic brain.
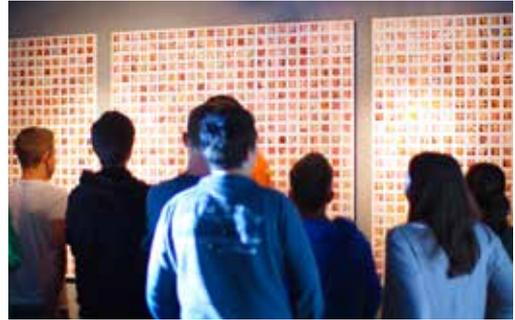
Martin Hielsmair

PhiloLab—Out of Control
Grade 5 and up, 4.5h

Florian Foggeneder

In the 21st century, loss of control in society is in numerous respects associated with the possibilities afforded by new communications and media technologies. Hateful postings on Facebook, shit-storms on Twitter and cyber-mobbing via YouTube—these three phenomena can serve as proxies for this development. We developed PhiloLab on the basis of the exhibition *Out of Control—What the Web Knows about You.* In this format, the accent is on a process of reflection and opinion formation. In the various phases of PhiloLab, students under expert supervision give some thought to the impact these digital phenomena have on social coexistence and what can be done to maintain control.

AEC Ambassadors

As an extramural educational institution, it is particularly important to stay in touch with the classroom instruction schools provide on a daily basis. This is the optimal way for us, a museum, to ascertain schools' tech-related needs and to satisfy them effectively. After all, we don't want to work at cross purposes with schools; we want to collaborate to complement their educational courses. These link-ups to regular classroom instruction are maintained by AEC Ambassadors, our contacts and multipliers at the respective schools.

More than 130 such AEC Ambassadors make up a wide-ranging network designed to propagate our educational programs via personal recommendations. Once a year, we invite our AEC Ambassadors to a get-together at which we can exchange views

on pedagogical subjects. This form of contact is very valuable to us as a way for every AEC Ambassador to contribute to improving our program for schools. Traditional educational institutions are welcome at this extracurricular place of learning with its exceptional infrastructure.

Magdalena Leitner

Prix Workshop

The space for the next generation of Prix Ars Electronica prizewinners!

A fully equipped sound studio, a greenscreen, an animationbox and lots more technical equipment offer creative tinkerers the chance to discover new production possibilities in film and music. There is plenty of space to develop new ideas or to finally complete projects launched long ago. The *Prix Workshop* especially targets kids and young people; the mission is to motivate them to submit works for prize consideration to the Prix Ars Electronica's u19 – CREATE YOUR WORLD category for young people. By way of motivation, there is a display of videos and musical works that have already been singled out for recognition.

The integrated SoundLab is a fully functional sound studio that makes available all the professional-grade hardware and software needed to capture and produce noise, sound and music. This outstanding infrastructure has been used by the Music School of the City of Linz to hold courses culminating in special concerts held in the Ars Electronica Center's *Deep Space*.

http://create.aec.at/prixwerkstatt/

Raffaela Vornicu

Kids' Research Lab

Exploring, gaining insights and comprehension by game playing is the basic concept behind the *Kids' Research Lab*, which opened at the Ars Electronica Center in January 2015. Now, this experimental realm for four-to-eight-year-olds has been reconfigured and educationally linked up to the *Spaceship Earth* exhibition immediately adjacent to it.

More than ten stations here provide opportunities to tinker, play music, draw, program and experiment. There is no prescribed path through the exhibits; instead, kids move about the space freely, guided by their own interests. Hands-on encounters with unusual devices and fascinating experimental installations are the young explorers' gateways to discovery across Ars Electronica's entire thematic spectrum: the interplay of the virtual and the real world, the enchantment of light and shadow, what goes on inside high-tech gadgets, construction and programming, and the human-machine relationship. Naturally, there is lots of fun stuff to try out and play around with, but there is also much to observe, to consider and to discuss. After all, that is the whole point of a research lab—giving some thought to extraordinary phenomena, recognizing interrelationships, testing new possibilities and deriving insights that will be useful in the future. This also applies to the young researchers' activities in the Ars Electronica Center.

Deep Space Weekends

An across-the-board upgrade of Deep Space's hardware components in August 2015 radically enhanced the venue's capabilities. Its repertoire now includes stereoscopic 3D visuals, 3D films and interactive 3D real-time graphics in top-of-the-line 8K resolution. The result: a virtual cornucopia of programming possibilities, an array of such diversity that it's simply impossible to work them all into the facility's regular schedule. That's why we launched *Deep Space Weekends*. Each one is dedicated to a specific theme, and guest experts are invited to contribute their insights, to spotlight particular aspects, and to answer audience questions. Here is an overview of the fascinating and informative topics of past *Deep Space Weekends*:

Adventures in Antiquity

Speakers who are experts in their fields accompanied audiences on an amazing excursion into ancient history in Deep Space 8K, where they perused the world of Antiquity from a variety of perspectives. The presentations included impressive visualizations of Ancient Rome and the *Tabula Peutingeriana*, a Roman road map.

The Universe Within

On this *Deep Space Weekend*, visitors immersed themselves in the human body—from the surface of the skin to the innermost reaches of the blood vessels, the organs and the bones. Dr. Franz Fellner, director of the Department of Radiology at Kepler University Hospital in Linz, demonstrated how superbly *Deep Space* is suited to serving as a virtual anatomy theater.

Astronomy

The speakers on this weekend were experts from the Austrian Space Forum and the Linz Astronomical Society, astronomy enthusiasts who were delighted to share their knowledge and insights as they elaborated on spectacular images of outer space.

Time-Lapse, Gigapixel and Panoramas

With their highly accelerated tempo, time-lapse images shed new light on things that occur in our world. Combining these highly detailed, fast-forward motion pictures with the extraordinarily high resolution in Deep Space 8K, the presentations screened on this weekend opened visitors' eyes to everyday events they had never seen in this form before.

Cultural Heritage

The Pacher Altar in St. Wolfgang, the Saliera by Cellini, the inundated city of Pompeii and the Million Room in Vienna's Schönbrunn Palace—3D visualizations, high-definition photography and expert explanations made viewing these cultural treasures of humankind an unforgettable experience.

Play Spaces: Cooperative Aesthetics and Interactive Games

Participants had to get their whole body into the swing of things on the weekend that Deep Space 8K served as a setting for interactive games and works of art. Students at the Upper Austria University of Applied Sciences' Hagenberg Campus and Linz Art University developed these fascinating games and exciting interactive works.

Bike Visions

From trial bikes to an around-the-world honeymoon on a two-wheeler, from a mountain bike tour of the Cape Verde Islands to the subject of eBikes, the various facets of cycling were presented from the points of view of bikers, photographers and filmmakers.

UNESCO City of Media Arts

In December 2014, Linz was named a UNESCO City of Media Arts, and thus joined the ranks of Lyon, Dakar, Tel Aviv and several other media art hotspots. The computer, digitization and art play major roles in Linz, and media art took the spotlight on this weekend.

Florian Voggeneder, Magdalena Leitner, Martin Hieslmair

Magdalena Leitner

TIME OUT

Time-Based and Interactive Media Meets Ars Electronica

TIME OUT has been produced jointly by Ars Electronica and Linz Art University's Time-Based and Interactive Media bachelor's degree course for two years now. The *TIME OUT* exhibition series gives outstanding students the opportunity to display works of interactive media art at the Ars Electronica Center and thus present them to museum visitors as well as international audiences.

Now that six exhibitions have been staged, it certainly is fair to talk about *TIME OUT* in terms of a success story and a win-win-win situation for the students, the Ars Electronica Center and the City of Linz. For up-and-coming media artists, it is, of course, a great experience to be showcased at a venue with a worldwide reputation. The prospect of displaying their work at the Ars Electronica Center

motivates students as they go about producing their projects. For those whose works are selected, the next assignment is to transform functioning prototypes into exhibition objects capable of withstanding several months of intensive use by visitors. For the young artists, these are important experiences that you can only get in real-world situations.

The *TIME OUT* series organized by the Ars Electronica Center and the City of Linz demonstrates that the local scene can give rise to exciting projects capable of holding their own in an international context. At the end of a current show's run, several of the works will be integrated into the museum's ongoing themed exhibitions or the Ars Electronica Festival's lineup, or become part of traveling exhibitions.

Text: Gerhard Funk, Linz Art University

TIME OUT .05
Opening on March 16, 2016
Works

Plug it, Fabian Erblehner
[un]readable, Elisabeth Prast
[inter]national coverage, Benedikt Reiter
Gitterlinge, Thomas Schwarz
aesthetic experiences, a dance performance by Anni Taskula, Jacqueline Schiller, Enyer Ruiz and Gergely Dudas, with visualizations by Simon Krenn (*Sinus*), Clemens Niel (*Geometric Soundscape*) and Gerhard Funk (*Curves*)

TIME OUT .06
Opening on June 8, 2016
Works

Scratching Wounds, Karol Kensy
Lightstorm, Katharina Gruber, Laurin Döpfner, Gregor Woschitz
Mirror_0.2, Gregor Woschitz
CRACKS, Sarah Youssef
In Vitro Typewriter, Simon Krenn

Magdalena Leitner, Martin Hieslmair

Deep Space 8K
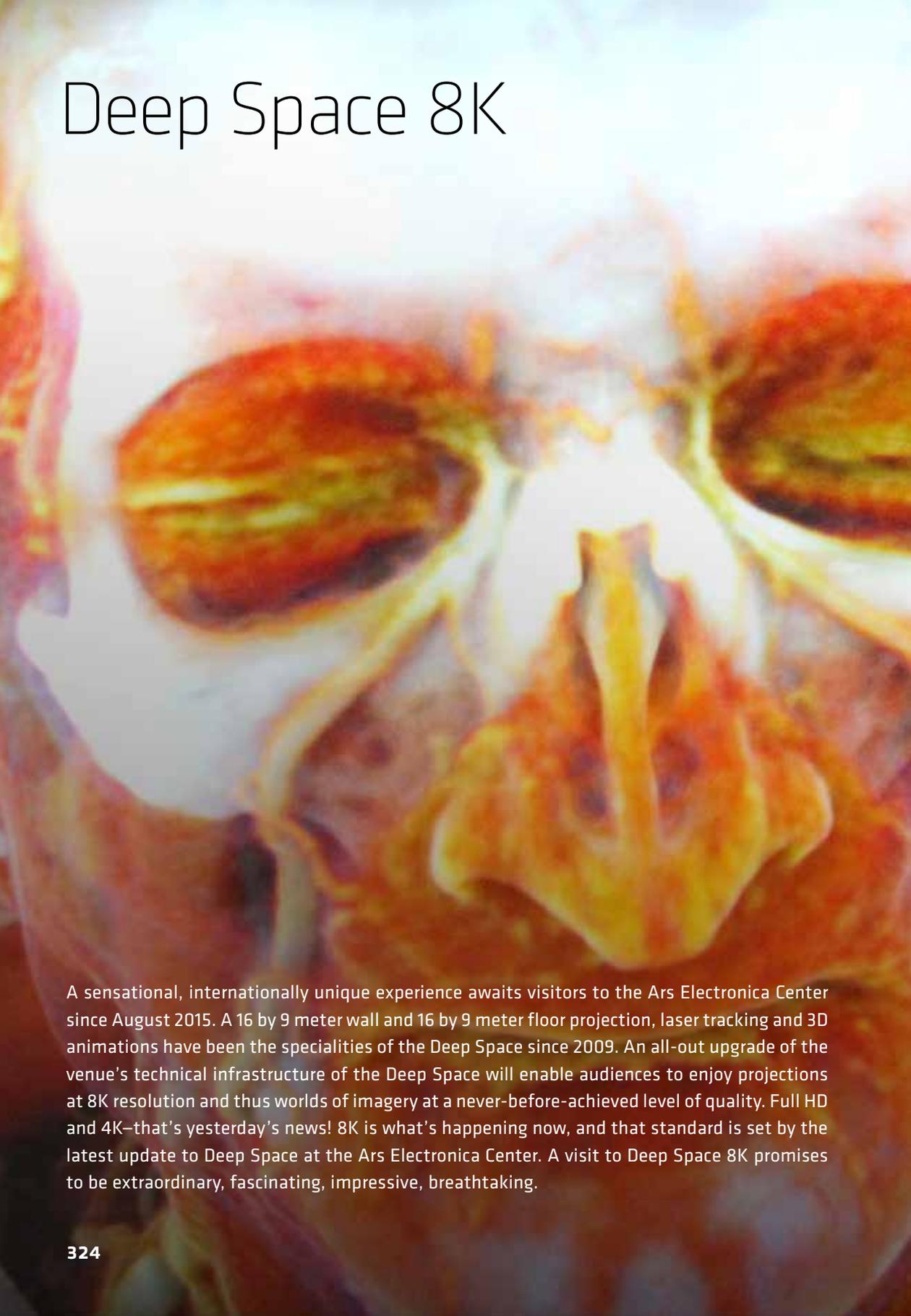
A sensational, internationally unique experience awaits visitors to the Ars Electronica Center since August 2015. A 16 by 9 meter wall and 16 by 9 meter floor projection, laser tracking and 3D animations have been the specialities of the Deep Space since 2009. An all-out upgrade of the venue's technical infrastructure of the Deep Space will enable audiences to enjoy projections at 8K resolution and thus worlds of imagery at a never-before-achieved level of quality. Full HD and 4K–that's yesterday's news! 8K is what's happening now, and that standard is set by the latest update to Deep Space at the Ars Electronica Center. A visit to Deep Space 8K promises to be extraordinary, fascinating, impressive, breathtaking.

325

Akira Wakita (JP), Tetsuya Komuro (JP)

Scalar Fields

This work visualizes the pressure field around the soles of shoes. By using the fluid simulation software developed by the artist, the propagation of pressure in air is visualized in 8K video, with a marvelous sound experience.

When wearing shoes and performing acts such as standing and walking, a pressure field that is invisible to the naked eye is generated on the contact surface, and this certainly continues to affect the surrounding areas. The shoe is not just a device to support walking; it is also a medium to propagate the wearer's existence and identity in the form of mild pressure.

A small storm is raging in the micro space around the shoe sole. Wind pressure generated by walking blows the mite off the carpet. Converting to macro scale, it is similar to the phenomenon in which human beings are blown down by the air pressure generated during wartime air raids. Through simulation and visualization, we may obtain a wide range of perception connecting the micro to the macro world.

Credits: Visualization: Akira Wakita; Music: Tetsuya Komuro
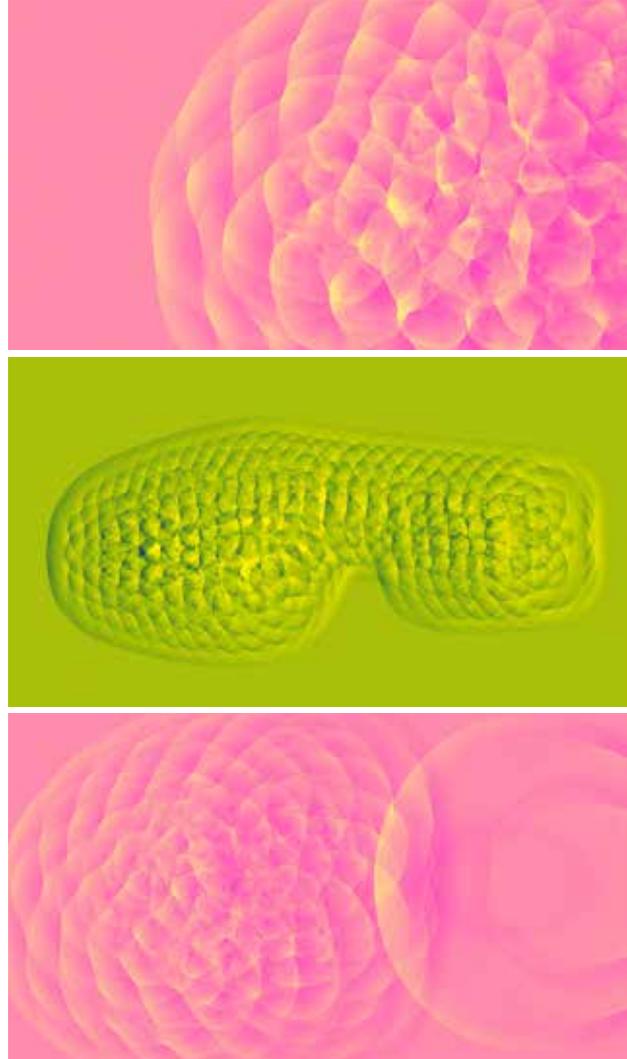
HYUNDAI MOTOR GROUP (KR)

VH Award

The *VH Award's* purpose is to uncover promising but relatively unknown Korean artists creating media art. It seeks to support these young, talented media artists' art-making process, but to also help them gain international recognition.

To guarantee a fair evaluation of these artists, all award winners will be selected by celebrated curators from both Korea and other parts of the world. This will also facilitate the creation of fruitful, global connections between potential award winners and established artists and well-known curators. In addition, the *VH Award* will introduce a new genre of media art to the public. This new genre centers on innovative ways of communicating information, which ultimately promote a more tightly knit field of art.

In order to showcase Korean media art in an optimal manner conducive to garnering global attention, the finalists of the *VH Award* will have the opportunity to display their works of art through the spectacular media-wall, located at the Hyundai Motor Group University–Mabuk Campus.

Je Baak (KR)
A Journey

In *A Journey* Je Baak uses RPG games to transform virtual reality into a place that simulates a person's life, and invites the viewers as travelers to experience this world full of symbolic elements and situations.

Sungjae Lee (KR)
Avyakrta

In *Avyakrta*, Sungjae Lee uses the technique of high speed cinematography to depict the long-term process of both physical and mental transformation of humans, and the constant and eternal relationship between individuals and groups.

Sukjoon Jang (KR)
FlatCity

Using a drone camera, *FlatCity* captures the modern cityscape enclosed in the flat computer screen, with zooming in and out and mouse-scrolling activities. The artwork simulates movements coming closer and drifting away captured in virtual reality.

http://www.vhaward.com/

Alen Kim

AROTIN & SERGHEI (AT/RU)

WHITE POINT 2016– subliminal art installation

The starting point of AROTIN & SERGHEI's art installation *WHITE POINT* for the Deep Space 8K is the smallest possible visible image: a single shining white light pixel of the matrix of 64 million of the 32 m x 32 m projection space is shown pulsing in the rhythm of a heartbeat. It moves gradually to the viewer and takes the whole space of the building. In the radical enlargement one can discover the structure of this white light point, a cube made of red, blue and green light cells dissolved by the brightness contrast of pulsation into visible and invisible phases. In the bright overexposure of the flashes, the colors melt into dazzling white. In the shadow phases memories of color cells "engraved" in the retina of our eyes blur and seem to change. The sequences of mutation of subliminal retinal images is realized as an 8K single-picture animation of six layers, projected onto the wall and floor and combined with the sound of Scriabin's synthetic hexachord, the origin of all sounds.

In cooperation with Bildrecht Vienna / Museum in Progress Vienna.

Maotik (CA)

FLOW

FLOW is an immersive interactive installation specially designed for the Deep Space 8K media display. Inspired by the natural phenomenon of the tides, the multimedia environment offers a sensory experience poetic, playful and aesthetic principles of the rise and fall of sea levels. It invites visitors to plunge into the fascinating world of science through interactive immersion. The multimedia space aims to create an intelligent data environment where various forms of information can be expressed in a dynamic representation and enhance the perception of the physical space. Synchronized with the moon, the sea levels would change gradually and will create an environment that offers various degrees of immersion. The installation is an "open form" that offers various combination options to the audience. The idea is to create a system with a random creation process, in a range of settings defined by nature. In this sense, every state, the time of installation is unique and inimitable.
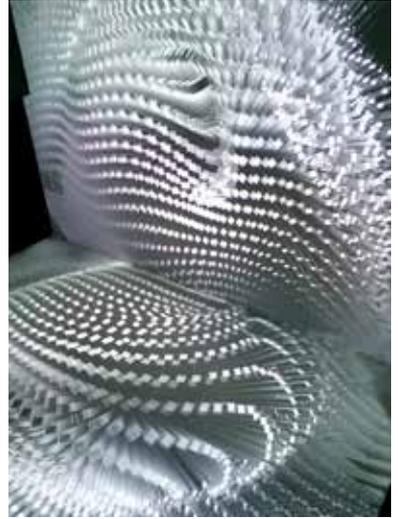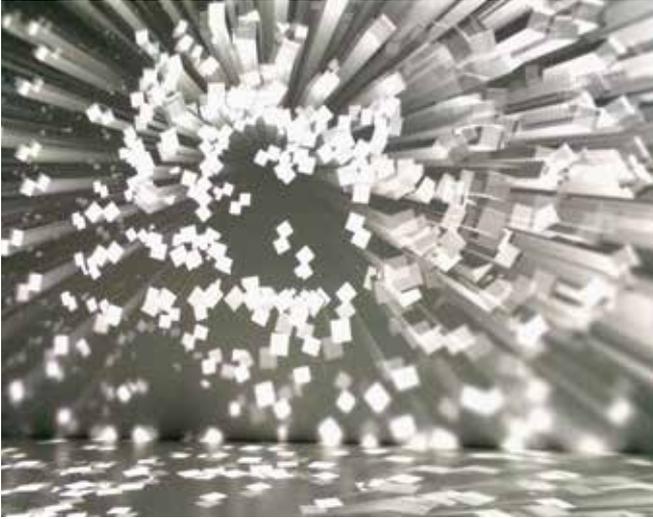
Maotic *FLOW*, Clemens Francis Scharfen

Didi Bruckmayr (AT), Dagmar Dachauer (AT), Viktor Delev (MK)

See what you made me do

A cross-disciplinary performance

> "Stimulus-hunger has the same relation-
> ship to survival of the human organism as
> food-hunger" Eric Berne, *Games People Play*

See what you made me do is a generative perfor-
mance for two characters, playing and interact-
ing according to roles and rules of power present
in social intercourse. According to archetypes of
behavior, our attitudes and actions are determined
within a dramaturgical thread and intertwined with
an immersive visual and sonic interpretation.
On the stage, the body and voice of the performers
are tracked and processed in real time by generative
algorithm software and reflected through abstrac-
tions, counter-forms and monochromatic scenes
that represent the collisions created by the char-
acters involved.

See what you made me do is a performance and a
game involving chance, improvisation and choice as
elements that determine the course of its narrative,
while playing with the possibilities of control.

Interaction design concept: Viktor Delev
Performance concept: Dagmar Dachauer, Didi Bruckmayr

Gerhard Funk (AT)

Kooperative Ästhetik
(Cooperative Aesthetics)

Kooperative Ästhetik is an exhibition by Gerhard Funk (AT) of a collection of programs designed to enable audiences to enjoy collective audiovisual experiences. The intention is to transform Deep Space into a setting in which visitors can move about freely and thereby influence the visual output of the wall and floor projections and the sounds audible in the space. Visitors are meant to playfully explore the phenomena triggered and controlled by their movements. In doing so, they come into contact with others in the space; they can mutually coordinate their movements, develop small choreographies, and thus create a shared aesthetic experience of space.

For the works screened by *Kooperative Ästhetik*, the emphasis isn't so much on their character as a game with a clearly defined objective, but rather on playfully exploring possibilities together with others.

And if there is such an objective, then the point is to achieve it by cooperating with others and not by competing against them. Accordingly, this isn't only an aesthetic experience, it's also an exercise in group dynamics.

Magdalena Sick-Leitner

Paguro Idea, Engineers without Borders Austria (AT)

Paguro Idea

The crisis as an opportunity. The earthquakes that shook Nepal in April and May 2015 have affected an estimated eight million people—that is almost a third of the country's population. Entire villages were flattened, while others were severely damaged.

That was one major reason to found *Paguro Idea*, a non-profit organization with the vision to help people who are affected by emergencies and structural poverty.

Paguro Idea initiated its first project in Nepal to support the reconstruction of villages, starting with

Klaus Dieterstorfer

Raghuchour in the Kavre Palanchowk district. Engineers without Borders supports the project in creating a concept to construct earthquake-resistant buildings with local materials and local resources as well as improving the water supply to secure a third crop.

Together with the locals, the project aims to reconstruct the village sustainably and to improve livelihoods. Based on an ecovillage approach, the villages can be rebuilt more socially, economically and ecologically sustainably, without losing their cultural background.

www.paguroidea.com

Text: Michael Badics

Klaus Dieterstorfer

Marco Palewicz (AT), Petra Wurz (DE), Soundfactory EXTD (AT)

SOUNDS LIKE UNIVERSE

Robert Bauernhansl

Take an audiovisual tour of the cosmos together with students from Soundfactory EXTD (staged jointly by Linz Music School and the Ars Electronica Center) and the piano and flute class taught by Marco Palewicz and Petra Wurz. The program will include both acoustic and electronic sounds, accompanied by breathtaking ultra-high-resolution visuals screened in an extraordinary setting: the Deep Space 8K. This sensory adventure is a very special experience suitable for the whole family.

Prof. Dr. Franz Fellner (DE), Siemens Healthineers (DE), Ars Electronica Futurelab (AT)

Cinematic Rendering– Dissecting Theatre of the Future

Considering how Computed tomography (CT) makes it possible to look inside the human body without resorting to a scalpel is actually quite fascinating in its own right, but the app *Cinematic Rendering* at the Deep Space 8K takes the teaching of the anatomy of the human body to the next level.

Cinematic Rendering is a completely new way to learn anatomy. For the first time, anatomy studies feature living human bodies. What we display here are data sets derived from examinations using computer tomography (CT) and magnetic resonance

imaging (MRI). In Deep Space 8K, these data sets can be screened three-dimensionally in extraordinary detail on huge projection surfaces. About two years ago, Siemens Healthineers began developing this software at Princeton. The idea for it came from the animated film industry. The aim was to develop a program that could depict medical imaging data from CT and MR scans as photorealistically as computer animations produced in a Hollywood studio. This is the reasoning behind the name *Cinematic Rendering*. Nevertheless, this program is still just a prototype and it will be a while until it is authorized for commercial use. But in the meantime, in Prof. Franz Fellner's view, Deep Space 8K fits perfectly as a dissecting theater of the future, which makes it possible to show real human anatomy as it has never been seen before.

Martin Hieslmair

Text: Magdalena Leitner
Credits: Prim. Univ.-Prof. Dr. Franz Fellner of Kepler University Hospital and Klaus Engel of Siemens Healthineers present this new way of teaching the anatomy of the human body with fascinating new forms of three-dimensional anatomical visualizations that deliver photorealistic images of the human body.

FAT–Fashion & Technology (AT)

Another Dimension of Fashion

Linz Art University's new Fashion & Technology program invites festival-goers to take a virtual journey that opens up unexpected dimensions of the anatomy of clothing. Cinematic rendering, a new form of computer tomography, reveals garments' interior

structures that are invisible to the naked eye. Students' designs have been shown by the internationally renowned photographer Günter Parth and Dr. Franz Fellner of Linz's Kepler University Hospital. Parth has worked with fashion legends such as Vivi-

Nina Wenhart

enne Westwood and Paco Rabanne. Fellner heads one of ten radiology departments worldwide that are testing revolutionary new rendering software developed by Siemens Healthineers. In this case, though, the subject is not a naked human body but creations designed to dress it up in style.

Directors of Fashion & Technology: Ute Ploier, Christiane Luible; Visualizations: Prim. Univ.-Prof. Dr. Franz Fellner, Günter Parth; Music: Richard Eigner;
Photos: Günter Parth, Nina Wenhart

Ina Conradi (US/SI), Mark Chavez (US/SI)

Media Wall Nexus

Media Wall Nexus is community–forming public art project of Nanyang Technological University (NTU) Art & Heritage Museum, Singapore. It explores new terrains to enhance digital interactive media and fine-art expressions. The recently installed *Media Wall Nexus* will offer a new platform to exhibit NTU artistic research. It is a channel for discourse, exchange, participation and novel expression created by students, faculty, local and international artists, scientists, researchers, artistic and cultural art institutions. Using the latest in multi-media technologies this nexus is an inclusive public event designed to enhance students' learning experience and contribute to the vibrancy on campus. Conceived with a vision to showcase digital interactive artworks, *Media Wall Nexus* is created as part of interdisciplinary collaborations in art, design, science, medicine and engineering technologies. This research project was produced and established in

collaboration with Associate Professor Ina Conradi (School of Art, Design & Media) and new-media artist Mark Chavez (Giant Monster Pte Ltd.).

Credits: The NTU Art & Heritage Museum, Ina Conradi / Associate Professor School of Art, Design & Media, Mark Chavez/Giant Monster Pte Ltd., Nuvola Media Pte Ltd.

XCEED (HK)

RadianceScape

RadianceScape is a data-visualizing audiovisual piece. It is based on the live radiation data from the Safecast.org, a global sensor network for collecting and sharing radiation measurements, to generate a cityscape. It appears in point-cloud depth-mapping visuals in which the density of the radiation level represents the visibility of the cityscape. The sequence of the images was grabbed from Google Streetview API's hidden depth-map data.

In the sound composition it is based on the relative radiation data to generate different tones of drone ambience and noise. The graphic scores were composed using the mapped data-log. It consists of two separate parts, first illustrating the route through Hong Kong, visualizing the radiation levels from Mongkok to the Tsim Sha Tsui area. The second part illustrates the route through Fukushima, visualizing the radiation levels from the Fukushima Prefecture to the nuclear power plant.

http://www.xceed.hk
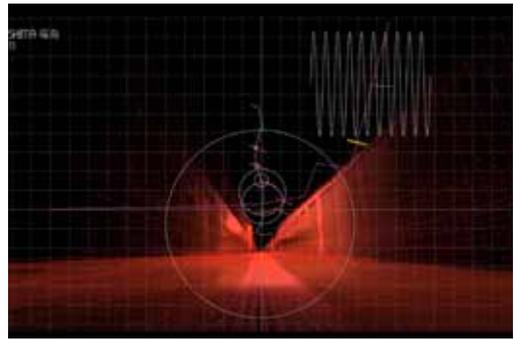
Credits: Artistic director / composer: Chris Cheung Hon Him; Creative technologist / visuals: Jason Lam; Technical director: Jeff Wong; Creative technologist: KwanKai; Data collection & research: XPLOR (Andio Lai, Janice, Dom and Tissue); Global sensor network and open-source platform: Safecast.org; Open-source software: openFrameworks, IanniX; Open-source library: ofxStreetView (created by Patricio Gonzalez Vivo); Presented by: XCEED.

Fraunhofer Institute for Medical Image Computing MEVIS (DE)

Pathfinding in the Human-Computer Medicine

During the last three decades we have witnessed the growing complexity of technology and a flood that is filling our hospitals today—functional imaging, full gene sequencing, automated laboratory medicine and much more. But the role and responsibility sharing in healthcare, clearly structured into specific disciplines, has remained almost unchanged despite almost complete digitization. For three years now, a paradigm shift has been taking place, triggered by achievements in machine learning which were

believed impossible only a few years ago, with Deep Learning as the most prominent example. Physicians are now regularly wondering: "Will I be replaced by the computer?" We follow the track of machine learning in medicine and look for answers to questions about future role models and the benefits and risks of the digital revolution. We will learn how emerging human-computer teams achieve a far superior performance while overcoming technical and spatial limits, with effects even in the most remote countries.

Credits: Prof. Dr. Horst Hahn (DE), Dr. Alexander Köhn (DE), Bianka Hofmann (DE), Fraunhofer MEVIS Team (DE)

The neuronal architecture of the human brain inspired the research into machine learning. These pictures, a fusion of anatomical and functional MR imaging, show the brain areas which are activated during listening to music (left) or during looking at a house (right).

NOHlab (TR)

PRIMA MATERIA—a stereoscopic audiovisual Journey

Alchemical authors have compared the "prima materia" to everything. To male and female, to the hermaphroditic monster, to heaven and earth, to body and spirit, chaos, microcosm, and the confused mass. It contains in itself all colors and potentially all metals. There is nothing more wonderful in the world, for it begets itself, conceives itself, and gives birth to itself.

The stereoscopic piece by the Istanbul-based multidisiplinary studio will take the audience on an audiovisual journey.

http://www.nohlab.com

This project is presented in the framework of the European Digital Art and Science Network and co-funded by the Creative Europe program of the European Union.

Quadrature (DE)
Orbits

The aesthetics of man-made objects in space, their appearance and especially their orbits are transformed into a minimal audiovisual performance, showing the poetic dance satellites and their trash perform while revolving around us. Seemingly chaotic paths mutate to amazing patterns of an almost organic nature—all of it due to pure physical necessity. To calculate the positions of an artifact one needs the current time and the corresponding two-line element (TLE) set.

When Quadrature (DE) started working with global satellite data, their information was based on a website maintained by the US Air Force. Yet after some time, based on information from the Union of Concerned Scientists, we discovered that some objects were missing. Fortunately the data on classified satellites is generated by enthusiastic amateur astronomers observing the night skies.

Merging the two sources, balancing between artistic autonomy and the necessary scientific rigor, the performance is an aesthetic and intuitive experiment, revealing this new layer of human infrastructure.

http://quadrature.co/

Quadrature collective: Sebastian Neitsch, Juliane Götz, Jan Bernstein
Datasources: *http://www.Space-track.org, http://www.wpusa.dynip.com/files/SPACE/* , *http://www.ucsusa.org/*
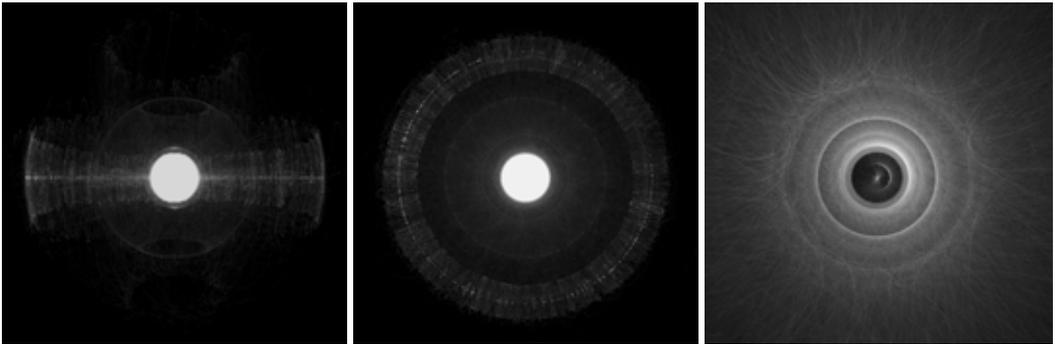
SEEC Photography (US)
SEEC Photography

SEEC Photography is a science-art project that investigates how light moves across objects. This happens at the speed of light and within a few nanoseconds (1 nanosecond = 0.000000001 seconds). We use a gated camera, which allows for exposure times as short as 0.1 nanoseconds, to record the motion of ultra-short laser pulses across subjects that represent traditional photographic themes, like the portrait, the still life or a horse's head—in reference to Eadweard Muybridge's pioneering work

in stop-motion photography. The main character of these archetypical forms of photography is not the subject in front of the camera but light itself, traveling across the subject, being scattered and reflected off of surfaces. We literally watch light (photo-) in the process of writing (-graphy) an image.

SEEC Photography: Enar de Dios Rodriguez, Philipp Haslinger, and Thomas Juffmann Technical assistance: Brannon B. Klopfer; The movies were recorded in the Kasevich Lab at Stanford University with equipment funded by the Gordon and Betty Moore Foundation.

0.0000000002820 sec

0.000000007440 sec
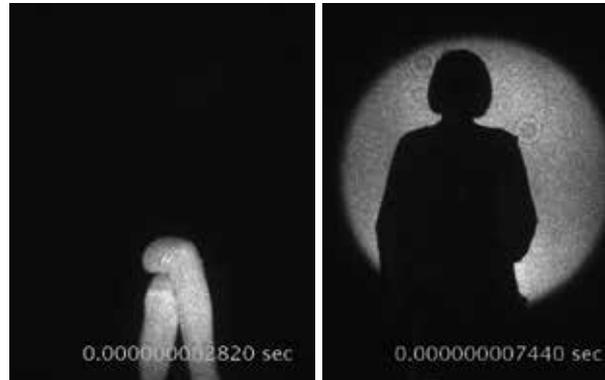
Society for Cultural Optimism (AT/DE/ES/RU)
The Conduit

The Conduit is part performance, part interactive installation that investigates social engagement and the consequences of speculative technological and political frameworks. Participants will negotiate an eight-bit simulation of the future and its effects on our everyday social interactions.

The Society for Cultural Optimism poses questions about the way new media, interactive devices and rule-sets, both technical and social, offer insights into a different everyday, and how through playful engagement and theatrical and participatory performances, one can establish a fictional reality that bridges the physical and the virtual.

http://culturaloptimism.org

Team Linz: Friedrich Kirschner, Monica Rikic, Maike Drexler, Clara Fritsche, Thea Emilia Girtler
Team Brisbane: Friedrich Kirschner, Christiane Hütter, Lena Fay, Stefano Trambusti, Katharina Halus, Stellan Grung, Daniil Shchapov; *The Conduit* was developed as part of the TRANSMIT³ residency at QUT the Cube for Queensland University of Technology in cooperation with Ars Electronica.
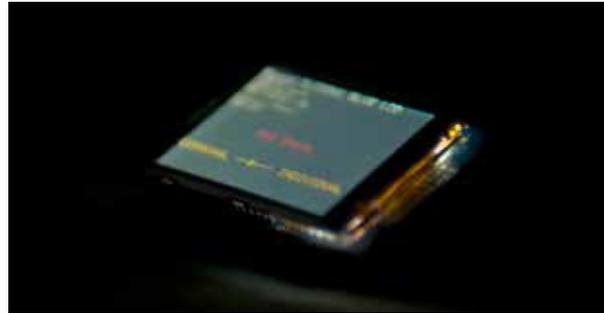
Playful Interactive Environments (AT/BG/US)

VR Playspace

Virtual reality applications tend to focus on the experience of an individual, creating an immersive experience that practically separates the user from the real world. *VR Playspace* strives to achieve a collaborative hybrid VR experience by integrating multiple VR players and live spectators into a cooperative game. In the game prototype *Cargo*, two VR players control a spaceship on its way to deliver valuable supplies to a remote space station. Developed specifically for the Ars Electronica Center's Deep Space, the game utilizes laser tracking and mobile VR headsets to allow two players to freely move about and defend their spaceship. Spectators can also join the action by entering the tracking space and becoming collection drones that accompany the spaceship on the way to its destination.

Playful Interactive Environments, University of Applied Sciences Upper Austria
Team: Daniel Rammer, Lorenz Krautgartner, Georgi Kostov, Jeremiah Diephuis

Daniel Rammer

Boris Labbé (FR)

Rhizome

Rhizome is an experimental animated short film that has its foundation in the homonymous philosophical concept coined and developed by Gilles Deleuze and Félix Gattari, involving research that is close to Steve Reich's serial music, Escher's mathematical art work, Bruegel and Bosch's paintings and various scientific theories about the development of life, genetics, the infinitely small and the infinitely large. From the beginning the film propels us to a big zoom over a dimension that has not been accessible for us until now, infinitely small or infinitely far away. There we attend the birth of an unknown form of life. By repetition, connection or metamorphosis the organism experiences rapid evolution, giving shape to three major ways of evolution: organic, vegetable and mineral.

Director: Boris Labbé; Animation: Boris Labbé, Loïc Sitti, Wen Fan; Compositing: Boris Labbé, Sami Guellaï; Music: Aurélio Edler-Copes; Sound mix: Victor Praud; Producer: Ron Dyens; Sacrebleu Productions 2015
The film received support from the Agence Culturelle d'Alsace during a two-month pre-production residency and from the Ciclic Région Centre during eight months on a production residency in 2014. The film also received financial support from SACEM, CNC, France Television and Procirep–Angoa.

Sacrebleu Productions

raum.null (AT), Mussurunga (AT)

Chant of the Proto-Alchemists

For that there still are chants beyond humanity that have not been sung, yet.

Alchemists deal with matter and meta-physics; they integrate human understanding of the world, visions, ideas, and their desire to reach ultimate enlightenment in their search for knowledge and creation. Fundamental knowledge must be communicated in a language that conveys all information and is accessible to all those, but also only those, who are adepts. Like the proto-human language, the origin of all linguistic understanding and development, proto-alchemists knew about the one language of those long gone worlds in order to bequeath their secrets. This lost proto-alchemist language was fundamental to cymatic (sound and resonance) transformation of matter. The alchemists of our time seek to find a proto-human language in the coding languages that they apply to transform matter, to program new material forms and to develop worlds that transcend the physical reality known to humans.

After *Quadrature* (2014) and *The Sixth Wave* (2015), the third part of the trilogy, *Chants of the Proto-Alchemists* (2016) reflects on the very sensual, instinctive, and in other words people's very Dionysian side, which is as important to growth, spiritual development and divinity as the analytic, rationalistic, Apollonian side.

Text: Claudia Schnugg

Sound: Chris Bruckmayr & Dobrivoje Milijanovic aka raum. null; Vocals: Siegmar Aigner aka Mussurunga; Visuals: Didi Bruckmayr and Florian Berger; Production: Claudia Schnugg
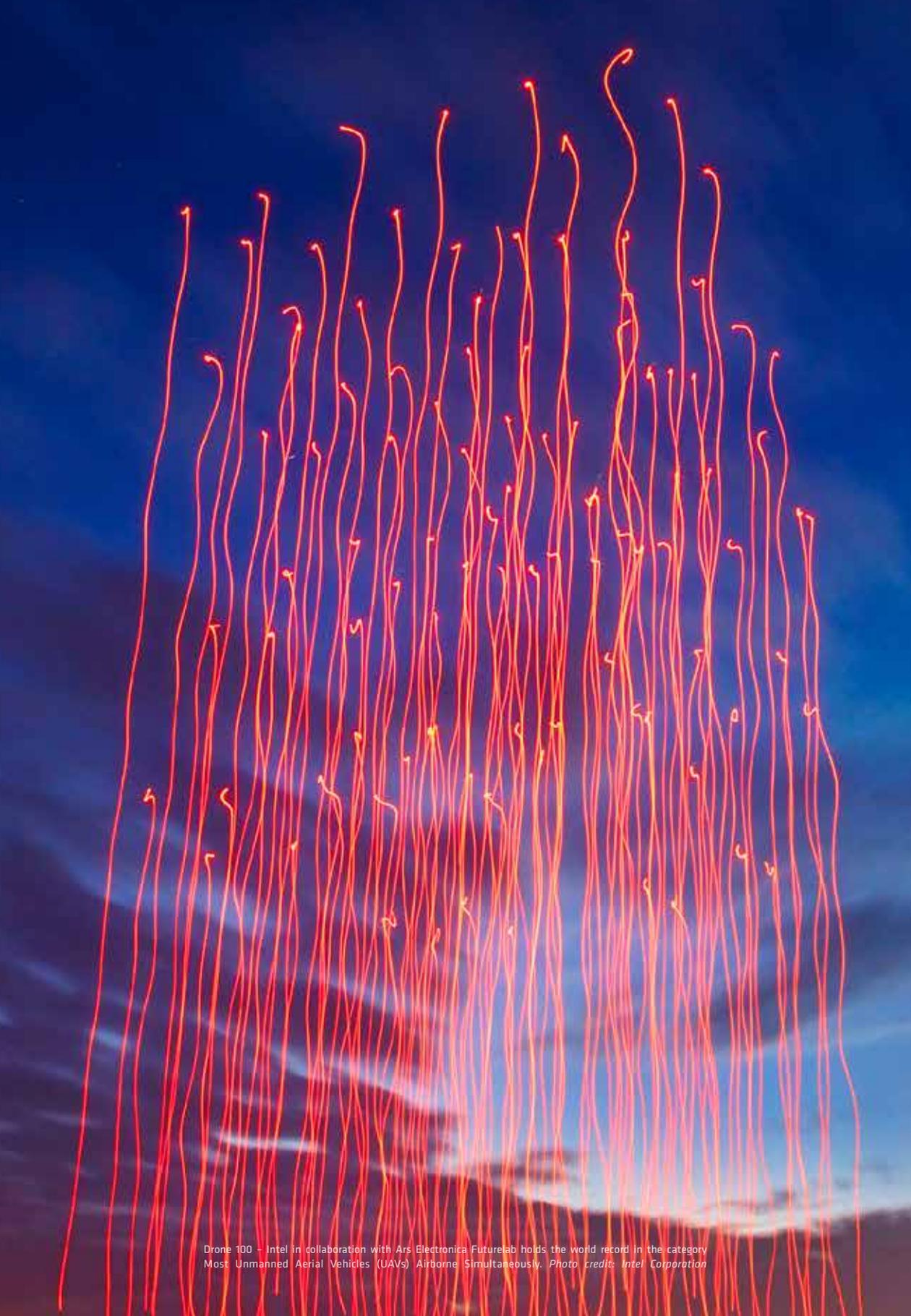
http://raumnull.tumblr.com/
https://soundcloud.com/mussurunga

Tom Mesic

Drone 100 – Intel in collaboration with Ars Electronica Futurelab holds the world record in the category
Most Unmanned Aerial Vehicles (UAVs) Airborne Simultaneously. *Photo credit: Intel Corporation*

Ars Electronica Futurelab

The Ars Electronica Futurelab was set up in 1996 as an in-house laboratory to perform R&D at the nexus of art, technology and society in cooperation with other divisions of Ars Electronica as well as external clients and associates in industry, science and culture. Its approximately 30 staff members possess skills in a wide range of fields, such as media and interaction design, computer science, hardware and software development, physics, architecture, the social sciences and the fine arts.

Applying processes that transcend the boundaries of individual disciplines, the Ars Electronica Futurelab takes technological development all the way to the early prototype stage. This mode of carrying out assignments is characterized by interdisciplinary conceptioneering, the merger of artistic and scientific methodologies, and the development of approaches that are highly receptive to new insights at the interface of various specialized fields. As art is a foundation stone and deeply ingrained in the DNA of the Ars Electronica Futurelab, artists among the team members as well as artists in residency cooperate to tackle social issues of tomorrow.

This past year as well, the Futurelab's staff have applied approaches from a wide range of fields and disciplines to dealing with social issues of this day and age and questions of great future importance as well.

Drone 100 –
The World Record for Intel 2015

A spectacular display of drone technology by Intel Corporation (USA) in collaboration with the Ars Electronica Futurelab involving a formation of 100 small aircraft being launched skywards has earned a new world record title for the Most Unmanned Aerial Vehicles (UAVs) airborne simultaneously. *Drone 100* took place at the Ahrenlohe airfield in Tornesch, Germany, in November 2015. Official Guinness World Records adjudicator Pravin Patel was on hand to verify, record and congratulate.

Intel was interested in expanding beyond its company's core business, computing, by entering a field with intriguing future prospects: unmanned aerial vehicles. Their research into what was happening at the sector's leading edge inevitably brought a visionary project to their attention. The *Spaxels* (LED-equipped quadcopters) shows in London, Brisbane and Dubai not only delighted the crowds, they also created a sensation in social networks.

With Intel's interest expressed in a display of coordinated aerial artistry in conjunction with a new Intel campaign, the company supported the technical R&D that aimed to make the flight more secure. The challenge was to launch 100 drones and deploy them aloft three-dimensionally for maximum impact. Making this happen called for tools offering significantly higher flexibility to enable twice as many *Spaxels* to fly in the formation now being proposed. Finally, an algorithm delivered the solution.

Success in attaining the goal of a world-record formation—one envisioned in 2012 and that was now suggested to the Guinness people by Intel—took a whole year of R&D work, which really gained traction in August 2015. The different designs of flight formations culminated in a 250-meter-wide Intel logo that was eventually synced with a custom-made composition.

The outcome of an entire year's development effort was an impressive sound and light show featuring unique resolution, cool colors and fascinating forms.

The *Spaxel's* Meteoric Rise Took Off in Linz

Since the summer of 2012, an Ars Electronica Futurelab crew has been working on how to put aloft a large group of LED-studded quadcopters that autonomously execute pre-programmed formations. The stunning result was to be admired in September the same year at the *Klangwolke*: in a multimedia extravaganza spanning the Danube, a group of 50 illuminated drones ascended and formed a huge eye in the night sky. This one-of-a-kind performance created a worldwide sensation, and it was not long before the first prominent client came calling. In conjunction with the promotional campaign preceding the premiere of *Star Trek—Into Darkness*, Paramount booked the Linz-based drone swarm to perform its aerial artistry immediately adjacent to London's Tower Bridge. By this point at the very latest, the *Spaxels* project had taken off. There followed airborne performances in Bergen, Norway (International Bergen Festival, 2013), Ljubljana, Slovenia (Ljubljana Festival, 2013), Brisbane, Australia (QUT Robotronica Event 2013), Umea, Sweden (official opening celebration of the 2014 European Capital of Culture), Sharjah, United Arab Emirates (official opening celebration of the 2014 Islamic Capital of Culture), Hanover (official celebration of the 25th anniversary of German unification, 2014), Dubai (the UAE's national day festivities in 2014) and Linz (2015 Eurovision Song Contest). These commercial appearances made it possible to finance the ongoing enhancement and tweaking of the *Spaxels*. Then, in autumn 2014, the Ars Electronica Futurelab received mail from Intel for something they called *Drone 100*.

Text: Markus Scholl

For an up-close-and-personal account of how this extraordinary production played out, by all means read the Ars Electronica blog posting *Spaxels: An Extraordinary Achievement Featuring 100 Points of Light* at
http://www.aec.at/feature/en/drone100/

Spaxels and the Ars Electronica Futurelab

Spaxels are unmanned aerial vehicles (UAV), each equipped with a controllable light source (an LED module). By flying many of them in a swarm, one can form a display made up of multiple picture elements free-floating in space. That is the derivation of the name—*Spaxels* is a portmanteau word formed from space and pixels.

Since the *Spaxels* project started in 2012, the primary focus of the research has been driven by a vision formulated very early on: achieving a dynamically changeable, three-dimensional display in real space.

Ideas such as the *Smart Atoms*, creating a shared space with the *Spaxels* and touching them, moving them manually through space, "constructing" virtual objects in real space by forming new configurations of *Spaxels* in space and being able to interact with these newly formed configurations of "virtual objects" in real space, have already been displayed in our concept demos at the Festival Ars Electronica. Demonstrating a concept is daily business in the R&D field, and there is nothing special about it. What is very special indeed is the fact that the team responsible for the *Spaxels* has not only been self-financing from day one, but also, with the increasing opportunities to perform shows around the world, has also financed the entire and growing R&D budget without any further outside investment. It is rare for this to happen, since it means having a functional outcome that is far more sophisticated than a working prototype. From the first appearance, our outcome has been a service: designing, preparing and executing *Spaxels* shows for clients.

The *Spaxels* performance for Intel's *Drone100*, set a world record. Achieving that is in itself quite outstanding; carrying out this record-setting performance not only for video production purposes but for a live show in front of an audience on a regular basis—every day after sunset, five days in a row, as the Ars Electronica Futurelab did for Intel at the Vivid festival in Sydney 2016 —is a challenge in its own right. The fact that all five shows were carried off successfully proves that Ars Electronica's system and team is mastering this challenge on the same level of excellence that underpins the internationally leading position of this art-and-technology-based institution.

The demand for shows has been increasing, and not only since this very fruitful collaboration with Intel, which has made it possible to create the Ars Electronica Futurelab's first spin-off: the Ars Electronica Spaxels GmbH. One might think this is a typical incubator/start-up business, and Ars Electronica Futurelab is following that path. That is very true, but it is not the whole story. Parallel to the spin-off, there is still the vision that is being kept alive. There is a whole lot of research and development to do in order to make the quantum leap to the next level.

With Ars Electronica Spaxels GmbH, we are about to roll out a product that allows others to utilize this dynamically changeable, three-dimensional display for their own needs and ideas. This system, a combination of software and hardware, will revolutionize the way we work with drones today. It's not about flying drones anymore; we want to liberate the creation process from UAV expertise. Everybody should be able to create content for this new media, and everybody should be able to perform their own content without the need to even understand what UAVs do. A complex display—flat screens, for instance—isn't necessarily understood by those who create content, cut videos or write code for and on it. Spaxels GmbH will endeavor to follow that path and make *Spaxels* more accessible on many levels.

The Ars Electronica Futurelab will continue to utilize

SPAXELS

and expand its expertise in controlling UAV swarms in several directions. Besides perfecting the layer of expression of this new media, *Spaxels* will be further investigated in order to extend the already formulated visions. One of these upcoming ideas is heading in the direction of future social communications aspects. *Spaxels* could be used to launch new forms of public decision-making processes for architecture—visualizing architectural structures by deploying them at the planned location, forming the outline of the planned architecture.

The current state of *Spaxels*—the technologies behind them and the complex apparatus to be mastered—is not what it will be in the future. Today we are only seeing the first inklings of what this could become in the upcoming months and years. *Spaxels* may now be comparable to the early days of 3D printing, a time when only very small parts could be printed, and they could then only be used for prototypes and demos. But the basic concept of *Spaxels* is actually very similar: "turn your idea into a 3D object." Yes, it takes days rather than minutes; yes, it is only doable on a comparatively small scale and at very poor resolution; yes, the costs are still quite remarkable . . . but the 3D object is real and the *Spaxels* objects are changing dynamically and reacting to your input in run time . . .

Ars Electronica Futurelab also collaborates with its industrial partners, Knapp and InmotionTec, on UAV swarms in the area of indoor logistics. This project, called Swarm Logistics, is being financed by a three-year grant from Austria's Research Promotion Agency (FFG) within the framework of its Take Off Call. In this, a very different application for UAV swarms is being investigated.

Spaxels were initially the outcome of a quest for a new layer of artistic expression for *Klangwolke 2012*. While attracting great interest from art, science

and industry, the project is still open enough to investigate a wide range of applications and their larger context in terms of the meaning of *Spaxels*. Accordingly, the freedom to cross over fields of activities and disciplines isn't seen as a bonus: this is the essence of *Spaxels*, the Futurelab, and Ars Electronica as a whole.

Sam Syed

Ma Mère l'Oye visualised

Commissioned by LA-Phil and Abu Dhabi Music and Arts Foundation

The Ars Electronica Futurelab has extensive experience in the stage-based media-art genre. From the dance and media performance *Apparition* (2004) to Stravinsky's *Le Sacre du Printemps* (2006) and the visual *mise en scène* for the live performance of *Tosca* accompanying the album *Odeon* (2013)–the Ars Electronica Futurelab has an impressive portfolio of successful multimedia joint productions to its credit, like a high-profile guest shot at prestigious Walt Disney Hall in Los Angeles February 12-14, 2016.

In conjunction with the venue's In/Sight series, the LA Philharmonic Orchestra conducted by Esa Pekka Salonen performed Ravel's *Ma Mère l'Oye* (*Mother Goose)* accompanied by impressive visualizations created by the Linz-based media lab. Seven projection surfaces above and behind the orchestra displayed abstract worlds of imagery that, instead of being derived from a literal orientation on the work's plot, complemented the tonal colorations of the music itself. The essential influence on the hues and shapes that made up the poetic visuals was provided by the orchestra itself. All of the musicians' movements, and even the shadows they cast, were captured by various tracking systems; specially programmed software then translated the data into abstract images in real time.

Walt Disney Music Hall by Frank Gehry

Foyer exhibition Memory of Ma Mère l'Oye
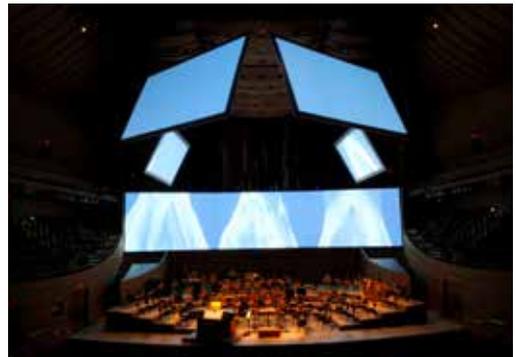
Screen setup in the concert hall

Roland Aigner
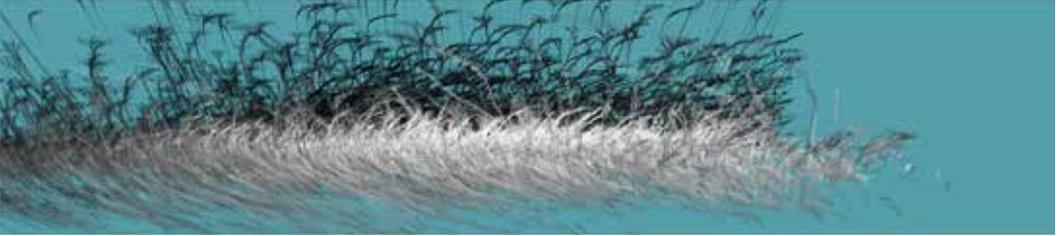
I. Prelude, *Thickets of the Inevitable*

II. Premier tableau−Danse du rouet et scène, *The Case*

V. Troisième tableau−Les entretiens de la belle et de la bête, *Landscapes of Ambiguity*

VII. Quatrième tableau−Petit Poucet, *Dark Forest*

Ars Electronica Futurelab at the World Science Festival, Brisbane

In March 2016, Queensland University of Technology (QUT) invited Ars Electronica Futurelab to bring six floor robots to the World Science Festival in Brisbane, Australia. The bots were developed as part of the ongoing research cooperation between Mercedes-Benz and Ars Electronica Futurelab on the topic of future mobility. The shared-space bots are proxies for autonomous cars in this installation, which is all about how future human-car communication will unfold. They communicate with their environment through light and audio signals and also by their movements, giving us an indication of the way robocars will communicate with us in the future. But effective communication needs to be a two-way street and the program also enabled members of the audience to "converse" with the bots via their movements and positioning devices that define bot-free spaces. Fruitful Q&A sessions afterwards reflected the intention to bring this research into a real-world scenario and to encourage the Australian public to think about this science in the context of their daily lives. In this way, Ars Electronica is actively exporting its unique and established approach of using art to educate society about technology as it does every day at the Ars Electronica Center in Linz.

Kristefan Minski

Paul Bauer

TMW

The Urban Future

In conjunction with the Ars Electronica Futurelab's expertise on visualizing data, it entered into a scientific partnership with the Vienna Museum of Technology. Kicking off this project-based collaboration is *The Urban Future*, which opened on June 8 as the first in a series of exhibitions entitled *thinking_forward_*. The featured attraction in the newly installed 1,000-sq.m space set aside especially for this show is a planning and sketch table showing the development of Aspern, a newly designed lakeside city in Vienna's 22nd District. This highlight also clearly demonstrates a core competence of the Ars Electronica Futurelab staff: the ability to integrate art and technology to facilitate sociopolitical discussions. Serving as the bridge here is a table that teaches how urban planning actually works and invites exhibition visitors to get hands-on experience in it.

Ars Electronica Residency Network

Sparks: Residencies for Artistic Visions of Health and Medicine

Partaking in the Sparks program, an EU-funded communication project which engages on the topic of technology shifts in health, medicine and well-being, the Ars Electronica Futurelab called for three artists in residence to research and develop an artistic realization of the topic *Responsible Research and Innovation (RRI)*. Within this framework and the Ars Electronica Residency Network, three artists working in the field of new media and technology eventually prevailed with their submissions and so gained the opportunity to contribute to the planned activities. Each selected artist produced an artwork that is part of a touring exhibition, which will be shown in 29 countries. From February to April 2016, the selected artists created their own vision of technology in medicine, health and wellbeing. Collaborating with the Ars Electronica Futurelab and scientists, they produced unique and compelling visual representations of innovation in order to provide a disruptive point of view about the impact of science and research.

Anouk Wipprecht (NL)

Agent Unicorn

The first attendee on the lab floor was hi-tech design celebrity Anouk Wipprecht, who achieve fame for her dresses incorporating science and fashion in order to transcend experiences beyond glamorous looks. Her Intel-Edison-based *Spider Dress* is a prime example of this aesthetic, where sensors and moveable arms on the dress help to create a defined boundary of personal space while employing a fiery style. Anouk Wipprecht researches how we can interface with the world around us in new ways through our wardrobe. So it was only a natural extension of her work when she introduced *Agent Unicorn*. The unicorn-horn-shaped wearable should help us to understand children with ADHS in a playful way. During her stay at the Futurelab, she teamed up with therapists, neuroscientists and other experts, creating an accessory that logs the wearer's observations through EEG. Triggered by brain activity, a built-in camera takes short movies when the wearer's attention is aroused. From this, therapists can draw better conclusions as to what caused the child's attention and how it stresses the wearer. Moreover it eases the interaction between therapist and patient, due to its fanciful look and the opportunity to work with the latest technology.

Claudia Schnugg

Veronika Pauser

Lucy McRae (UK)
Future Day Spa

The second artist in residence was Lucy McRae. She calls herself a body architect in order to stress her aim of testing her body in extreme situations. Her activities as a director and actor in the body of film-works portray her way of pushing the limits. As a forerunner to the short film that Lucy went on to produce with the aid of Ars Electronica Futrurelab staffers, she chose the subject of body isolation as a preparation for space travel. Her film *Future Day Spa* envisioned the prospects of becoming used to zero-gravity while lying underneath a tinfoil blanket. That concept eventually led her to the idea for *The Institute of Isolation*, a short film about the effects that a process of body-optimization will have during a stay at a sanitarium. Some locations were spotted by Sparks project manager Claudia Schnugg, who pretty much organized all the residencies on behalf of the Ars Electronica Futurelab. For example, the picturesque Fischau thermal spa was the perfect setting for a film shot in the aesthetics of Wes Anderson.

Jakob and Lea Illera (AT)
BeBots

Michael Mayr

Last but not least, the third artistic approach to RRI was provided by Viennese product designers Jakob and Lea Illera, who took the idea of a wearable to the next level, with the device not on the body, but inside it. Their artistic vision, called *BeBots*, cures humanity by racing through the "wearer's" veins. In their case, the nanorobots are designed to mitigate the desire for unhealthy food and thereby treat the worldwide problem of obesity. After doing their job, they should leave the body as easily as they entered. Whereas the designers opted for a nasal intake via an inhaler, they chose them to be washed out through the pores. A consumer-friendly vision, if there was no ethical debate on the basis of health insurance, marketing of vanity via a medical tool, and the consequences for a society of whose members already stigmatize people for the way they look. The idea, which sounds like a classic Sci-Fi movie plot, is by no means far-fetched, as experiments with nanorobots to cure cancer are already under way.

Text: Markus Scholl, Claudia Schnugg

The Ars Electronica Futurelab Academy

A Vital Exchange with Queensland University of Technology

The Ars Electronica Futurelab Academy comprises a range of activities that share the goal of knowledge transfer and exchange with educational institutions and organizations acting at the nexus of art, design and technology.

In one of the academy's most successful program formats, Futurelab experts act as external mentors for university students in a range of fields from human-computer interaction to media art. This co-supervision of projects, including on-site lectures and workshops as well as teleconference discussions, results in an exhibition at the Ars Electronica Festival.

Jared Donovan

This year, the Futurelab again partnered with its long-time collaborator Queensland University of Technology (QUT) in Brisbane, Australia, continuing a series of high-quality works created by QUT students in the Futurelab Academy for the festival in 2013 and 2014. Three student teams from backgrounds such as interactive and visual design and mechatronics have been given the challenge to create original works of interactive art. The students have also been encouraged to use the LinzerSchnitte device in their projects, an FM-radio-based physical computing platform developed in the Futurelab.

Their projects negotiate such different topics as sculptural transformations of public discourse, exploring cultures through sound and the playful embodiment of involuntary physical expression. But the Futurelab Academy is really all about the process the students develop for themselves, their individual version of a way to work across borders (both metaphorical and literal), which will soon become axiomatic, as the grown-apart disciplines of art, science and engineering are woven back into an elevated "alchemy" of our age—nowhere more so than at forward-thinking universities.

Text: Peter Holzkorn, Artist & Researcher at the Ars Electronica Futurelab. Peter coordinates programs for the Futurelab Academy. Project descriptions by the artists. Technical Services Manager, QUT Precincts: Nigel Oram

Joseph Benigno and Joshua Lake
Ripples

Ripples (by Joseph Benigno and Joshua Lake) is an interactive installation where users record their pulse onto an object and place it on a pool of water. Each chosen object produces a visual representation of the users' recorded heart beat through synchronized lights and vibrations, causing ripples in the water. Multiple users can embody their heartbeat in their own objects to collaboratively interact with one another in the water. Through *Ripples*, people are enabled to experience their core essence of being alive and share a connection with others visually and interactively.

Peter Holzkorn

Peter Holzkorn

Chloe Jade de Santa-ana and Krishan Rana
On the Line

On the Line (by Chloe Jade de Santa-ana and Krishan Rana) is a participatory project for people to give their opinions about current topics in the media in a safe and positive environment. Participants are asked to respond to a topical question with a "yes" or "no" answer accompanied by a written explanation. These responses become part of an interactive installation where people can see where they stand in relation to others. The aim of this project is to provide a forum where people feel comfortable to speak their mind and share their opinions with their community.

Natasha Lawrence and Dimity Miller
Melody Map

Melody Map (by Natasha Lawrence and Dimity Miller) is an experiment on world sounds and our perception of cultural diversity. Participants can create their own personal composition by pressing holes in paper sheets or playing pieces composed by previous visitors on a wind-up music box. By generating melodies of sounds from across the world, the exhibit will provoke thought on the differing but complementary nature of varied cultural music.

Peter Holzkorn

Ars Electronica Japan

In 2016 Ars Electronica is announcing the official launch of *Ars Electronica Japan*, a new initiative in Futurelab, dedicated to driving a wide range of innovative projects with its Japanese partners. *Ars Electronica Japan* is designed to strengthen the productive relationship with creators, industries, public organizations and cultural institutes in Japan, and will provide unique cultural medium with a mixture of Japanese and European backgrounds.

Since its very early days in the 1980s, Ars Electronica has had a close relationship with Japanese artists who addressed pioneering challenges. *Mind of the Universe* (1984) by the Japanese composer Isao Tomita broke new ground in computer music, astonished an audience of over 60,000 in the Donaupark by the spectacular performance of electric-spatial music with cutting-edge technology of the time: synthesizers, lasers and computers. Most recently, 165 Japanese participants, including artists, scientists, social activists, companies and cultural institutes joined Ars Electronica 2015. Apart from notable Golden Nica winners such as Masaki Fujihata (1996, Interactive Art), Toshio Iwai and Ryuichi Sakamoto (1997, Interactive Art), Ryoji Ikeda (2001, Digital Musics & Sound Art), more than 200 Japanese artists and creators have won Prix Ars Electronica awards since it was established in 1987. We moved to Linz as artists in residence in 2007, and since then we have engaged in various projects, including the renewal of the Ars Electronica Center in 2009, exporting the installation/workshop to Japan, and innovative joint research projects with Japanese companies.

The efforts are well exemplified in following projects: In 2010, Ars Electronica Futurelab conducted a joint research project with Honda's R&D department to discover the ideal interaction between humans and the humanoid robot ASIMO, and influenced its long-term development approach. With Elekit, the educational engineering kit provider, we collaborated in developing an interactive drawing kit, *Switch*, which has been released as a commercial product. We have been involved in projects to explore future product design with the Toshiba Design Center and Kokuyo (a stationary and office furniture manufacturer). At the Knowledge Capital in Osaka, Ars Electronica is not only providing a regular program, with exhibitions and workshops, but consulting to create sustainable cultural hub in a city. From 2014, the advertising agency Hakuhodo and Ars Electronica started the *Future Catalysts*, initiative, which aims to create multidisciplinary platforms that can empower innovations in Japanese companies. Currently, as a part of this initiative, we are working together with Toyota's children's educational program in Linz and Japan. In 2016, we will initiate a joint research project to design a new form of societal communication infrastructure towards 2020, with the R&D department of the telecommunications infrastructure provider NTT.

Another interesting new collaboration with NHK will explore the possibilities of 8K video production in the Ars Electronica Deep Space 8K.

By engaging with research projects, Futurelab helps to embody the prototype, the center provides the place to demonstrate it and to get feedback, and the festival gives the opportunity to present the idea on a global scale and provoke worldwide discussion among creators, industries, governments and citizens. Ars Electronica works comprehensively as a unique ecosystem connecting art, technology and society.

Ars Electronica Japan aims to promote cooperation with various social sectors in Japan, and to encourage them to leverage their own innovative capabilities through collaborating with us. We aspire to revitalizing Japanese society by promoting innovation, and we believe our approach to creating a nexus between art and society will become a key to achieving that goal.

Text: Hideaki Ogawa, Emiko Ogawa

NTT (Nippon Telegraph and Telephone Corporation) Research Lab and Ars Electronica Futurelab

Advanced Social Communication Design towards 2020

NTT (Nippon Telegraph and Telephone Corporation) Research Lab and Ars Electronica Futurelab have established a joint research project entitled development of social communication design towards 2020. This project aims to develop advanced social communication design to support innovative people-city interaction in 2020 Japan future town through the fusion of Technology and Art.

NTT is Japan's largest telecommunications service and infrastructure company and carries out world-class advanced ICT research in three laboratory groups: the Service Innovation Laboratory, the Information Network Laboratory and the Science & Core Technology Laboratory. Its R&D is aimed at creating new communications services and fostering foundation technologies that will realize the communication networks to support them. The Ars Electronica Futurelab in Linz is a transdisciplinary research and development atelier/laboratory. The team consists of international members from different disciplines, and focuses on developing future scenarios in art-based experimental forms, creating methods and strategies of applied science which can address various societal issues and pursuing empirical demonstrations in the real world. The objective of the collaboration is to develop a vision of a future generation of communications. NTT and Ars Electronica Futurelab leverage each other's strengths, advanced technologies and creative methodologies to apply technologies to living reality, and plan to implement the results of this joint development in Tokyo, one of the world's largest cities.

At Ars Electronica 2016, we will be introducing *Deformation Lamp* and *Ars Wild Card+* as the first prototypes of the joint project.

Deformation Lamp is a new light-projection technique that NTT developed in 2015, and a magical lighting system that can bring completely novel visual experiences, making physically static objects appear to move, deform or flutter. The lamp can add a range of realistic movement impressions to static objects. We are jointly developing this fantastical digital signage system and will bring it into whole festival venue.

Ars Wild Card is a smartphone app developed by Ars Electronica Futurelab which enables visitors to enjoy exhibitions in public spaces. Visitors can use it to get information about works in the exhibition, as well as photographing the works, even including themselves, and creating their original postcards. Powered by angle-free object-search technology developed by NTT, we have renewed the app as *Ars Wild Card+*, a smartphone app specially designed for festival visitors. The angle-free object-search technology can accurately specify a three-dimensional object from a photographed image of it from any angle. Users can get information on any work at the festival instantly, not by scanning a conventional barcode but by holding their smartphone over the object. *Ars Wild Card+* can provide visitors with a more intuitive experience to connect with works and encourage new discoveries.

Through this prototype, at Ars Electronica 2016, NTT and Ars Electronica Futurelab will deliver a new vision of what human-information communications will look like in the city of the 21st century.

> "The city, it would appear, is humankind's most successful survival strategy, and still our greatest social experiment." Gerfried Stocker

http://www.ntt.co.jp/RD/e/index.html
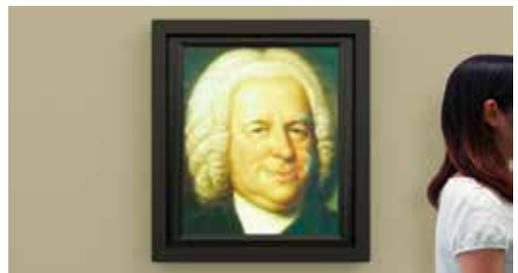
Matthew Gardiner (AT/AU)

The Futurelab as Catalyst: From Artist to Alchemist

Project-based thinking evolves most artistic practices, but only to a certain point. The alchemists of our time are artists who have transformed their practice into fields of research, beyond projects and immediate concerns, where social relevance is paramount. This short essay reflects on my transition from project- to research-framed thinking, and how I think the Futurelab, in the small town of Linz, enabled and fostered it.

Project-to-project thinking guides most early-career artists; we go from inspiration to inspiration. If we employ any type of technology, on our own or with collaborators, we engage a type of alchemy special to art-making. In a project, we ask how can the material fulfill our vision? We tend to be goal-focused, and this is very practical, as exhibition deadlines have a way of thumping us like a six-foot waves and tumbling us around and around till we come up for air, and finally reach the shore of the opening night. This was how I arrived at Ars Electronica Futurelab in 2010, ocean-smoothed and tumbled from years of projects. My role was artist-in-residence, and it felt like home for me, among a group of diverse, talented, extremely driven and hard-working people. I came with a project, as you do with that type of thinking, and I had a purse full of gold from various sources. Little did I know, I was creating my magnum opus, *Oribotics [the future unfolds]*. 52,500 folds, 1,800 hours of 3D printing, 250 LEDs, 50 circuit boards later, Gardiner's little team in the Futurelab had made an artwork that far surpassed our previous works and visions. What made that

possible? Was it access to technology? Or was it that six-months in the Futurelab seemed like a utopia for art making because the environment and inhabitants are inspiring? Maybe it was due to being asked to think deeper about what I do. Sure, access to a high-end 3D printer and a laser cutter reduced my prototyping cycle from weeks down to hours, I could go for a near-enough approach, make it, and iterate. The laboratory provided fabrication machinery otherwise inaccessible to me, but nowadays access to a community fablab can provide this low-cost access.

The questions the lab framed for me, and to this day still pushes me to answer, was the push to identify the social dimension of my work. Where did it intersect, what was the impact? I went down the rabbit-hole of thinking that led me to examine my own field: *oribotics*, specifically the changing meaning of the ancient art of origami to its contemporary meaning as a sophisticated do-all technology. I discovered that folding DNA, soft robotics, self-folding self-assembling robots and origami science was and is blooming as a field. This allowed me to see and position my artworks in a research field, in a discussion that included art, technology and society. And when I saw this I began to see how science, conceptually through technology was bleeding osmotically to artistic and therefore social concerns. This concept was reinforced in my role as curator of *Project Genesis*. The deeper philosophical concerns of the science of synthetic biology became the paramount concerns of a future society. We chose works that

Matthew Gardiner

Matthew Gardiner, Futurelab Artist in Residence, circa 2011

Rachel Hanlon

Matthew Gardiner, Embracing the alchemy of the Futurelab, circa 2016

represented the broadest possible points of view, from pure technical innovation, to social drama, and speculative designs that could terrorize corporations, governments and the public on a global scale. The point was to demonstrate the discussion from multiple, equally radical points of view, to ambush them with ideas, so that by the time the audience steps into it, they are uninhibited by the relative mildness of their own opinions. Ultimately, this is to inspire them to see the dramatic consequences of being in the discussion, and the disaster that occurs when they are left out of it.

The research framing finally sank in, and now my position is totally unique, after consecutive years of applying to the FWF PEEK fund, I was awarded a 36-month grant, and now spend six months per year in my studio in Australia and six months at the Futurelab. In Australia I work on concepts, materials and processes, and when I work with the team in the Futurelab, we implement the things that I don't have the capacity to do independently; this year we wrote code that makes unfoldable patterns foldable, and made our own oversized 3D printer to produce these patterns in materials that are easy

to fold, and therefore program. It is open-ended research, so-called fundamental artist research; my aims are to produce new oribotic works, but we can see that the research itself has more applications, and that our research field has the potential to touch and intersect with future society in a very meaningful way. Our team's key opportunity is to mine this meaning and make works that reflect this, and the first steps are to open new roads into the field.

When I set out to write this little essay I thought to myself,

> "I know what the alchemy is, it's the research we do, it's the placing of art in new contexts, it's the search for meaning in technologies that make up our daily lives."

But as I write, it becomes clearer,

> "it's also the making of new fields, catalyzing new creative domains, and it's the place in which these reactions occur,"

and the Futurelab really makes those reactions explode!

Text: Matthew Gardiner, Artist and Key Researcher in Functional Aesthetics at the Ars Electronica Futurelab.

Horst Hörtner (AT)

The Future of the Lab

When we consider the history of new media technology and art, the concept of the lab has played a significant role as a symbol of the experimental nature of media art and as a provider of infrastructure and expertise for these cutting-edge developments.

Ever since the MIT Media Lab was founded in 1985, or in the early years of Art+Com in Berlin (1988), it has also become synonymous with the encounters and exchanges between art and creativity on one hand and engineering and science on the other. The 1990s saw the propagation of this idea beyond universities and corporate R&D departments; artist-run labs like x-space in Graz (1990) and the Ars Electronica Futurelab (1995) were among these early adopters.

Nowadays, "lab" is a fashionable yet also inflationary term, used for almost anything that aims to be cool and experimental—for instance, fashion labs, food labs, beauty labs and inspiration labs. And, of course, in the age of ubiquitous technology there are pop-up labs in kitchens, living rooms and garages of all sorts.

So what's left or, even more important, where are the new frontiers for the labs of the future?

One of the lab's purposes is derived from its nature as a place for scientific experimentation (experimental science and research)—to verify or falsify hypotheses and generate proof of concepts and demonstrations.

Labs soon changed from workshops to places where the actual research is done. This practice-based research approach allows artistic practices to become part of the scientific toolkit. Since the early days of these proving grounds, labs have also been ateliers (and vice versa). One reason may be the fact that the field of work seemed to naturally transcend the borders of discrete disciplines, and the particular question or project was more important than the disciplinary borders were, and still are. The nature of the work in labs incorporated the requirement of at least working in cross-disciplinary teams and, depending on the research question, perhaps required interdisciplinary and transdisciplinary approaches entailing several disciplines. Work at a lab makes cross-disciplinary communication and collaboration an everyday practice rather than just a concept to be praised. This allows for the easy adoption and integration of further disciplines, and this potentially works almost naturally.

By implementing a transdisciplinary environment, labs provide accessibility: accessibility to an often costly technical infrastructure, at least in the past; shifts more clearly to provide access to other methods; inspiration and direct exchange among staff; and an environment built to support fast and fluctuating collaboration among them.

As new technologies (such as 3D printing) become widely accessible almost as soon as they appear and corresponding knowhow is accessible online, the role as the provider of accessibility to technological infrastructure will increasingly lose its relevance. In fact, at this point many Ars Electronica Futurelab staff members bring new technologies to the lab with them—having found something promising on the Web, simply having constructed their own tools to meet the requirements of a project, or in pursuit of an idea.

Lately, the Ars Electronica Futurelab has recognized a growing demand for new or changing forms of collaboration with the private sector. Industries have begun to focus on their role within our society, and started to open up towards projects that aim to discuss the relationship between themselves and a future society.

The Ars Electronica Futurelab is not any better equipped than anybody else when it comes to the ability to predict the future—the difference, as we see it, is in the way Ars Electronica embeds art in its activities.

The Ars Electronica Futurelab is investigating the way art projects take shape and take off. It is very hard even to describe the many different approaches, and it is probably impossible to create modules and a method that incorporates all the diversity. Nevertheless, "Art Thinking" has been made—almost naturally—one of the lab's core processes. In contradistinction to "Design Thinking"—as an iterative process and method to find creative designs and to generate specific solutions for a specified task—Art Thinking is a description of a process that generates visions rather than solutions. By identifying new ways of looking at a task, raising questions about it, a solution increasingly disappears from the focus of the team. Strategies rather than solutions are discussed. That in turn leads to new fields of potential activities, which results in something like a vague description of a vision and a catalog of questions. Accordingly, the Ars Electronica Futurelab does not refer to art in terms of artistic results, the process of art production, or artists as the key, whereas all three might be valuable as starting points or destinations.

Art Thinking

In referring to art, the reference is to a very specific artistic knowhow that exists in most if not all art forms in varying amounts and qualities. This know-how concerns the very abstract ability to express something in a very specific way, which allows an audience (visitor, user, etc.) to learn or understand by experience. This "art of mastering a communication layer" is specific to the arts (at least—and potentially limited to—the type of art that in the past few decades has roughly been subsumed under the term media art and which has evolved into so-called key technologies). At the same time, art is very open with respect to its addressees, with open referring to its character as "an open invitation to everybody." Not only do art pieces "speak" to people of all ages, but art also invites people of all levels of education and experience. Art communicates on a layer of the "meaning of . . ." rather than its layers of the "making of . . . and its "layer of communication" sets it apart from scientific concept demos or tech demos of applications.

Some examples may help to explain this complex construction a bit better.

Art is an open invitation (to curiosity).

An example is *The Listener* by Partricia Piccinini, which was part of an exhibition called Project Genesis curated by Ars Electronica in 2013.

The exhibition focused on the topic of synthetic biology, a very complex area, totally unfamiliar to many of us, and hard to generate awareness of. There were very few visitors to this exhibition who did not immediately react to *The Listener*—with attention to and curiosity about the entire topic being raised immediately.

The Listener is a work of art that can question us on a very intimate level. Its strength is not based on a purely provocative creature; its strength is its precise, well-thought-out layer of communication. Not only is it a mixture of several creatures in one, which has all the remarkable "schemes of childlike characteristics", but it also is entitled *The Listener*. With that step, the artist created a story right away, and endowed this creature with a task and a "function."

Patricia Piccininni, *The Listerner*

This implication of a "functional life form provokes not the lowest human reactions of like and dislike"; it immediately addresses this challenge of an artificial life form in terms of our ethical criteria: "should we–as a society–allow for such a future?" It takes the "like and dislike" from the initial emotional reaction to this level of that social challenge and its question of our society's ethical criteria. And it does this with children, with retired people, with university staffers and members of the working class. It communicates on all levels of education and age.

Art is an open invitation (to experience)

Another example of this very specific "layer of communication" of art is another installation that Ars Electronica has exhibited: *Bell*, by Soichiro Mihara, at the exhibition Art&Science.

What is addressed here is the question of the need and ability of our society to adapt to an environment that is increasingly pervaded by technology. The work is based on the idea of integrating new environmental phenomena into the traditional concept of wind chimes.

When we hear and see a glass cylinder shaking and touching a glass sphere inside a glass casing, then this is not caused by the wind, but by radioactivity, which is read by the Geiger counter inside the casing. The beautiful appearance of the work, which lets us experience omnipresent radioactivity in our environment, and the fact that the Fukushima disaster focused global attention on the future of nuclear power, raise questions about our societies' adaptability to the increasing technologization of our planet's natural world. By watching and listening to this work, all the above becomes an experience, and one that is not limited to Asian culture or society. Art's layer of communication works cross-culturally. Art does not explain things or concepts, but it can make them accessible to many.

The integration of such sophisticated "communication layers" into projects at labs generates an essential benefit for the project's outcome, and this benefit is accessibility. Art thinking might become a very important aspect for the future of labs, which will have to extend their role as providers of accessibility to their own work and project outcomes.

This is very speculative to be sure, but how are we to write about the future without speculation?

There is another aspect that might strengthen the argument for a lab that provides accessibility to its projects' outcome:

Soichiro Mihara, *Bell*

What many of our future challenges (global warming, global migration flows, financial crises and other sources of uncertainty) have in common is the fact that these phenomena are really hard to understand and hard to break down; they are extremely inaccessible. For individuals, these phenomena are impossible to understand, and it is difficult for them to maintain—or even obtain—an overview of the particular challenge and its consequences. These problems do not even impact on a single person hard enough for that person to be able to make a connection between the impact and the source—especially since these are interconnected sources and not a single one, and the chain of causality is way too complex to be tracked.

It is therefore not to be expected that we will find one single solution that resolves the challenge for us. It is more likely that our global community will fail or succeed in the attempt to cope with it. Answers need to come from every discipline and branch, and it is a huge set of answers that needs to be found.

Hyperobjects

The consequences of these phenomena are beyond our human ability to experience. For example, it is no longer possible for one person to experience what it means for 25 million refugees to be on the move worldwide. Even if a single person visits all the refugee camps, the tragedy of one person at sea on the Mediterranean cannot be understood. We can only experience single events such as a boat that has sunk. That has nothing to do with an overview of global migration flows and their consequences, which our society is focusing on in the future.

These challenges, which grow beyond our horizon of perception, have been framed by Timothy Morton in his book *Hyperobjects*, and we are constantly surrounded by their consequences without even understanding that we are.

It is a challenge to cope with hyperobjects, since even getting an overview of the challenge as a whole requires a transdisciplinary approach. And this is still far removed from solving something; it is just about getting a grasp of what sort of challenge we are really dealing with.

 Hyperobjects are challenges that elude our perception—which doubtlessly does not cause hyperobjects to disappear.

Labs are sites of transdisciplinary collaboration, and therefore could potentially be used as a role model to start work on hyperobjects.

If this work is understood as a process that involves large segments of our global society, education of our societies will play a key role in the future. Explanation may fail due to the nature of the challenge, but experiencing it might work—which again makes mastering the layers of communication a form of expertise with great future value.

The uncertainty and instability that also increasingly characterizes our generation's future will be both a threat and a chance for these labs. Including our societies as our "clients"—as proposed by several science and technology studies over the past decade—and adding persons "affected by the research field" to the research team seem to be promising future prospects for science and research in general.

But what will become increasingly important in the future of the lab is the need to involve a broad audience with its outcomes. More opportunities to communicate with the general public need to be found and new opportunities need to be offered. Labs will need to develop an "art of dialog" with public audiences in order to maintain their relevance as forerunners and pioneers.

Ars Electronica
Solutions

The 34-member staff of Ars Electronica Solutions gleans ideas, concepts and developments from throughout the Ars Electronica context and transforms them into trailblazing (media) applications customized for culture and commerce. In Ars Electronica Solutions' ateliers and workshops, the most creative approaches flow into the design of interactive products and services in the domains of Event & Show Design, Brandlands & Exhibitions and Urban Media Development.

ESA: Living Planet Symposium in Prague

Like their previous events in 2004 in Salzburg, 2007 in Montreux, 2010 in Bergen and 2013 in Edinburgh, the European Space Agency (ESA) staged a Living Planet Symposium in Prague in May 2016 to showcase the impressive work the organization does.

In the wake of successful collaboration with the Ars Electronica Center on the *Spaceship Earth* exhibition, Ars Electronica Solutions was commissioned to conceive and execute an interactive Hyperwall to feature the ESA's breathtaking images and simultaneously satisfy the information needs of symposium attendees. A tiled arrangement consisting of nine screens with a resolution of 3,240 x 5,760 pixels lets users access various items of geo-referenced information projected onto a large globe. Videos, texts, images, Twitter messages, symposium speakers, satellites, points of interest—these are just some of the topics on which users can obtain answers to specific queries or simply browse. If no user interaction is taking place at that moment, an ESA video is screened on the entire Hyperwall. This installation is based on GeoStage, software developed by Ars Electronica Solutions to effectively and attractively present geo-referenced information.

The event was held in Prague, Czech Republic, from 9-13 May 9-13, 2016, and was organizsed in cooperation with the Ministry of Transport, Ministry of Environment and Ministry of Education, Youth and Sports of the Czech Republic and the with local support from Charles University in Prague.

Ars Electronica Solutions

voestalpine Wire Rod Austria GmbH Donawitz
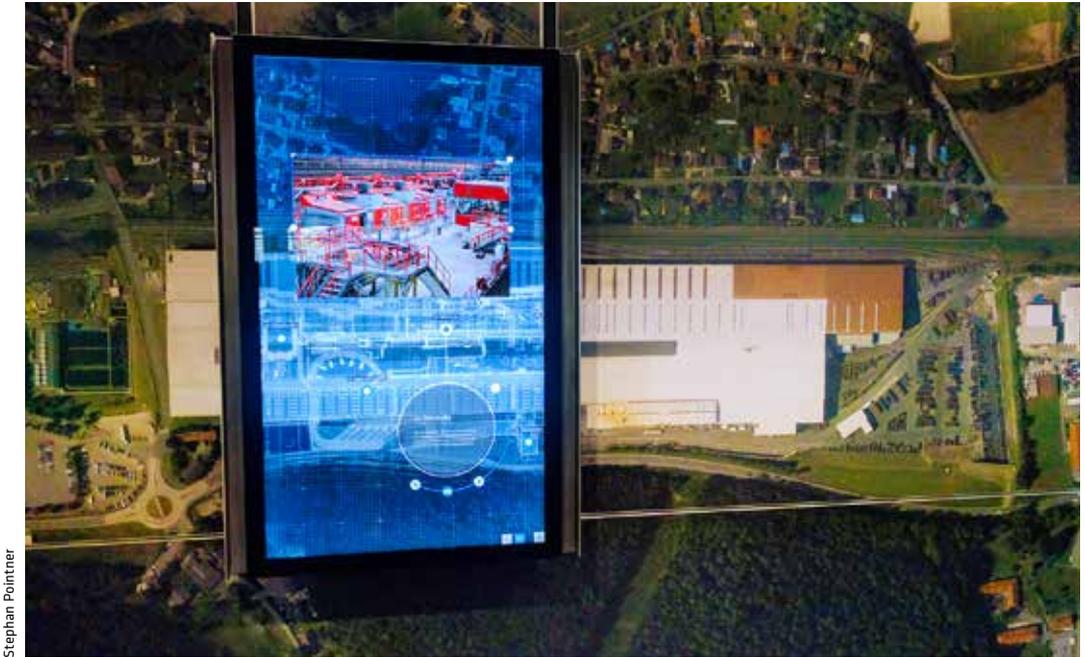
Stephan Pointner

voestalpine Wire Rod Austria GmbH produces steel products for the most demanding uses in the auto industry, energy sector and mechanical engineering field. At the company's Donawitz facility, voestalpine is currently building on of the world's most modern wire-rod plants; the centerpiece is a 100,000-sq. m² plant complex. In order to provide for visitors' tours, voestalpine and Ars Electronica Solutions have launched a collaborative conceptioneering phase.

The resulting design concept is meant to yield a new and innovative form of presenting the technological highlights of this industrial facility. Even from afar, an imposing metal sculpture announces the unique, creative design of this rolling mill, featuring an all-encompassing guidance system and media

installations integrated directly into plant's architecture show the unique and innovative approach of this rolling mill.

Infocontainers will utilize a combination of print and touch monitors, for instance, to demonstrate the entire production process. When visitors look out of it onto the production floor, they don't just peer through a conventional window; instead, they gaze through a huge transparent screen on which additional information is positioned at just the right locations. This offers a completely new way of understanding what they are seeing at the moment. Plus, a ceiling projection above the visitor walkways provides a virtual view designed to clarify these highly complex processes.

A Deep Space for Singapore

Science Centre Singapore and its group of attractions bring out the wonders of science, technology, engineering and mathematics through its unique blend of exhibitions, educational programmes or events. In nearly four decades, over 17 million visitors have entered our doors, arriving with curiosity and leaving inspired by our creative and innovative content.

Just recently the Science Centre Singapore opened the exhibition "E3–Emmersive Experimental Environments", inviting in a playful way to think further than reality. Alongside projection mappings and virtual reality glasses Ars Electronica Solutions contributed the knowledge for a Deep Space Theater. Big screens have been a mainstay of the cinematic experience for so long they are an expected part of watching movies. But to take it further, the field of view is extended down beneath your feet–giving the visitor a feeling of floating in deep space. By presenting the Deep Space, the successful cooperation of between Science Centre Singapore and Ars Electronica has continued.

Florian Voggeneder

BAUMA 2016

In April 2016, Ars Electronica Solutions made a double contribution to BAUMA in Munich, the world's leading trade fair for construction & and mining machinery. AES supported two of the most important exhibitors with innovative media technology and futuristic information systems.

Liebherr

At BAUMA 2016, the Liebherr Group of Companies presented its L550–L586 Wheeled Loader with a new XPower drive system on the Munich Fairgrounds. An innovative interactive media installation was designed to showcase these models' many outstanding features and to support Liebherr representatives' interactions with sales prospects. Serving as the basis for this installation was slide- presenter hardware, a touchscreen including an outdoor housing that had already debuted at BAUMA 2013. This year, Ars Electronica Solutions enhanced the installation with a laser position–measuring system and a new substructure for the sliding system.

At a total of eight positions on the presentation vehicle, animated sequences and pertinent information designed and produced by Ars Electronica Solutions were displayed on the slide presenter. Plus, the animation material can be used to good advantage after the trade show—for instance, it 'is superbly suited to employee training sessions.

Ars Electronica Solutions

Doka Group

For the Doka Group's trade show booth, the job was to come up with attractive, innovative presentation possibilities to vividly depict the company's world-wide network of locations. This was accomplished by means of two central, interactive reference based on AES's GeoStage software for the visual presentation of geo-referenced data.

The two walls—each consisting of 12 monitors—played a dominant role at the booth as eye-catching attractions displaying special effects to steer trade show visitors inside and to encourage them to interact with Doka's sales force. The main motif is a globe displaying localized references to Doka. It is also possible to rotate the globe, zoom in and select individual spots. A variety of formats including videos, photographic stills, texts and statistics graphically document the relevance of the reference.

shopconsult

Groninger Forum—GeoGroningen

Groningen, a Dutch city with almost 200,000 inhabitants, of whom 40,000 are students, already enjoys a rich cultural life. The *Groninger Forum* will be a spectacular, universally accessible, ten-storey building designed by NL Architects. When completed, the forum will be open for admittance seven days a week and will host a wide range of (inter)national exhibitions, movies, documentaries, debates, literary events, talk shows, presentations and demonstrations about the world today.

It will become the place to be for information, inspiration, pleasure and get-togethers for a wide audience of all ages. The *Groninger Forum* will demonstrate trends and popular culture, will challenge existing views and beliefs and will provide up-to-date information. People can bring their own device and get to work, make new discoveries, play and relax. The *Groninger Forum* will be officially opened for the general public in 2018.

Ars Electronica Solutions is working together with the Groninger Forum to jointly conceive trailblazing concepts that foster participation by Groningen's residents and to encourage them to make use of their right to have a say in communal municipal affairs. In a process of exchange that has proceeded since 2014, AES has already developed a preliminary prototype, *GeoGroningen*, an interactive installation by means of which demographic, statistical and social information can be displayed and explored. This ongoing process of exchange and input from the general public is meant intended to give rise to an installation that can serve as the centerpiece of the *Groninger Forum*—one that not only disseminates information to visitors but also is also the recipient of contributions from them, and thus constantly grows.

Ars Electronica Solutions
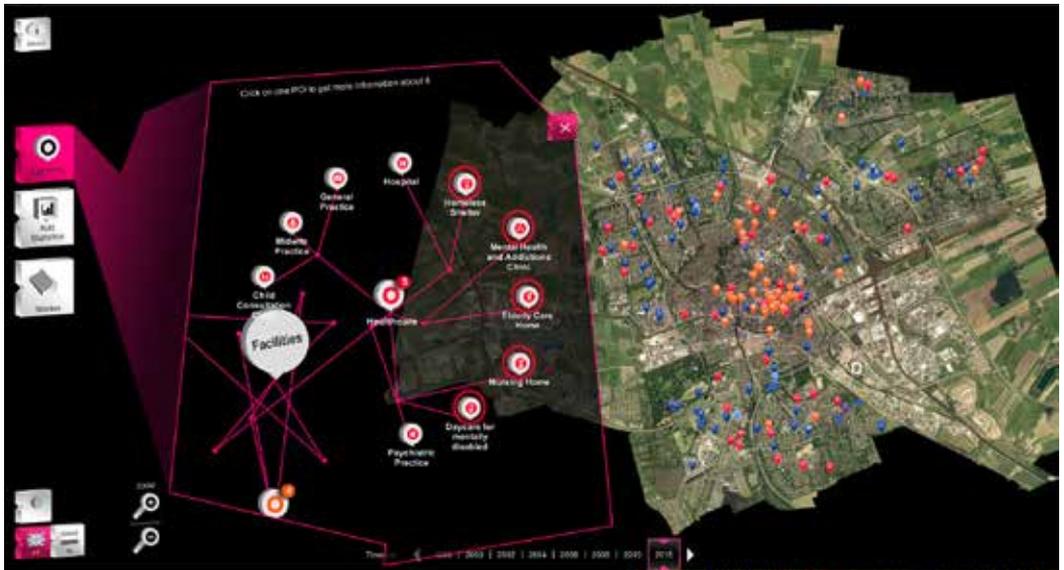
Curating Room—Ferdinandeum

Ars Electronica Solutions has installed a space designed as a setting for an interactive experience —a *Curating Room*—at the Ferdinandeum Museum in Innsbruck, Austria.

Visitors to Innsbruck's Ferdinandeum can use the #myFERDINANDEUM app to independently customize an exhibition space at the museum. All objects that visitors see on display and any that particularly appeal to them as they tour the museum —paintings, drawings, graphics, sculptures, bronze castings, archaeological finds or musical instruments—can be collected and arranged in a fun way with the app. In their personally curated exhibition, visitors can, for instance, combine science and art, consider Modernism in light of the Baroque, and even organize an encounter with a particular theme —say, love—or they can simply gather works selected on the basis of aesthetic criteria. In the *Curating Room* the collections are then presented in true-to-life dimensions on three projection walls. Here, visitors can also swap objects, rearrange them, apply a different color to the space's walls, and, of course, spend some time considering what they have amassed and letting the impressions sink in.

Credits: The app was created by Fluxguid

in the headroom

Ars Electronica Solutions with DS AUTOMOTION at LogiMAT 2016

DS AUTOMOTION, an Austrian manufacturer of driverless transport systems (AGVs, automated guided vehicles), has successfully established itself on the international market. For many years now, DS AUTOMOTION has been present at LogiMAT, Europe's largest annual intralogistics trade show held annually in Stuttgart.

With support provided by Ars Electronica Solutions, the launch of DS AUTOMOTION's latest product—nicknamed Sally—was a big hit at the most recent LogiMAT. AES morphed this compact, industrial-strength AGV into an independently roving photographer. Throughout the trade show, Sally tirelessly mixed and mingled on the perimeter of DS AUTOMOTION's booth, cordially inviting attendees to pose for a snapshot. The portrait Sally took was then enhanced with a new, preselected background. This fun little pause was a welcome respite from the hustle and bustle for hundreds of trade show guests, who also got to take an amusing souvenir photo home with them.

More photo safaris by Sally the Photographer are already being planned.

Ars Electronica
Export

Perhaps our paths crossed recently in Berlin or Moscow, Singapore or Osaka, Takamatsu or Gijon. Wherever . . . Ars Electronica Export really lived up to its name this past year, with lots of new additions to a travel log that already includes the likes of Bangkok, Bilbao, Brussels, Doha, Florence, Kiev, Madrid, Mexico City, Mumbai, New York, Beijing, Regensburg, Sao Paulo, Saragossa, Shanghai, Taichung, Tokyo and Venice.

This long journey took off when Ars Electronica Export went into operation in 2004. Ever since, we have been developing exhibitions, workshops and educational programs for associates world-wide. Our work is commissioned by clients across the artistic and cultural spectrum, in many fields of science and education, and throughout the private sector.

Especially noteworthy are the spinoffs—how Ars Electronica Export's activities have a history of launching new excursions into previously unexplored terrain. In this respect, we have recently witnessed how Ars Electronica Export's productions are making a real impact on new client acquisition at the Ars Electronica Futurelab and Ars Electronica Solutions too. Also notable in this context is our successful collaboration over many years with the Austrian Foreign Ministry. Through their good offices, the extraordinarily creative animated short films that have been selected for inclusion in the Ars Electronica Animation Festival are being screened at Austrian Cultural Forums and Austrian Libraries worldwide.

And we are delighted to report that a memorandum has just been signed with the Austrian Foreign Ministry formalizing our shared intention to do even more to present Austrian digital art and culture throughout the world. In going about this, Ars Electronica will serve as a bridge between historical and futuristic forms of expression and a showcase of state-of-the-art trends at the nexus of art and science.

Materia Prima

Art and Science Join Forces to Respond to the Questions of Our Time

LABoral Centro de Arte, Gijón, Spain
November 14, 2015–May 8, 2016

In our present time, which is so essentially dominated by technology, it appears that science has taken over the leading role in culture and in many cases replaced religion. Under these circumstances the growing focus on collaborations between art and science and their greater synthesis seems only logical. Humans will always make art and do science, and this is probably one of the most defining characteristics of our species.

The interrelationship between art and science has been a crucial issue throughout history—you will not find a period in which artists do not strongly refer to science as a source of inspiration or as a topic worth addressing. Many would even claim that in the beginning art and science were not separate fields at all, and that they continue to be motivated today by the same human desires. In our digital age, this issue has again become a very visible, public topic.

The LabExhibition as an experiment

But *Materia Prima* is not just an exhibition, at least not an ordinary exhibition, it is an experiment on its own, an attempt to create access, to blaze trails into the vast overlapping territories of art and science. Above all it aims to achieve a new level of visitor involvement and participation. What could be more appropriate than a place like LABoral, which itself is exemplary for a new type of hybrid and collaborative institution, a center for original artistic creation as well as community-based co-creation. Moreover, it is a platform for knowledge production and education, and an innovative instrument for establishing new directions in research and developing partnerships in the region with local experts.

The *Materia Prima* LabExhibition presented outstanding works at the nexus of art and science, while also providing a showcase for the notorious curious. The whole exhibition space served as an inspiring laboratory environment that had a set of visitor labs literally at its core. This hybrid form of presentation is a clear commitment to the educational and inspirational potential of art and science. It is also an expression of our wholehearted belief in the potential impact of art and science to go beyond their present territories, as well as our belief in the power and creative energy that can be derived from their collaboration.

Fifty Sisters, Jon McCormack (AU)

Sergio Redruello LABoral

With: Andy Gracie (UK/ES), Agnes Meyer-Brandis (DE), The ARTSAT: Art and Satellite Project (JP), Jon McCormack (AU), Nelo Akamatsu (JP), Rüdiger Trojok (DE), Teresa Dillon (IE) in collaboration with Naomi Griffin-Murtagh (IE), Claire Dempsey (IE) and Aisling McCrudden (IE), Patricia Piccinini (AU), Matthew Gardiner (AU), Cornelia Hesse-Honegger (CH), Nick Ervinck (BE), Yasuaki Kakehi (JP), María Ignacia Edwards (CL), Lorena Lozano (ES) and Verónica G. Ardura (ES), María Castellanos (ES) and Alberto Valverde (ES), Biopresence (JP/AT)

Ear on Arm, Stelarc (AU)

Ear on Arm, Stelarc (AU)

Chijikinkutsu, Nelo Akamatsu (JP)

Prix Ars Electronica Selection

Takamatsu, Japan
December 18–27, 2015

Prix Ars Electronica has been the world's most time-honored media arts competition since 1987. The award has focused the spotlight on inspiring projects created by its first prize, Golden Nica winners such as John Lasseter (Computer Animation category in 1987), Toshio Iwai and Ryuichi Sakamoto (Interactive Art category in 1997) and Wikipedia (Digital Community category in 2004).

At the Takamatsu Media Art Festival, Ars Electronica showcased projects by the Golden Nica winners Stelarc (AU) (Hybrid Art category in 2010), Alex Verhaest (BE) (Computer Animation / Film / VFX category in 2015) and Nelo Akamatsu (JP) (Digital Music and Sound Art category in 2015). This exhibition aimed to share the power of questioning by media art with visitors through innovative projects in three different areas of Hybrid Art, Computer Animation and Sound Art. The artists presented new possibilities with science and technology and enhanced social awareness through the artistic explorations. The creative initiatives were precise indications for our future society.

http://www.maf-takamatsu.jp/

Cloud, Christina Kubisch (DE)

Falling Records, Ei Wada (JP)

Ars Electronica in the Knowledge Capital— FREE SOUND (Vol. 5)

Knowledge Capital Osaka, Japan
January 28–April 10, 2016

The event series *Ars Electronica in the Knowledge Capital* in Osaka, Japan, invites business and creative people to be inspired by artistic perspectives with a mix of exhibition, lectures and workshops. In edition Vol. 5, the theme of this get-together was "Free Sound". From January 28 to 30, 2016, the participating artists were Christina Kubisch (DE) and Ei Wada (JP). Ars Electronica was represented by Martin Honzik, director of the Ars Electronica Festival, and Hideaki Ogawa from the Ars Electronica Futurelab.

EARTH LAB
Artists as Catalysts

**Red October chocolate factory, Moscow, Russia
June 22–September 25, 2016**

The Polytechnic Museum in Moscow and Ars Electronica Linz invite visitors to participate in a stimulating encounter with important issues to do with our planet. Visitors become researchers in the *EARTH LAB*, a fascinating mix of exhibits, participative infographics and a discursive ancillary program. The artworks are designed to stimulate creative processes and encourage people to look at the Earth from a very different perspective for a change. But the site of this rethinking process is not a museum or some other established institution; it is the basement of the mothballed Red October chocolate factory in the heart of Moscow.

Of course, a laboratory is a place that is not usually open to the public. It is where specialist knowledge culminates in the hope of generating new insights. The experiments conducted in labs are not always successful and their aim is not necessarily to promote the general well-being. Furthermore, the intentions and agendas behind these research initiatives are tremendously wide-ranging. Nevertheless, a lab's mission is always the same: generating new knowledge.

With: Búi Aðalsteinsson (IS), ARTSAT: Art and Satellite Project (JP), Sonja Bäumel (AT), Dmitry Bulatov (RU) and Alexey Chebykin (RU), Yulia Glukhova (RU), Massoud Hassani (AF), Cornelia Hesse-Honegger (CH), Yasuaki Kakehi (JP), Vadim Kolosov (RU), Julian Melchiorri (UK/IT), Ursula Neugebauer (DE), Leo Peschta (AT), Finnbogi Pétursson (IS), Shinseungback Kimyonghun (KR), Stain (RU), Marek Straszak (PL), ::vtol:: (RU), The European Space Agency, Ars Electronica Solutions (AT)

A project supported by Austrian Cultural Forum Moscow.

tour en l'air, Ursula Neugebauer (DE)

All voices, Stain (RU)

Silk Leaf, Julian Melchiorri (IT/UK)

Lapillus Bug, Yasuaki Kakehi, Kono Michinari and Takayuki Hoshi (JP)

Daniil Primak Polytechnic Museum

HUMAN FACTOR
Endless Prototyping

The Human Factor, the very thing that has fostered our survival so far, is now yielding consequences that threaten to overwhelm us. We now face ever larger and more complex challenges, the causes of which are our own doing. Dealing with these problems calls for, once again, the Human Factor.

PROTOTYPES

The HUMAN FACTOR exhibition shows ways in which creative human beings like artists, researchers and inventive technologists are unabashedly encountering entrepreneurs and business executives on an equal footing in an effort to confront issues and challenges that call for alternatives and novel approaches to solutions.

UNFINISHED

Even if prototypes represent a well-thought-out idea, they are nevertheless usually unfinished. Davide Quayola presents us with uncompleted, robotically modeled copies of statues by Michelangelo. Nick Ervinck's *Agrieborz* heads and the *Teacup Tools* by Agnes Meyer-Brandis also take up the idea of being unfinished and develop it further.

UNKNOWN

Most prototypes face an uncertain future, one determined by factors that are often external to their immediate surroundings and dependent upon complex interrelationships. In *Opimilk*, an artistic work by Teresa Dillon and Claire Dempsey, the operative concept is this uncertainty, this resonance between a state of affairs that is all-too-real and quite problematic, and fictitious proposals for a solution.

UNSEEN

On one hand a prototype helps to see what currently exists from a new point of view; on the other hand prototypes provide a glimpse into the future. Regarding Daniel Boschung's *Face Cartography*, for instance, makes it apparent how different seeing and perceiving are. The three drawing robots by Patrick Tresset, *Human Study #1, 3RNP*, come across as street artists—they behave like human beings in that they observe, measure and then execute their internalized images in the form of portraits rendered on paper. And then there's *Rare Earthenware*, an installation and video work by Unknown Fields / Toby Smith, which takes what is unseen and makes it visible as well as tangible, and thereby conveys a feeling for another reality.

Sculpture Factory, Quayola (IT)

AGRIEBORZ, Nick Ervinck (BE)

Florian Voggeneder, AEC

UNSAFE

The artists Jacob Tonski, Maria Castellanos / Alberto Valverde and Burton Nitta have fashioned prototypical measuring devices designed to better assess the degree of security or danger. But then again, in terms of prototypes, unsafe also means working without a net, since dealing with prototypical experimental arrays usually means doing without direct experience and the security that results from it.

With: BCL / Georg Tremmel (AT/JP), Shiho Fukuhara (JP), bioMASON Inc. (US), Daniel Boschung (DE), Burton Nitta (UK/JP), Nicolas Deveaux (FR), Teresa Dillon (IE) in collaboration with Naomi Griffin-Murtagh (IE), Claire Dempsey (IE) and Aisling McCrudden (IE), Nick Ervinck (BE), The IGB–Leibniz Institute of Freshwater Ecology and Inland Fisheries (DE), The IGB–Leibniz Institute of Freshwater Ecology

UNRIPE

It is precisely this lack of experience that usually imparts a problematic status to prototypes. Afroditi Psarra, Golan Levin /Shawn Sims, Shiho Fukuhara and Georg Tremmel are artists who demonstrate how unripe ideas and prototypes can be developed into instruments of a highly critical nature. An unripe snapshot of the prototype thus has an influence on its professional continuation in the sense of duplication and serial production.

and Inland Fisheries (DE), Julian Melchiorri (UK/IT), Agnes Meyer-Brandis (DE), Jennifer Lyn Morone (US), Gavin Munro (UK), Tobias Nolte (DE), Afroditi Psarra (GR) and Dafni Papadopoulou (GR), Quayola (IT), Jacob Tonski (US), Patrick Tresset (FR/UK), uh513 / María Castellanos (ES), Alberto Valverde (ES), Unknown Fields Division (UK/AU), Andrew Witt (US) and CERTAIN MEASURES (DE/US), YQP (US/DE)

Face Cartography, creating new Identities, Daniel Boschung (CH)

Human Study #1, 3RNP, Patrick Tresset (FR/UK)

Teacup Tools, Agnes Meyer-Brandis (DE)

Switch, Ars Electronica Futurelab (AT)

Florian Voggeneder

Luc Dewaele, Peter Verplancke

from left to right: *AGRIEBORZ, BORTOBY, ELBEETAD* by Nick Ervinck (BE)

Selected Works by Nick Ervinck

Vienna, Bildraum 07
August 26–September 10, 2016

Ars Electronica Linz and Bildraum 07 are hosting an exhibition of works by the Belgian artist Nick Ervinck.

Nick Ervinck explores the boundaries between various media, fostering a cross-pollination between the digital and the physical. He applies tools and techniques from new media in order to explore the aesthetic potential of sculpture, 3D prints, animation, installation, architecture and design. Ervinck's work, in short, oscillates between the static and the dynamic, prospecting new virtual or utopian territories.

The exhibition at Bildraum 07 is Nick Ervinck's first solo show in Vienna and features 3D sculptures videos and a print. Bildraum 07 is a cultural facility in Vienna operated by Bildrecht GmbH.

The exhibition is supported by the embassy of Belgium, representation of Flanders.

Bildrecht

Écorché, Anemona Crisan (AT)

Biographies

Ad Achkar (LB), born in 1988 and raised in rural Beirut, Lebanon, developed lenses where other people had eyes. After gaining his bachelor degree in photography, Achkar worked in the art scene and held exhibitions in multiple galleries worldwide. He is currently living in Berlin and completing his MA in Media Spaces. *http://www.adachkar.com*

Roland Aigner (AT) is researcher and multimedia programmer at the Ars Electronica Futurelab in Linz. His major interest is advancing real-time sensing for adaptive environments and coping with the challenges of making environments "alive" using ubiquitous sensing and display technology.

Nelo Akamatsu (JP) creates installations, sculptures, paintings and photos. He received an MFA from the Department of Intermedia Art at the National University of Fine Arts and Music in 2005. Main exhibitions: Taro Okamoto Award for Contemporary Art (2004, 2014), Italian Embassy in Tokyo (2009), Prix Ars Electronica 2015 (Golden Nica, Digital Music and Sound Art), LABoral in Spain (2015), Takamatsu Media Art Festival 2015, ICC in Tokyo (2016) *http://www.neloakamatsu.jp*

Branislav Ulicny / AlteredQualia (SK) likes to explore possibilities of real-time computer graphics on the web. Before succumbing to the temptations of the dark arts of rendering, he dabbled in academic research into artificial life, crowd simulations and bioinformatics. He is an alumnus of a popular open-source project *three.js* and has a doctorate in computer science from EPFL.

Jussi Ängeslevä (FI) teaches at the University of the Arts Berlin and the Royal College of Arts alongside leading the creative efforts at ART+COM studios as a Vice-Creative Director. Throughout his career his focus has always been intentionally in between fields: combining understanding of visual, physical and interaction design with algorithmic, electronic and mechatronic knowledge to create innovative and elegant experiences. *http://www.angesleva.iki.fi*

Steffen Armbruster (DE) has been working in the production of spatial media installations for almost 20 years now. During this time he was responsible for the production, post-production and implementation of large-scale installations worldwide. In the last two years, with his own team Steffen developed the new immersive audio system *usomo*, which creates a ground-breaking connection between architectural space and sound. *http://www.usomo.de*

AROTIN & SERGHEI (AT/RU), are an Austrian-Russian artist duo creating intermedia installations and paintings focused on light cells. They have staged exhibitions at TEFAF Maastricht, MACBA Barcelona, in galleries in Brussels, Paris, Geneva, Berlin and Vienna and collaborated with numerous contemporary composers and institutions. *Infinite Screen* is a large-scale installation in cooperation with the Museum in Progress, Klangforum Wien, Wiener Konzerthaus, Ars Electronica, Gujral Foundation, Biennale di Venezia and the Kunstistorisches Museum Vienna. *http://www.arotinserghei.com*

ART+COM Studios (DE) designs and develops new media installations and spaces. It uses new technology as an artistic medium of expression and as a medium for the interactive communication of complex information. In the process, it is constantly improving the technologies and exploring their potential for spatial communication and art. ART+COM e.V., founded in 1988, is now ART+COM Studios, working internationally for clients in business, culture and research. *http://www.artcom.de*

The Artificial Skins and Bones Group (DE) is an interdisciplinary group of young designers from the Weißensee Kunsthochschule Berlin. Their expertise ranges from textile, surface and product design to fashion and visual communications. In the *Artificial Skins and Bones* project the group freely explored the design of and interaction with artificial bodies and body parts. The projects presented illustrate a great variety of possible starting points, prototyping techniques and application scenarios. *http://www.skinsandbones.de*

Mahdieh Asadikachehbashi (IR) is an illustrator who enjoys creating a fantasy world in her work. She is keen on drawing and creating work that is related to illustration. She obtained a BA in visual communication in Iran. Mahdieh has exhibited illustrations and photos in Iran and Berlin. Currently, she is studying in the master's program at BTK University of Art and Design in Berlin.

Sidra Ashraf (PK) is a sculptor interested in creating experiences. She experiments with audiovisual installations. She received a distinction from the National College of Arts, a leading institute of arts in Pakistan, and she has worked as a freelance set designer. She has exhibited works in Pakistan and in Berlin, and she is currently studying Media Space in the BTK–University of Art and Design.

Sam Auinger (AT/DE) is a sonic thinker, composer and sound-artist. Together with Bruce Odland he founded O+A in 1989. Their central theme is "hearing perspective." Their work is known for large-scale, public-space sound installations which transform city noise into harmony in real time. Since 2000 he has been collaborating with Hannes Strobl and Dietmar Offenhuber. *http://www.samauinger.de http://www.o-a.info*

Michael Badics (AT) is senior director of AE Solutions, a new division of Ars Electronica, and is responsible for developing the most promising prototypes and research results of the Ars Electronica context into products ready for real-world implementation, especially in the fields of urban development and brandlands & exhibitions. He studied computer science at the Johannes Kepler University in Linz and was founder and managing director of Memetics GmbH in Berlin. After 15 years working as a software engineer and manager in the multinational software company Fabasoft AG, he co-managed the Ars Electronica Futurelab for about eight years. *http://www.aec.at/solutions www.fabasoft.com*

Ralf Baecker (DE), based in Berlin, works at the intersection of art, technology and science. Through installations and machines, Baecker explores fundamental mechanisms of action and the effects of new media and technologies. Born in 1977 in Düsseldorf, Ralf Baecker studied computer science and media art at the Academy of Media Arts Cologne, and has taught at the Bauhaus University in Weimar and the University of the Arts in Bremen. Baecker is currently a fellow at the Graduate School at the University of the Arts Berlin. Baecker has been awarded multiple prizes and grants for his artistic work, including an honorary mention at the Prix Ars Electronica in 2012 and 2014. *http://www.rlfbckr.org*

BCL (AT/JP/DE) is an artistic research framework founded by **Georg Tremmel** (AT) and **Shiho Fukuhara** (JP). BCL explores the space between art, biology and society, leading to cultural interventions and societal uncertainties. Works by BCL include *Biopresence—Human DNA Trees* and *Common Flowers/Flower Commons—Reverse-engineering genetically engineered flowers*. *Ghost in the Cell* is a collaboration with the artists Yuki Yoshioka (JP) and Phillip Boeing (DE). *http://bcl.io*

David Benjamin (US) is Founding Principal at the architecture firm The Living and an assistant professor at Columbia University Graduate School of Architecture, Planning, and Preservation. The Living explores new ideas through full-scale, functioning prototypes—often working at the intersection of biology, computation and design. More generally, The Living welcomes rapid change, embraces design with uncertainty, develops rules rather than fixed forms, and designs with shifting and unknowable forces. Clients include the City of New York, Seoul Municipal Government, Nike, Prada, 3M, Airbus, Quantified Self, Miami Science Museum, Eyebeam Center for Art and Technology and Björk. *http://thelivingnewyork.com/hy-fi.htm*

Myriam Bleau (CA) is a composer, digital artist and performer based in Montreal. Exploring the limits between musical performance and digital arts, she creates audiovisual systems that go beyond the screen, such as sound installations and performance-specific musical interfaces. Her presence on the popular music scene influences her hybrid electronic practice, which integrates hip hop, techno and pop elements. Her work has been presented and recognized internationally. *http://www.myriambleau.com*

Line Birgitte Borgersen (DK) is an illustrator, storyteller and interaction designer from Denmark. *http://www.linebirgitte.dk*

Daniel Boschung (CH) focuses as an artist on human-machine interaction and the transition from the analog to the digital age. In the project for which he is best known, *Face Cartography* he explores how people react to portraits rendered by industrial robots. His live performance *The Past is Faster than You* visualizes the pace and quantity of the flow of digital information. His interactive installation *Ways to Fortune* is an animated depiction of the personal, individual dialog between bank customers and their advisors. *Moving Universe* is an installation about globalization. *http://www.danielboschung.com*

Dietmar Bruckmayr (AT), Dr. rer. soc. oec. Born 1966 in Linz. Doctor of economics. Dissertation on the Nazi welfare-system in Austria 1938-1945. He has worked in national and international archives for several years. Since 1985 he has seen a singer, actor and performance artist, with shows and festival gigs in Europe, Australia, Japan and the US. He has worked for composers and orchestras such as Klangforum Wien and the RSO. Since 1999 he has been focusing on real-time 3D art. He is an award-winning artist with multiple international festival screenings. *http://www.fuckhead.at/bruckmayr*

John Brumley (US) is an artist who works with communication systems and their traces to investigate alternative modes of relation. He received his MFA from the Design Media Arts program at UCLA and is currently a PhD student of Empowerment Informatics at the University of Tsukuba. *http://www.johnbrumley.info*

Michael Burk (DE) is an interaction designer, media artist and creative coder based in Berlin. His work ranges from critical design to spatial media environments.

Miguel Canal (CO) is a Colombian artist with a visual arts degree from Javeriana University in Bogotá, Colombia. At the moment he is studying in the master's program in Media Spaces at the BTK University of Art and Design in Berlin, Germany. His works have been shown in various places, including the well-known Plataforma Bogotá, the National University of Colombia, the University of Granada, Spain, the Lange Nacht der Wissenschaften in Berlin as well as in international fairs such as the Berliner Liste.

Riccardo Cereser (IT) is a digital-service designer and social-media marketing expert from Italy. *http://www.riccardocereser.com*

Mark Chavez (US) is an award-winning animator, artist, educator and entrepreneur who has developed systems and techniques for animation in many different media, including laser light at LaserMedia Inc., (1980), broadcast television at Tokyo Broadcasting System (1990), Triple A games at Acclaim Entertainment, (1993) and feature films. Recruited by DreamWorks SKG (1995), he worked on visual effects for a number of their fully animated films. At the original Rhythm and Hues Studios in Playa Vista (2002), he worked on visual effects for numerous big-budget, award-winning live-action films. He is an animation industry veteran and founder of the faculty at Nanyang Technological University's School of Art, Design and Media's Digital Animation area. He is currently based in Singapore, consulting on Ed-Tech start-up on games and animation and working on public art installations that focus on realizing contents that benefit humanity. *http://www.markchavez.guru*

Alessio Chierico (IT), an artist with theoretical background in contemporary art, design theory and media studies, graduated from the Interface Culture department of the Linz University of Art. In the last ten years of activity he has had more than 60 exhibitions, and he regularly contributes to academic publications and conferences. In 2014 Chierico won the Lab Award, and Milano in Digitale in 2008. *http://www.chierico.net*

Tony Chong (CA) was the artistic director of Le Groupe Dance Lab in Ottawa, Canada. Tony has danced and toured internationally with prestigious dance companies such as La Compagnie Marie Chouinard, Carbon 14, Belgium's Ballet C de la B, Jean-Pierre Perreault, Dominique Porte's Système D and Germany's Steptext. Alongside his career in dance, Tony is also a photographer and a professional chef.
Copenhagen Institute of Interaction Design / CIID (DK) is an international hub of creative minds. The integrated structure creates a unique environment that encompasses world-renowned education, a cutting edge research group, an award-winning consultancy and a start-up incubator. The overarching objective for CIID is to create impact through the design of innovative products, services and environments.

Paolo Cirio (IT) works with information systems that impact on the dynamics of social systems. Cirio's artworks investigate privacy, copyright and finance. He shows his works through prints, installations, videos, online performances and interventions in public spaces. Cirio has presented in international museums and his works have been covered by hundreds of media outlets worldwide. *https://paolocirio.net*

Dr. Marjan Colletti (IT/AT/UK), born 1972 in Bolzano/Bozen (Italy), is an architect, an architectural educator, researcher, and co-principal of marcosandmarjan design limited in London. He is a professor at the University of Innsbruck (Austria) and head of the Institute for Experimental Architecture. His own work, his students' work and that of his studio marcosandmarjan has been widely published and exhibited. He has exhibited in approx. 60 exhibitions worldwide and is a regular guest critic and lecturer internationally. *http://marjan-colletti.blogspot.co.at*

Ina Conradi (US/SI) is an award-winning new-media artist, living and working Singapore and the US. Ina has presented her works at the Ars Electronica Festival, 3D Beyond Festival ZKM, Siggraph Asia Hong Kong, ISEA, Asia Animation Forum PISAF Korea, 3D Stereo MEDIA Liège, the 67th Edinburgh International Film Festival, Women 3D directors Paramount Studios Hollywood, and the FMX Conference on Animation, Effects, Games and Transmedia Stuttgart. Currently an associate professor at the Nanyang Technological University, Singapore, she has won the Koh Boon Hwee Scholars' Award 2015 and the Nanyang Education Award 2014 (School) for recognition to the influence of inspirational teaching. Her recent community-forming project Media Nexus features a participatory multimedia art display. The project will be embedded with technology to explore interactive design's new terrain: enhancing communicative possibilities, embodying a new balance between technology and people. Ina has an MFA from UCLA. *http://www.inaconradi.com*

Sam Conran (UK),1989, is a London born and based sound artist and performer working with custom electronics and sound systems in practice-based research exploring the boundaries between art, design, music, science and technology. Sam received an MA in Design Interactions from the Royal College of Art in London in 2015 and a BA in Sound Art and Design from the University of the Arts London in 2013. Sam has already shown his work and performed at world-renowned venues such as the V&A London, the Science Museum, Tate Modern, ZKM Karlsruhe, ACC Korea and KAAT Tokyo. *http://www.samconran.com*

Gina Czarnecki's (UK) art is realized in a diverse and often unconventional range of media, including installations, sculpture, video and site-specific works. She is interested in developmental biotechnologies and their future applications, cultural evolution and ethics. She generally works in collaboration. Her work has been shown internationally, winning numerous prizes. She currently lives in Liverpool, UK. *http://www.ginaczarnecki.com*

Dagmar Dachauer (AT) is a Linz native who works as a freelance choreographer, dancer and dance teacher. In 2014, her dance film *Treeo* was honored with the Dioraphte Encouragement Award by the Cinedans Festival in Amsterdam. In 2016, her piece entitled *Wie soll ich das erklären* (how shall I explain that) won first prize at the Festival of Choreographic Miniatures in Belgrade. In addition to her solo projects, she regularly collaborates with artists in other genres, including the visual arts, film, new media and kinetic arts, circus, theater, music and sound.

Dr. Theresa Dankovich (US) is the co-founder and chief technical officer of Folia Water, Inc., based in Pittsburgh, USA. She is the inventor of the biocidal paper filters in the *Drinkable Book*. She holds a PhD in chemistry from McGill University and is motivated by her desire to use science to address fundamental inequality on a global scale. *http://waterislife.com*

Dennis Russell Davies (US) studied piano and conducting at the Juilliard School in New York. His activities as an opera and concert conductor, pianist and chamber musician are characterized by an extensive repertoire ranging from Baroque to contemporary modern works, by fascinating and brilliantly conceived programs, and by close collaboration with such prominent composers as Luciano Berio, William Bolcom, John Cage, Manfred Trojahn, Philip Glass, Heinz Winbeck, Laurie Anderson, Philippe Manoury, Aaron Copland, Hans Werner Henze, Michael Nyman and Kurt Schwertsik. Since 2002, Dennis Russell Davies has been chief conductor of the Bruckner Orchester Linz and opera director at the Landestheater Linz.

Joe Davis (US) pioneered sculptural methods in laser carving at the University of Cincinnati Medical Center Laser Laboratory and Bell Telephone Laboratories, Murray Hill, NJ, while earning his creative arts degree (1973) from Mt Angel College in Oregon. In 1981 he joined the MIT Center for Advanced Visual Studies as a research fellow and lecturer. In *Poetica Vaginal* (1986-7) and *Rubisco Stars* (2009) Davis sent the most powerful and lengthy radio messages ever transmitted to other stars. Davis joined Alexander Rich's laboratory at MIT in 1989, where he is widely regarded to have founded new fields in art and biology. In 2010, he joined the laboratory of George Church at Harvard as "Artist Scientist." Davis and collaborators genetically modified silkworms for production of biomineralized transgenic silks in 2011, and initiated *Astrobiological Horticulture* in 2016 to create organisms suited for survival on Mars.

Antoine Delacharlery (FR) studied 3D animation and then turned to the field of animated short filmmaking and digital arts, all the while putting a great deal of manual work into his many projects. Exhibiting consummate versatility, he is equally adept at exploring many different techniques: 3D, camerawork, graphic experimentation and bricolage. His work thus seeks to weave interconnections among the real, the dreamlike and the organic. In 2010 he received the Prix SCAM for his graduation film from Supinfocom *Telegraphics*.

Jérôme Delapierre (CA) is a visual artist and interaction designer working in Montreal. His research is based on the relationship between human and technology and non-linear interactivity, focusing on the experiences of urban social behavior. He is interested in new ways to create visual sets and environments by exploring eclectic projection techniques.

Viktor Delev (MK) was born 1988 in Macedonia and is currently living in Linz/Austria. He earned his bachelor's degree in Time-Based and Interactive Media at the University of Art and Design Linz with an interactive dance performance which was shown at the Ars Electronica 2014. His interactive installations and short films have been featured in several exhibitions. Currently, he is a master's candidate in Interface Cultures at the University of Art and Design Linz. In addition he works as a software developer in the CGI/automotive field.

Artem Dementyev (US) is a PhD student in the Responsive Environments Group at the MIT Media Lab. Broadly, his research interests include ubiquitous computing, sensing, and medical devices. Artem received an MSc in 2013 from the University of Washington Electrical Engineering department. He was advised by Joshua Smith in the Sensor Systems Lab. His research there focused on applications of RF-powered systems.

Manu Dixit (IN) is an interaction designer and computer science engineer from India. *http://www.manudixit.net*

Evelina Domnitch (BY) & **Dimitry Gelfand** (RU) create sensory immersion environments that merge physics, chemistry and computer science with uncanny philosophical practices. Current findings, particularly in the domain of wave phenomena, are employed by the artists to investigate questions of perception and perpetuity. Such investigations are salient because the scientific picture of the world, which serves as the basis for contemporary thought, still cannot encompass the unrecordable workings of consciousness. *http://www.portablepalace.com*

Maike Drexler (DE) has a background in multimedia production and is currently developing skills in the art of contemporary puppetry at the Ernst Busch Academy of Dramatic Art, hoping to connect these two fields in her future work. She has performed in Berlin at the Schaubude puppetry theatre and in festivals in Austria and Poland.

Eric Dyer (US) is an artist, experimental filmmaker and educator. His work has been exhibited worldwide at events and venues such as the Smithsonian National Gallery of Art, Ars Electronica, the London International Animation Festival and the Cairo and Venice biennales. He has been honored as a Fulbright Fellow, Sundance New Frontier Artist, Creative Capital Artist, and Guggenheim Fellow. Dyer's work explores a variety of cyclic ideas and themes through zoetrope-like sculptures. He teaches animation at UMBC in Baltimore and is represented by Ronald Feldman Fine Arts, New York. *http://www.ericdyer.com*

Ori Elisar (IL) is a Jerusalem-based designer. He graduated from Bezalel Academy of Art and Design in Jerusalem from the department of Visual Communication and has also studied Hebrew linguistics and archeology at Ben-Gurion University in the Negev. *http://orielisar.com*

Nick Ervinck (BE) explores the boundaries between various media, fostering cross-pollination between the digital and the physical. Studio Nick Ervinck applies tools and techniques from new media, in order to explore the aesthetic potential of sculpture, 3D prints, animation, installation, architecture and design. Ervinck's work in short oscillates between the static and the dynamic, prospecting new virtual or utopian territories. *http://www.yingeli.net*

evala (JP) is a musician and sound artist, born in Kyoto, 1976. He is known for his cutting-edge electronic music, and has shared his creativity in many national and international music/art festivals, performed and provided topological transform-sound design for public spaces, stage, films and ads. His recent works includes the CD *acoustic bend*, the installation *Otocyon megalotis-Bat-eared Fox*, as well as collaborations with Perfume, ONE OK ROCK and Sakanaction. *http://www.evala.org*

Behnaz Farahi (IR) is an architect and interaction designer whose work explores the potential of interactive environments and their relationship to the human body. Her goal is to enhance the relationship between human beings and the built environment by implementing design/motion principles inspired by natural systems. Currently she is an Annenberg Fellow and PhD candidate in interdisciplinary media arts and practice at the USC. *http://behnazfarahi.com*

Lena Fay (DE) lives in Berlin and works as a stage and costume designer for theatre, opera, dance and film projects. Among others she has worked with the directors Anestis Azas and Prodromos Tsinikoris, Florian Lutz, Philipp Döring, Friedrich Kirschner, Melanie Sowa, Dominik Wagner, Olga Kastsel, Anja Gronau and Stefan Bünnig. In addition she develops and realizes her own works as a performance and comic artist.

FM Einheit (DE) is a German musician, performer and composer who from 1980 to 1996 gained fame as a member of the Einstürzende Neubauten. This group performed countless concerts worldwide that rocked the very foundations of music. Steel instruments and incinerated stages attest to these times. Throughout his career, FM Einheit has sought to engage in a dialog with other artists (Rio Reiser, Marianne Rosenberg, Diamanda Galas etc.). Since the late 80s he has increasingly worked in the theater and as the author/composer of audio plays. He has created approximately 150 musical works for the theater, and has twice been the recipient of the Hörspielpreis der Kriegsblinden (Audio Play Prize of the War Blinded). He still works as a performer and writes music for the theater, film and radio. *http://www.fmeinheit.org*

Sean Follmer (US) is a human-computer interaction researcher and designer. He is an assistant professor of mechanical engineering and computer science (by courtesy) at Stanford University, where he teaches the design of connected devices and directs the Interactive Machines Research Lab. His research team explores the intersection of the physical and digital worlds, creating new technologies for tactile and haptic devices, ubiquitous robotics, mobile interaction and remote collaboration. Prof. Follmer explores the future of design and collaborative work.

Fractal Fantasy (AT/CA) has established itself as an observatory for otherworldly textures, both aural and visual, over the last past years. The brain child of Sinjin Hawke and Zora Jones found life as an outlet for audiovisual pieces in 2013 and has since grown to encompass code experiments and interactive musical works, all the while remaining a fluid and ever-expanding endeavor: *"[Fractal Fantasy] is a space to create and evolve freely and not being tied to a mission. It's a platform for us to create whatever we want, whenever we want, with whoever we want, without any restrictions."* (Zora Jones *The Fader*, Nov. 13, 2015)

Clara Fritsche (DE) works in projects which focus on the intersection of puppet and object theater and interactive game performances and installations. Currently she is studying contemporary puppetry at the Ernst Busch Academy of Dramatic Art. She has performed in various projects, including puppetry slams in Berlin and Mainz and the Impuls Festival in Saxony-Anhalt.

Masaki Fujihata (JP) is a trailblazing media artist, renowned in Japan as well as abroad. In the mid-90s, Fujihata produced canonical pieces of what would later be called interactive art, including the multimedia installation *Beyond Pages* (1995-1997) and the exploration of networking technologies *Global Interior Project*. His work problematizes everything from how we interact with interfaces to the ways we might communicate in virtual space. *http://www.fujihata.jp*

Naotaka Fujii (JP) is an opthalmologist, neuroscientist, entrepreneur and artist. He was born in Hiroshima in 1965 and is head of the Laboratory for Adaptive Intelligence, BSI, RIKEN and CEO of Hacosco Inc.

Funkstörung (DE) is an electronic music project founded by Michael Fakesch and Chris De Luca in 1994. They gained worldwide attention through their remixes for Wu-Tang Clan and Björk and are credited as one of the inventors of glitch hop and intelligent dance music (IDM). Their live shows have been booked all over the world (including Australia, the US and Japan). In 2015 they celebrated their comeback with the eponymous album Funkstörung on Moderat's Monkeytown Records. The former guest vocalist Anothr is becoming a regular member. *http://www.funkstorung.com*

Charlotte Furet (FR/US) is a London-based Franco-American design engineer, fascinated by the intersection of design, science, and technology, and how the three can be merged together to design innovative products which change the world. Charlotte holds a BA in architecture from Barnard College, Columbia University and is a graduate of the MA/MSc Innovation Design Engineering program at the Royal College of Art and Imperial College London. *http://www.charlottefuret.com*

Future Catalysts (Hakuhodo × Ars Electronica) (JP/AT) is a joint project established by Hakuhodo and Ars Electronica. By utilizing the creative resources of both sides and the development/implementation of life experience, it proposes "creative questions" that serve as indicators of new innovations and a creative system that allows the sustainable innovation of value. Its mission is to actualize an innovative strategy that has the power to trigger new growth, by stimulating industry, government and the local community. *http://www.future-catalysts.com*

Ying Gao (CN/CA) questions our assumptions about clothing by combining urban design, architecture and media design. She explores the construction of the garment, taking her inspiration from the transformations of the social and urban environment. Ying Gao has achieved personal distinction through her numerous creative projects: five solo exhibitions in Switzerland and Canada, participation in more than fifty group exhibitions around the world. *http://www.yinggao.ca*

Ron Garan, Col. (US) is a highly decorated fighter pilot, test pilot, explorer, entrepreneur and humanitarian who believes that appropriately designed /targeted social enterprise can solve many of the problems facing our world. Ron traveled 71,075,867 miles in 2,842 orbits of our planet over 178 days in space and 27 hours of EVA during four spacewalks. He flew on both the US Space Shuttle and Russian Soyuz spacecraft. Ron is also an aquanaut and has conducted research in Aquarius, the world's only undersea research laboratory. Ron's last NASA assignment was in its Open Innovation Initiative, which seeks to increase transparency, collaboration, and innovation within government. In this capacity, Ron has been involved in many global mass-collaboration and citizen-science programs. Ron is also a serial entrepreneur and has founded multiple business enterprises/social-impact focused start-ups, including Manna Energy Ltd., which was created to leverage the $120bn/year carbon market to finance humanitarian projects. Ron is currently the chief pilot of World View Enterprises taking experiment packages and people to the edge of space in high-altitude balloons and is the author of the highly acclaimed book, *The Orbital Perspective—Lessons in Seeing the Big Picture From A Journey of 71 Million Miles*.

Matthew Gardiner (AU/AT) is an expert in the field of oribotics, having coined the field, and pioneered the fusion of origami, folding and robotics with his generations of oribotic artworks. Gardiner's artistic contexts include team-based research, and individual artworks with experience extending across aesthetic and experience design, digital manufacturing, expert-level origami and writing code. Gardiner is project lead for *ORI. http://www.oribotics.net*

Dr. Thomas Gardner (UK) is a composer, improviser, teacher, computer programmer and academic. His work is concerned with the relations between sound art and music, focusing on group interaction and the kinds of change introduced by electronic media. His practice consists of composition, improvisation, the design of instruments and software, and the exploration of new performance contexts. He is course director of the MA in Sound Arts at the London College of Communication.

Emilia Thea Giertler (DE) is currently a student in the second year at the Faculty of Contemporary Puppetry, Ernst Busch Academy of Dramatic Art, with a former product-design assistant degree. She has performed on several stages in Berlin, worked on *Stage A* directed by Robert Wilson in 2015 and has participated in the RoboCup in Germany as part of a two-year robotics class.

Slavko Glamiočanin (SI) started in the computer demo scene, where he was mostly active in making music, co-created the first Slovenian breakbeat compilation *Monkorama*, which also contained his creations. He continued with programming and exploring the media and for that purpose he created a programming platform, Naprava. After one-way video/effects he proceeded with interactive projects, motion capture, kinect and openGL visualizations. His main interests include synesthesia, complex systems and interactivity. *http://www.naprave.net*

Silke Grabinger (AT) is a dancer and choreographer. She works at the intersection between contemporary performing art and space/design strategies. As an artistic director of the artist collectives SILK Cie and SILK Fluegge, she pursues new approaches in a critical engagement with social phenomena, artistic paradigms and the role of the audience. Her works take place in the theater as well as in the white cube of the museum or in public spaces as social spaces. *http://www.silk.at*

Mihai Grecu (RO) has been pursuing his artistic research at the Fresnoy Studio of Contemporary Arts, after studying art and design in Romania and France. Recurring topics such as distress, cloning, hallucination, city life and war express the whole of his exploration of mysterious and subconscious beginnings. These visual and poetic trips mix several techniques and styles and may be seen as propositions for a new dream-oriented technology. His work has been shown in numerous film festivals (Locarno, Rotterdam, Festival of New Cinema in Montreal) and exhibitions (*Dans la nuit, des images* at the Grand Palais, *Labyrinth of my mind* at the Cube Video shortlist, *the Dream Machine* at the Passage du Retz, and *Studio* at Les Filles du Calvaire Gallery, etc.). *http://www.mihaigrecu.org*

Antye Greie-Ripatti (DE) is a digital songwriter, electronic musician, sound artist, composer, poet, curator, educator and public speaker. Her work emphasizes the relationship between language, sound, voice and communication, which is expressed in music, audiovisual live performances, digital communication, sound installations, commissions for movies and theater, exhibitions and conceptual works. *http://www.antyegreie.com*

Benjamin Greimel (AT) is the founder and inventor of *PRINT A DRINK*. He has a bachelor's degree in industrial design and is now investigating new, creative applications for robots as a graduate research assistant at the new laboratory for creative robotics of the University of Arts and Design Linz. *http://www.printadrink.at*

Thomas Grill (AT) works as a technologist and researcher of sound and its perception, as well as a composer and performer, focusing on concept-driven sound art, electro-instrumental improvisation and compositions for loudspeakers. He is a lecturer at the University for Music and Performing Arts Vienna, and a researcher at the Austrian Research Institute for Artificial Intelligence. *http://www.grrrr.org*

GRINDER-MAN (JP) is a performance art group aiming for the creation of art that is thematic of "here and on." Its members, Hitoshi Taguchi and Makiko Izu, work in a broad range of the performance fields: artistic direction, choreography, sound and lighting design, direction for film, casting, producing, etc.

Javier Gurza (MX) is a Mexican industrial designer interested in applying new technologies and interactive motifs in spaces. He obtained his degree with outstanding honors at the Monterrey Institute of Technology and Higher Education in his former city. He started his career focusing on product development and his interest in technology applied to design led him to study at BTK University of Art and Design's master's program Media Spaces.

Peter van Haaften (CA) is a sound artist based in Montreal (Quebec). His work looks to explore interactive algorithmic models for composing music and sound. Through the creation of intelligent performing/composing machines, his projects seek to question established conventions of the composer, the performer, the audience and the instrument. *http://www.petervanhaaften.com*

Jürgen Hagler (AT) is an associate professor in the Digital Media department at the Upper Austria University of Applied Sciences (Hagenberg, Austria) and is in charge of computer animation and animation studies. He became the program coordinator for the Digital Arts master's degree in 2009. Since 2008 he has been actively involved in Prix Ars Electronica and in 2009 he became curator of the Ars Electronica Animation Festival.

Horst Hahn (DE) studied physics in Bayreuth, Toulouse and Heidelberg. His scientific work focuses on the digital transformation of medicine. He is institute director of Fraunhofer MEVIS and Professor of Medical Imaging at Jacobs University in Bremen. In 2014, he was elected one of the Digital Heads of Germany and coordinated several national and European research projects on improved cancer therapy through quantitative and interdisciplinary computer support.

Beatrice Haines (UK) has an MA in printmaking from the Royal College of Art. She has exhibited in solo and group exhibitions, completing residencies at Marlborough College, the University of Abertay's forensics lab and Centrespace Gallery. She will be in residence at the Griffin Gallery this winter. Listed in Artlyst's "top 10 artists under 30," Haines is a Print Fellow at the Royal Academy of Arts. Winner of the Anthology Art Prize, an RBS Bursary award and the Mann drawing prize. *http://www.beatricehaines.com*

Katharina Halus (AT), born 1986 in Salzburg, is an actress and puppeteer, mainly working in Austria and Germany. After studying acting at the Otto-Falckenberg-Schule Munich and working at the Landestheater Linz and Badisches Staatstheater Karlsruhe, she began studying puppetry at the Hochschule für Schauspielkunst Ernst Busch Berlin. Meanwhile she realized various projects with theaters and artist groups experimenting with any kind of material.

Rachel Hanlon (AU/AT) is a researcher at the Ars Electronica Futurelab, whose art practice examines how found materials, in particular cultural "objects" that were once significant to a generation simply as technological devices, may transcend their intended purpose and be used to evolve (transform) into another "thing" altogether. Her research sits within the parameters of media archaeology, utilizing the methodology of ethnography and practice-led creative research.

Ai Hasegawa (JP) moved to London, after studying animation at the Institute of Advanced Media Arts and Sciences (IAMAS) in Japan. For several years, she worked as a researcher at Haque Design + Research, and in 2012, she completed a master's degree in Design Interactions at the Royal College of Art. She is currently part of the Design Fiction Group at MIT Media Lab. *http://www.aihasegawa.info*

Takahiro Hasegawa (JP) is an undergraduate student of Keio University.

Simon Hauser (CH) received his BSc/MSc in mechanical engineering from the Swiss Federal Institute of Technology in Zurich (ETHZ), where his studies were built around bio-inspired robotics. He joined the Biorobotics Laboratory at EPFL in December 2014. There he mainly focuses on modular robotics and is part of the *Roombots* project. His further interests also include evolutionary robotics and soft robotics.

Benjamin Heidersberger (DE), born 1957, has a background in physics, biology and computer science (dropout). He was co-founder of the artist group Head Resonance Company in Wolfsburg in 1978 and of Ponton-Lab in Hamburg in 1989, and founder of Kulturserver in 2000 and of the Institut Heidersberger in 2002. He has various large-scale media projects (Van Gogh TV, Ars Electronica, Documenta) in Europe, the USA and Japan, and publications on computers, the media and society and lectures on interactive media. *http://benjamin.kulturserver.de*

HILL–Hakuhodo Institute of Life and Living (JP) was established in 1981 and since then has conducted various researches to understand people's lives. At HILL, all research is conducted from a multi-angle unique perspective, such as analyzing change in people's sense of value by time-series analysis, predicting the future by experimental methods, and thinking together with people by actually stepping into their lives. It is a think tank like no other, specializing in *People Thinking*. *http://www.hakuhodo.jp* *http://www.seikatsusoken.jp/miraihaku2016*

Michael Hirsch (US) is a data scientist based at R/GA in New York City. He is interested in the creative applications of machine learning and pure math, specifically around visualization, networks, and AI. Michael studied at NYU's Courant Institute of Mathematical Sciences and the University of Amsterdam's Institute for Logic, Language and Computation.

Aniela Hoitink (NL) launched NEFFA in 2004. Textile innovation, but just that bit different, is what NEFFA is all about. Through her multi- and interdisciplinary way of working and by altering or adding properties to textiles, Aniela Hoitink investigates how we can and how we will use textiles in the future and what the related implications will be. Using technology and microbiology, she is on a quest to improve / change the properties of traditional textile materials. *http://www.neffa.nl*

Peter Holzkorn (AT) is an artist and researcher at the Ars Electronica Futurelab, and coordinates programs for the Futurelab Academy.

Pablo Honey (ES) is a designer, currently based in New York City, who has always been involved in varied artistic fields, from video performances to experiential spaces. Pablo has been recognized for his work internationally by various festivals and awards, as well sharing his passion for art, technology and design in forums such as SVA, Bloomberg LP, Festival Ars Electronica, IED and IxDA among others.

Horst Hörtner (AT) is a media artist and researcher. He is an expert in the design of human-computer interaction and holds several patents in this field. Hörtner was a founding member of the Ars Electronica Futurelab in 1996 and since then he has been the director of this atelier/laboratory. He started work in the field of media art in the 1980s and co-founded the media-art group x-space in Graz, Austria, in 1990. Horst Hörtner works at the nexus of art and science and gives lectures and talks at numerous international conferences and universities. *http://www.new.aec.at/futurelab*

Christiane Huetter, alias Frau Hue, (DE) is a Berlin-based artist. She designs games, playful situations and collaborative design processes always envisioning social fiction. She works both alone and as a core member of either Invisible Playground or the Society for Cultural Optimism. The works (or processes) have been commissioned by cultural institutions all over Europe, South America, Japan, Russia, Australia. Christiane Hütter is breeding the first prototype of a human egg.

IAAC (ES), the Institute for Advanced Architecture of Catalonia, is an international center for education, fabrication and research dedicated to the development of architecture capable of meeting the worldwide challenges in constructing 21st century habitability.

iTOPIA (CN), curates urban future projects in China to form a collective vision and practices towards future urban challenges.

Dragan Ilić (RS/AU/US), born in Belgrade, 1948, lives and works in New York and Belgrade. His work has been termed post-subjective, a designation that indicates a re-ordering of artistic authorial hierarchies. In 2009, Ilić founded the experimental performance space ITS-Z1 in Belgrade, which serves as a platform for the intersection of art and science. ITS-Z1 has hosted internationally-acclaimed experimental artists such as Stelarc. Ilić's work has been featured in television presentations and shown in numerous performance spaces, galleries and museums internationally. These include Documenta, PS 1 MoMa, the Center for Cultural Decontamination in Belgrade, Queens Museum of Art, and, in April 2010, at the Museum of Science in Boston, as a part of National Robotics Week. *http://www.draganilic.org*

Masa Inakage (JP) is a dean and professor at Keio University Graduate School of Media Design. *http://www.inakage.net*

Hiroshi Ishii (US/JP) is the Jerome B. Wiesner Professor of Media Arts and Sciences, at the MIT Media Lab. He joined the MIT Media Lab in 1995, and founded the Tangible Media Group, which he currently directs. Hiroshi's research focuses upon the design of seamless interfaces between humans, digital information and the physical environment. His team seeks to change the "painted bits" of GUIs to "tangible bits" by giving physical form to digital information. In 2012, he presented the new vision *Radical Atoms* to take a leap beyond *Tangible Bits* by assuming a hypothetical generation of materials that can change form and appearance dynamically, becoming as reconfigurable as pixels on a screen.

Sukjoon Jang (KR) works between a variety of media-interplaying digital interfaces and photography, site-specific installation. She has worked with variety of media, including photography, site-specific installation and interactive media. She focused on collecting the images of urban landscape under a rapid industrialization that represent vernacular culture in contemporary everyday life.

Werner Jauk (AT) is a musicologist/psychologist and scientific media artist, and professor of musicology at the University of Graz (KFU), working on music and media/art, with the focus on music as a role model for media arts. Studies in perception, cybernetics and experimental aesthetics led him to try and bridge the gap between science and arts. He has published many scientific papers and exhibited installations as a scientific artist at international festivals such as Ars Electronica, Cynetart, liquid music and the Biennale di Venezia.

Je Baak's (KR) artistic practice centers on meeting points of contemporary philosophy and his practice of Zen Buddhism. The object or subject of attention is constantly shifted, sometimes deleted, to prompt the viewer to experience familiar scenes from altered perspectives. Je Baak forces viewers into introspection, developing the beginning of an '"inward eye," whereby self-realization and ultimately enlightenment can be attained in an unfamiliar way.

Floris Kaayk's (NL) work focuses on futuristic visions, fantasies and concepts. It visualizes technological progress, sometimes by showing the benefits at other times by presenting the negative consequences. His video works include *The Order Electrus*, *Metalosis Maligna*, *The Origin of Creatures* and *Juxtaposis*. These have been presented and won awards at exhibitions, film festivals and art events all around the globe. In 2012 his online media project *Human Birdwings* reached the world press. It allowed Floris to share the project's content on television and radio shows, including ABC news, CBS news and the Dutch primetime television show *De Wereld Draait Door*. Simultaneously he worked on the *Rayfish Footwear* project, a collaboration with Next Nature Network, Koert van Mensvoort and Ton Meijdam. *Rayfish Footwear* was the story about a fictional company that offered personalized sneakers crafted from genetically modified stingray leather. *http://www.floriskaayk.com*

KairUs (AT/FI) is a collective of two artists, Linda Kronman (FI) and Andreas Zingerle (AT). Their work focuses on human-computer and computer-mediated human-human interaction with a special interest in interactive storytelling. Since 2010 they have worked with the thematic of Internet fraud and online scams, constantly shifting focus and therefore approaching the theme from a number of perspectives. The subjects of their research are online scammers, vigilante communities of scambaiters, and their use of storytelling and technology. Besides the artworks the artists also publish research papers related to their projects, and through workshops they contextualize their highly focused research topics from the artworks in broader discourses like data privacy, activism and hacking culture, ethics of vigilante online communities and disruptive art practices. *http://www.kairus.org*

Yasuaki Kakehi (JP) is a media artist and HCI researcher. An associate professor of environment and information studies at Keio University, he develops interactive media that extend the human body, tools and communication by multiplying the five senses, affecting the properties of physical materials. *http://www.xlab.sfc.keio.ac.jp*

Volkmar Klien (AT) grew up in Vienna and spent his childhood immersed in the city's rich musical life with all its glorious traditions and engrained rituals. Working from this background Volkmar Klien today strives to extend traditional practices of composing, producing and listening far beyond the established settings of concert music. He works in various areas of the audible and occasionally inaudible arts, navigating the manifold links in-between the different modes of human perception, the spheres of presentation and the roles these play in the communal generation of meaning. His installation *Relative Realities* is on display at Ars Electronica 2016 at the Mariendom Linz. He is a professor for composition at the Anton Bruckner University. *http://www.volkmarklien.com*

Tetsuya Komuro (JP) works as a record producer, lyricist, composer, keyboardist, synthesizer programmer and DJ since 1984. The artists he produced have become million-sellers. His CDs have sold over 170 million copies.

Michinari Kono (JP) is a PhD student at the University of Tokyo who leads the technical part of the *Loopers* project.

Julia Körner (AT) is an award-winning designer working at the convergence of architecture, product and fashion design— specializing in additive manufacturing and robotic technology. Her work stands out, recognized today at the top level of these disciplines, where it has been featured in the National Geographic Magazine, at the Venice Biennale, Paris Haute Couture and institutions such as the FRAC Center in Orleans, the Art Institute of Chicago, the High Museum of Art in Atlanta and the Metropolitan Museum of Art in New York to name a few. The constantly intriguing aspect of Julia's work is the embodiment of a beautiful organic aesthetic. Julia is founder of JK Design GmbH, specializing in digital design for 3D printing. She has been a faculty member at the UCLA Architecture and Urban Design Department since 2012. *http://www.juliakoerner.com*

Thom Kubli (DE) works as an artist and composer in Berlin. His sound-related installation pieces and performances have been shown internationally, among others at New Museum of Contemporary Art/New York, Transmediale/Berlin, Laboratorio Arte Alameda/Mexico City, Eyebeam/New York, EMPAC/New York, LABoral/Spain and in numerous art galleries. *http://www.thomkubli.de*

Michael Kugler (US) is a media artist and filmmaker whose practice engages "psychogeographic" modalities—practices, rituals, and spaces in which these occur. His recent work traverses the nebulous margins of science and art. He currently lives and works in Berlin. *http://einsdreidrei.com*

Verena Kuni (DE) is scholar in the field of art, cultural and media studies and professor for visual culture at the Goethe University, Frankfurt am Main. Her curatorial work is dedicated to interdisciplinary projects and programs at the intersections of theory and practice. In her research and publications she explores the multiple intersections, transfers and transformations between material and media cultures. *http://www.kuniver.se*

Boris Labbé (FR) obtained a DNAP (National Diploma in Visual Arts) at l'Ecole supérieure d'art et de céramique de Tarbes and then continued his studies at the EMCA of Angoulême (Ecole des métiers du cinéma d'animation). At the EMCA, he produced *Kyrielle*, his final film project, which was awarded the Special Jury's prize for Graduation Films at the Annecy International Animated Film Festival in 2012. Simultaneously, he developed an artistic work that is both visual and plastic. He spent a year at the Casa de Velázquez in Madrid. *RHIZOME* is his first professional film. *http://www.borislabbe.com*

Cécile Lapoire (FR) holds a PhD in experimental particle physics. She took part in the Higgs boson discovery at CERN in Geneva and spent a significant amount of time underground in the heart of the ATLAS detector. She is now back at the surface, orienting herself toward the world of textile and design.

Claudia Larcher's (AT) highly distinctive body of work encompasses photo-collage, site-specific video animation, and mixed-media installation. At the heart of all her work, whatever the medium, is a preoccupation with architecture and with the traces of history and memory that suffuse particular places. Questioning the meaning of "home" and notions of identity, many of her moving image pieces take the form of digitally-manipulated explorations of interior spaces in which people are absent and yet their imprint is unmistakably present. *http://www.claudialarcher.com*

Sungjae Lee (KR) has experimented with diverse techniques in his work, mostly referring to concepts of "monism-dualism," "changeability," and "simultanitism." Recently he has further interests in "duration" and "lifespan" to combine his digital animated images with the atmosphere of Asian funerals by planning a new installation project. In developing new techniques through experimental media art projects, Sungjae has used technology in a way that challenges the possibilities of the way the qualities of painting will evolve in the contemporary art world.

Julie Legault (CA) is the creative director, founder and CEO of Amino Labs, a company pioneering bioengineering accessible to the home. Throughout her career teaching and consulting, she has worked to make scientific and technological innovations approachable to and desirable by the public. She holds degrees from the MIT Media Lab, the Royal College of Art and Concordia University. *http://julielegault.com*

Dr. Daniel Leithinger (AT) is a researcher, inventor and designer whose shape-changing computer interfaces blend digital information with the physical world. He is chief design officer at Lumii, a 3D display company he co-founded. Daniel developed a passion for human-computer interface research during his studies at the FH Hagenberg in Austria and an internship at the nearby Ars Electronica Futurelab. Inspired by the work of Professor Hiroshi Ishii, Daniel joined the Tangible Media Group at the MIT Media Lab, where he received his PhD for his research on tangible computer interfaces that can programmatically change their shape and materiality.

Mathieu Le Sourd / Maotik (CA) is a digital artist based in Montreal. His work focuses on the creation of immersive multimedia environments and generative visuals. As lead of Moment Factory's interactive team in 2011, Le Sourd produced large-scale projects such as the multimedia experience in the new terminal at the Los Angeles airport as well as the visuals for Nine Inch Nails' world tour. In 2013, he produced the critically acclaimed immersive multimedia performance *DROMOS*, which was presented at the SATosphere in Montreal as part of the Mutek festival. Always in search of new challenges, Le Sourd designs his own visual tools by generating animations from algorithms and creating 3D worlds to transform perceptions of space. He collaborates with musicians, sound artists and scientists in order to continue his research into the relationship between art, science and technology. *http://www.maotik.com*

Christopher Lindinger (AT) is co-director of the Ars Electronica Futurelab and is responsible for the areas of research and innovations. His work is characterized by cooperation with international partners, with whom he develops entrepreneurial innovation strategies or shifts concepts and trends of radical innovations for social future scenarios. Lindinger has worked together with large companies such as Daimler, Toshiba, Vodafone, Honda Robotics and Nokia in the past few years. Beyond that, he advises local authorities and government institutions on the formation and development of a creative industry and lectures at several European universities.

Claudia Livia (IT) was born in Trieste, Italy, and in 2010 moved to Florence to study industrial design. Recently she moved to Berlin to join the Media Spaces master's program at the BTK University of Art and Design. Her greatest passion inspiring her work is everyday experiences. These are her muse for creation and design which she aims to share with other people.

The Living (US) is an architecture firm that explores new ideas through full-scale, functioning prototypes—often working at the intersection of biology, computation and design. More generally, The Living welcomes rapid change, embraces design with uncertainty, develops rules rather than fixed forms and designs with shifting and unknowable forces. Clients include the City of New York, Seoul Municipal Government, Nike, Prada, 3M, Airbus, Quantified Self, Miami Science Museum, Eyebeam Center for Art and Technology, and Björk. David Benjamin is Founding Principal at The Living and an assistant professor at Columbia University Graduate School of Architecture, Planning, and Preservation. *http://www.thelivingnewyork.com*

Joana Lobo (PT) graduated in bioengineering from the University of Porto in 2013. Afterwards, she worked on assistive technologies and HCI at Fraunhofer AICOS. Currently she is pursuing her PhD in empowerment informatics at the University of Tsukuba, Japan.

Andre McQueen (UK), London-born, second-generation black and British, is a graduate in footwear design from Cordwainers@London College of Fashion, questioning the boundaries of footwear construction and winning awards for innovative approaches to footwear design. As a graduate, Andre worked and lectured for several years in Trend Forecasting. The marriage of innovation, design and futures are Andre's principal drivers, with progressive practices and innovative techniques at the core.

Lucy McRae (UK) is a science fiction artist, director and body architect probing the frontiers of the body, health and human adaptability. Trained in classical ballet, McRae's artistic study of technology began during her years at Philips Design, where she led the technology company's far-future research lab. A broad portfolio that focused on emotional sensing, she developed stretchable electronics, an electronic tattoo and a range of emotional sensing dresses. McRae partners with synthetic biologists and scientists to connect health, beauty and biotechnology with science fiction. McRae is a TED Fellow, inventor of the *Swallowable Parfum*, *The Future Day Spa* and listed by Fast Company as a woman shaping the future. Her latest project is *The Institute of Isolation*. http://www.lucymcrae.net

Armin Medosch (AT) PhD is a Vienna-based artist, curator and scholar working in art and media theory. In 2014 he curated the international exhibition Fields (Riga European Culture Capital 2014) and he is the initiator of the Technopolitics working group in Vienna. His new book, *New Tendencies—Art at the Threshold of the Information Revolution*, is published by MIT Press in September 2016.

Laurent Mignonneau and **Christa Sommerer** (AT) are internationally renowned media artists, researchers and pioneers in the field of interactive art. For 25 years now they have been exhibiting their works worldwide, and they have won numerous awards such as the 2012 Wu Guanzhong Art and the Science Innovation Prize of the Ministry of Culture of the PRC and the Golden Nica of the 1994 Prix Ars Electronica. They are professors and heads of the Interface Cultures Department at the University of Art and Design Linz, and guest professors at Aalborg University in Denmark and the Université Paris 8.

Elena Mitrofanova (RU) is a designer who works in architecture, planning, design and digital fabrication. At the same time she conducts a research on the frontier of science, biological processes and design. In 2014 she gained a master's in advanced architecture, after which she began worldwide collaboration. Elena belongs to a multidisciplinary team at Hyphen-Labs specializing in committed, meaningful interaction, robotics, physical computing, digital tooling and fabrication. Since 2015 she has been giving international lectures and workshops on computational design, urban planning and advanced architecture. http://elenamitro.com

Michael Montanaro (CA) is a transdisciplinary artist known for his work in the field of contemporary dance and mixed media. He has worked as a choreographer and director on numerous projects, including the Cirque du Soleil's *Varekai*, Opéra de Montréal`s *Carmina Burana*, a theatrical work *Frankenstein's Ghosts*, and a series of short films, *Dances For Small Spaces*.

Luka Mustafa (SI) is the founder the IRNAS institute, Shuttleworth Foundation Fellow and full-time *KORUZA* developer, as well as a PhD candidate at University College London. He is actively involved in wlan-Slovenija, the deployment and management of national and international wireless backbones. He actively pursues the development of new and efficient systems by re-purposing mass-produced components. http://www.irnas.eu

Mehmet Mutlu (TR) has a BSc (2011) and MSc (2014) in electrical and electronic engineering from the Middle East Technical University (METU). He is a PhD student of manufacturing systems and robotics (EDPR) and research assistant in the Biorobotics Laboratory in EPFL. He is working on the development of modular robots and vision/locomotion-based problems with them.

William Myers (NL) is a curator, writer and teacher based in Amsterdam. He is the author of *Biodesign* (2012) and *Bio Art: Altered Realities* (2015). http://www.william-myers.com

Ken Nakagaki (中垣 拳) (JP) is an interaction designer from Japan. Currently, he is a PhD candidate at the Tangible Media Group, MIT Media Lab. He is interested in developing interfaces which seamlessly combine digital information or computational aids into daily physical tools and materials, and also interested in designing human perception with such interfaces.

Akiko Nakayama (JP), born in 1988, is a painter who depicts the beauty of conveying energy metamorphosis through several media, such as installations, photos and performance. In recent years, she has been energetically engaged giving her performance *Alive Painting* in various cities. She has an MFA from Tokyo Zokei University and participated in TEDxHaneda (2015) and the Takamatsu Media Art Festival (2015). http://www.akiko.co.jp

Ukawa Naohiro (JP), born in 1968, is a multi-talented artist known for his wide range of activities as a video artist, graphic designer, music video director, VJ, writer, college professor and Genzai artist, among other roles. In March 2010, Ukawa founded the live streaming channel *Dommune*, which immediately attracted a record-breaking number of viewers for its daily programs, and was widely discussed both inside and outside Japan.

Navid Navab (CA) is a media alchemist, composer, audiovisual sculptor, phono-menologist and gestureBender. Interested in the poetics of gesture, materiality, and schizophonia, his work investigates the transmutation of matter and the enrichment of its inherent performative qualities. Navid uses gestures and vibration from everyday life as basis for real-time compositions, resulting in augmented acoustic poetry and painterly light that enchants improvisational and pedestrian movements. *http://www.navidnavab.net*

NOHlab (TR) is a studio founded and directed by two experienced creative partners: Deniz Kader & Candaş Şişman. The studio was born at the end of 2011 as a result of highly collaborative experience these two motion and visual artists had in the past. Both are charged with carrying a unique and distinctive art and concept direction in their projects, focused in the areas of art direction, motion design, projection mapping, audiovisual performance and new media for art and culture and the advertising industry. They are motivated by pushing the boundaries in design and visual communication. NOHlab has received several awards, including an Honorary Mention from Prix ARS Electronica Computer Animation/Film/VFX and Best Prize in Sound Design from Roma Viedram Video Festival. They have participated in many exhibitions and festivals, such as TED X, Ars Electronica, Genius Loci Weimar and OFFF. *http://www.nohlab.com*

Yoichi Ochiai (JP), born in 1987, is a media artist and assistant professor of the University of Tsukuba and head of its *Digital Nature* Group. He holds a PhD in applied computer science from the University of Tokyo. He works on new inventions and research through a mixture of applied physics, computer science and art. He has a strong interest in post-pixel multimedia and conducting research towards his vision called *Digital Nature*, an alternative perspective of nature and humanity in the post ubiquitous computing era. He has received the Innovative Technologies Prize from METI Japan, the World Technology Award from WTN, and many more. *http://96ochiai.ws*

Hideaki Ogawa (JP) is a creative catalyst, artist, curator and researcher in the field of art, technology and society. He has realized many innovative projects for with industries such as Honda R&D, Toshiba, Toyota, Hakuhodo etc. His special focus is on *Art Thinking* as a catalyst for innovation. He is a representative and artistic director of the media artist group "h.o". Currently he also works at the Ars Electronica Futurelab and has realized many projects for research, festivals and the Ars Electronica Center.
http://www.howeb.org

Jifei Ou (欧冀飞) (CN) is a PhD candidate and researcher at MIT Media Lab. His works focuses on programming material in construction processes across scales. The ability to programmably assemble materials with tailored architectures at the centimeter, millimeter, and micrometer scales enables tunable mechanical, optical and electrical properties. As a designer, he is also interested in new interactions that emerge from programmable materials.

Dafni Papadopoulou (GR) is an architect based in Athens. She has collaborated with various architecture studios in Barcelona and Athens and has been awarded prizes in various architectural competitions. Her fields of interest are focused on the interaction between body techniques, space and urban condition. She has been experimenting on algorithmic design, interaction technologies and electronic textiles.

Simone Pappalardo (IT) is a graduate in electronic music from the Conservatory of Santa Cecilia. Simone creates interactive sound installations and electronic compositions arranged and performed in many Italian and international festivals (the Romanian Academy, the American Academy, Macro and Maxxi Museum in Rome, Beijing Conservatory, Globe Theater of Buenos Aires). He teaches computer music at the Conservatory of Bari and at the Conservatory of Latina.

Joseph Paradiso (US) joined the MIT Media Laboratory in 1994, where he is now an associate professor of media arts and sciences directing the Responsive Environments Group, which explores how sensor networks augment and mediate human experience, interaction and perception. His current research interests include embedded sensing systems and sensor networks, wearable and body sensor networks, energy harvesting and power management for embedded sensors, ubiquitous and pervasive computing, localization systems, passive and RFID sensor architectures, human-computer interfaces and interactive media.

Raphael Perret (CH) is a Zurich-based artist exploring the interplay between physical and virtual spaces, the closing of circles and the examination of value systems. Over the last years, he has focused on the cyclic processes of electronic waste and the aesthetics of dying technology. He holds a master's in advanced scenography studies and has exhibited in Europe, Asia and the Americas.
http://www.raphaelperret.ch

Špela Petrič (SI), BSc, MA, PhD, is a Slovenian new-media artist and scientific researcher currently based in Amsterdam, NL. Her artistic practice combines natural sciences, new media and performance. While working towards an egalitarian and critical discourse between the professional and public spheres, she tries to envision artistic experiments that produce questions relevant to anthropology, biotechnology and philosophy. *http://www.spelapetric.org*

Playful Interactive Environments (AT) is a research group founded by the Department of Digital Media at the University of Applied Sciences Upper Austria, School of Informatics, Communication and Media in Hagenberg. The research group focuses on the investigation of new and natural playful forms of interaction and the use of playful mechanisms to encourage specific behavioral patterns.
http://www.pie.fh-hagenberg.at

Dr. Ivan Poupyrev (RU/US) is an award-winning scientist, inventor and designer working at the cutting edge of interaction design and technologies blending the digital and physical realities. Ivan is currently a Technical Program Lead at Google's Advanced Technology and Projects (ATAP) division, where he directs efforts focused on interaction technologies and design for future digital lifestyle. Prior to Google he was Principal Research Scientist at the Walt Disney Imagineering research division and at Sony Corporate Research laboratories in Tokyo before that. He also did stints at the University of Washington as a visiting scientist, while working on his dissertation at Hiroshima University, Japan and at Princeton University School of Architecture as a Visiting Lecturer.

Afroditi Psarra (GR) is a multidisciplinary artist and researcher working in the field of e-textiles. Her interest focuses in the creation of handcrafted technological artifacts and the use of the human body as an interface. She holds a PhD on cyberpunk, digital art and performance, focusing on the merging of science fiction ideas with digital practices. In September 2016 she will join the Center for Digital Arts and Experimental Media (DXARTS) at the University of Washington in Seattle, US as an assistant professor.

Quadrature (DE) is a collective for arts, light and robotics. The emphasis of its work is on the intersection of the physical and digital worlds and of art and science. The three members, Jan Bernstein, Juliane Götz and Sebastian Neitsch, met 10 years ago at the Kunsthochschule Burg Giebichenstein in Halle/Saale, Germany. Six years ago the first collaboration resulted in the wish to join forces and formulate a common artistic practice. Since 2012 all three members of Quadrature have finally been living and working in Berlin. They all share a love of machines and outer space. *http://www.quadrature.co*

Quayola (IT) is a visual artist based in London. He investigates dialogs and the unpredictable collisions, tensions and equilibriums between the real and artificial, the figurative and abstract, the old and new. His work explores photography, geometry, time-based digital sculptures and immersive audiovisual installations and performances. Quayola's work has been exhibited at the Venice Biennale; the Victoria & Albert Museum, London; the British Film Institute, London; Park Ave Armory, New York; Bozar, Brussels; Palais de Tokyo, Paris; Cité de la Musique, Paris; Palais des Beaux Arts, Lille; MNAC, Barcelona; National Art Center, Tokyo; UCCA, Beijing; Paco Das Artes, Sao Paulo; Triennale, Milan; Grand Theatre, Bordeaux; Ars Electronica, Linz; Elektra Festival, Montreal, and the Sonar Festival, Barcelona. *http://www.quayola.com*

Carlo Ratti (IT) is an architect and engineer, who practices in Italy and teaches at the MIT, where he directs the Senseable City Lab. Ratti has co-authored over 250 publications and holds several patents. His work has been exhibited in several venues worldwide, including the Venice Biennale, New York's MoMA, London's Science Museum, and Barcelona's Design Museum. Two of his projects–the *Digital Water Pavilion* and the *Copenhagen Wheel*–were hailed by *Time* Magazine as 'Best Inventions of the Year'. He has been included in Blueprint magazine's "25 People Who Will Change the World of Design" and in *Wired's* "Smart List: 50 People Who Will Change the World". He was curator for the "Future Food District" at Expo Milano 2015 and is currently serving as Chair of the World Economic Forum Global Agenda Council on Future Cities.
http://www.carloratti.com http://www.senseable.mit.edu

Andreas Refsgaard (DK) is an interaction designer and creative coder from Denmark. *http://www.andreasrefsgaard.dk*

Marc Reibel (DE/AT) currently holds the positions of conductor and head of musical preparation in the Landestheater Linz. Working together with the Bruckner Orchestra Linz enables him to look back upon an impressive series of concerts, e.g. the Voestival 2004, the Gradus ad Parnassum final concert 2009 and the opening concert of the International Bruckner Festival 2012 in the Brucknerhaus concert hall. Concert tours and guest performances have so far led him to Switzerland, Hungary, Italy, France and Japan, where in Nagoya he conducted Beethoven's 9th Symphony numerous times. Besides working with the Bruckner Orchesta Linz he has also worked with the Stuttgart Philharmonic, the Wuerttemberg Philharmonic Reutlingen, the Baden-Baden Philharmonic and the Györ Philharmonic Orchestra.
http://www.marcreibel.com

Erwin Reitböck (AT) is a senior producer at the Ars Electronica Futurelab and is the go-to technician for projects of all scales. He specializes in mechatronics, electronic hardware, interactive systems, 3D printing and machine design and maintenance. Reitbock and Gardiner designed and built the NIWASHI machine from stock and customized parts.

Monica Rikic (ES) studied fine art at the University of Barcelona until 2009, focusing mostly in video art and animation. She holds a master's in digital arts from the Pompeu Fabra University of Barcelona, where she discovered code as a very powerful artistic language and the one that best suited her needs: the de-hierarchization of the traditional relations in art–piece, artist, public–to bring people closer to it. She has participated in a number of international art festivals such as Ars Electronica, FILE Festival or Sónar, and was awarded a Jury Selection at the 19th Japan Media Arts Festival, an experimental game development residency in Montreal in 2015 at the TAG Research Center and an EMARE residency in 2014.

Don Ritter (CA) is a Canadian artist and writer living in Hong Kong who has been active internationally in the field of digital media art since 1986. Ritter's work has been presented at festivals, museums and galleries throughout North America, Europe and Asia. His recent writings examine the relationships between aesthetics, ethics and digital media. *http://www.aesthetic-machinery.com*

Mikhail Rudy (RU/FR) is a Russian pianist who has played with the most prestigious conductors, from Karajan to Maazel, made numerous recordings and won international prizes. He has participated in interdisciplinary art projects with the Quay Brothers (New York MoMA, London Kings Place), Jeff Mills (Paris Louvre) Philippe Parreno (Palais de Tokyo Paris, Park Avenue Armory, Bicocca Milano), AROTIN & SERGHEI (Basel, Vienna) and in the films *Chagall: The Sound of Colours*, *Kandinsky/Mussorgsky* (Paris, New York and Bilbao Guggenheim, Centre Pompidou, i.a).

Thomas Schmickl (AT), project coordinator of *ASSISIbf*, is a professor at the Department. of Zoology at the University of Graz, Austria, where he founded the Artificial Life Lab in 2007. Besides his research activities in the fields of zoology, biological/ecological modeling, bio-inspired robotics (swarm robotics, modular robotics, neural networks, artificial hormone systems and evolutionary robotics), he also teaches at the Department of Environmental System Sciences at the University of Graz. *http://www.assisi-project.eu*

Claudia Schnugg (AT) is senior curator of the Ars Electronica Residency Network and is carrying out research in the field of art and science collaborations at Ars Electronica Futurelab, with a focus on aesthetic and embodied knowing and understanding and its influence on creating, work and organization. She holds a PhD in social and economic sciences from the University of Linz.

Philipp Schoessler (DE) is a multidisciplinary interaction designer/engineer and currently working for Samsung Research's Think Tank Team. He holds an MA from the Berlin University of the Arts and an MSc from the Tangible Media Group at the MIT Media Lab. He has worked for companies such as ART+COM, Disney Research, and WHITEvoid. He is skilled in many engineering and design innovation fields and is particularly adept at devising creative solutions to problems.

Christine Schöpf (AT), PhD, studied German and Romance languages. She has worked as a radio and television journalist and was the head of the art and science department at the state broadcaster ORF Upper Austria (1981-2008). She was appointed Honorary Professor at the University of Art and Industrial Design in Linz (2009). Since 1979, she has held a number of positions in which she has been able to contribute considerably to the development of Ars Electronica. She was responsible for conceiving and organizing the Prix Ars Electronica from 1987 to 2003. Together with Gerfried Stocker, she has been the artistic co-director of Ars Electronica since 1996.

Robertina Šebjanič (SI) is an internationally exhibited artist, combining art, technology and science. Her ideas and concepts are often realized in collaboration with others, through interdisciplinary and informal integration in her work. She is a member of the Hackteria Network, Ljudmila, UR Institute and the Theremidi Orchestra. *http://www.robertina.net*

SEEC PHOTOGRAPHY (US) is a collaboration between the artist and photographer Enar de Dios Rodriguez and two physicists, Philipp Haslinger (UC Berkeley) and Thomas Juffmann (Stanford University). Having met during their studies in Vienna, the trio is now based in and around San Francisco. *http://www.seecphotography.com*

Semiconductor (UK) is the artist duo Ruth Jarman and Joe Gerhardt. In their moving image and other artworks they explore the material nature of our world and how we experience it through the lens of science and technology, questioning how they mediate our experiences. Their unique approach has won them many awards and prestigious fellowships including the 2012 Samsung Art+ prize for new media, a NASA space sciences fellowship and the Collide@CERN Ars Electronica Award.

Daniil Shchapov (RUS) is a Russian puppeteer studying in Berlin. He choreographed theater performances for Theater Spiel und Schule e.V., and has performed at a number of German theater festivals as a puppeteer and actor.

Yoko Shimizu (JP) is a contemporary artist and biochemistry researcher based in Tokyo, Japan. Born in Kyoto and raised in the US, she was inspired by the art scene in NY as a child. She studied biology and chemistry in Kobe University. Yoko has received numerous awards for biology-inspired installations that integrate art and science, and has held exhibitions in countries around the globe. *http://www.yokoshimizu.com*

Shinoda & Makino Lab (JP) at University of Tokyo, including Takayuki Iwamoto and Takayuki Hoshi, demonstrated the world's first midair ultrasonic haptic display in 2008 and a touchable aerial image in 2009. After Keisuke Hasegawa and Yasuaki Monnai of the lab exhibited *Tactile Projector* in 2013 and *Haptomime* (midair touch-panel) in 2014, the renewed lab with the co-organizer Yasutoshi Makino developed *Haptoclone* with two students, Yoshikazu Furuyama and Seki Inoue. *http://www.hapis.k.u-tokyo.ac.jp*

SILK Fluegge (AT) is an artist collective for urban contemporary dance and art. The collective's artistic work includes theater performances, interventions in museums and public spaces and arts and cultural education. The focus is on projects in the area of urban and contemporary dance and art, with special attention on the promotion of youth. *http://www.silk.at*

Lydia Smolin (IE) is an award-winning graphic designer with an honors degree in visual communications from the Dun Laoghaire Institute of Art, Design and Technology, Ireland. After working in Europe and the US, she returned to Dublin and worked as a motion graphic designer in RTE, Ireland's national television broadcaster. She is currently studying for an MA in Media Spaces at the BTK University of Art and Design in Berlin. *http://www.lydiasmolin.com*

Susana Soares (PT/UK) is a designer, researcher and lecturer at LSBU London. She explores the implications of the current technological redesign of nature, often incorporating living matter harnessed towards new functions. Her projects involve developing collaborative frameworks for public engagement and awareness. *http://www.susanasoares.com*

Stadtwerkstatt (AT), based in Linz, is an innovative cultural space founded in 1979 by a group of socially engaged art students. In advocating open-source software and free spaces, they add a political dimension in confronting contemporary issues across borders, creating and presenting interdisciplinary projects in public space, radio and the Net. *htttp://www.stwst.at*

Gerfried Stocker (AT) is a media artist and electronic engineer. In 1991, he founded x-space, a team for the realization of interdisciplinary projects. In this framework numerous installations and performance projects have been carried out in the field of interaction, robotics and telecommunications. Since 1995 Gerfried Stocker has been a managing and artistic director of Ars Electronica. In 1995/1996 he developed the groundbreaking exhibition strategies of the Ars Electronica Center with a small team of artists and technicians and was responsible for the set-up (and establishment) of Ars Electronica's own R&D facility, the Ars Electronica Futurelab. Since 2004 he has been in charge of developing Ars Electronica's program of international exhibition tours. Since 2005 he has planned the expansion of the Ars Electronica Center and implemented the total substantive makeover of its exhibits.

Lino Strangis (IT) is a media artist (video art, experimental animation, virtual reality interactive, sound art and experimental music) who lives and works in Rome and Turin. Also active as a sound and multimedia performer has founded various projects related to sound experimentation and free improvisation (solo and with groups such the ETERE project) and is the author of music and sounds for himself and other artists. Lino founded the curatorial team Le Momo Electronique and since 2011 he has been the artistic director of CARMA (Center of Arts and Multimedia Applied Research).

Hannes Strobl (DE) is bass player, composer and sound-artist and lives in Berlin. The main starting point for his music is the sound-based potential on the electric bass / electric double bass. He expands the instrumental-specific repertoire of expression by combining advanced playing technology with live electronics. With David Moss and Hanno Leichtmann he is the founder of the project *Denseland*. *http://www.hannesstrobl.de*

Studio99 (US) is a Microsoft research program designed to foster collaborations between researchers/engineers and artists/designers to create beautiful and innovative experiences that inspire new ways of thinking about existing and future scientific challenges. Team Members: Helene Steiner, Paul Johns, Asta Roseway, Chris Quirk, Sidhant Gupta, Jonathan Lester. One of the ways this is achieved is through their artist-in-residence program, in which Helene Steiner participated as Visiting Artist. *Project Florence* drew together individuals from natural language processing, human-computer interaction, engineering and biology teams, all inspired by the notion of creating new dialogs with the natural world. *http://www.helenesteiner.com*

Catherine Ka Hei Suen (CN) is a design engineer who has won both the iF Gold and Red Dot the Best of the Best Awards for her product design work from Hong Kong. She loves working with complexity and uncertainty, and is always looking for ways to maximize design possibilities. Catherine is a graduate of the MA/MSc Innovation Design Engineering program at the Royal College of Art and Imperial College London. *https://www.kahei-suen.squarespace.com*

Hiroshi Sugihara (JP), born 1992 in Hiroshima, is a master of mechanical engineering at the University of Tokyo. He researches into prototypes made by additive manufacturing at the Prototyping & Design Laboratory.

Kazuma Suzuki (JP) is a researcher at the Keio Media Design Research Institute. He worked on *FOG PIXEL* while he was a graduate student at Keio University Graduate School of Media Design Global Innovation Design Program.

Tomotaka Takahashi (JP) is the founder and CEO of Robo Garage, a research associate professor at the University of Tokyo and visiting professor at the Osaka Electro-Communications University. He researches, creates, develops, designs and manufactures humanoid robot prototypes from scratch. He developed *RoBoHoN*, *Kirobo*, *Robi*, *Ropid*, *Chroino*, *FT*, *Evolta*, *Tachikoma* and *VisiON*. His awards include *Time* magazine's "Coolest Inventions 2004," *Popular Science* magazine's "33 Persons Changing the Future," three Guinness world records for *Evolta* and *Kirobo*, and Robo-Cup world champion 2004-2008. On August 21, 2013, *Kirobo* became the first communications robot in space. *https://www.robohon.com*

Rintaro Takashima (JP) graduated from the College of Engineering Systems at the University of Tsukuba, Japan. He is researching wearable robot systems.

Shohei Takei (JP) is a media artist and HCI researcher. Shohei has worked with Yasuaki Kakehi on the *MorPhys* project since 2012.

tamtam (DE) are Sam Auinger (AT), Hannes Strobl (AT). They refer to their work with the sentence: "The sound environment is becoming the instrument, the instrument is becoming the sound environment." Their instrument is, for all intents and purposes, not only a sounding object that we are well familiar with. It is also the space itself where sound lives-the acoustic and psychoacoustic fields that enable us to extend our accepted senses to hear the habitual and the everyday as something extraordinary. *http://www.tamtam.berlin*

Cengiz Tekin (TR) lives and works in Diyarbakir, Turkey. His solo exhibitions are *Original Message* (with Şener Özmen, Outlet Gallery, Istanbul, 2009), *Inner Issues* (Pilot Gallery, 2013) and *Just Before Paradise* (Pilot Gallery, 2016). Recent group exhibitions include *Istanbul: Passion, Joy, Fury* MAXXI-Museo Nazionale delle Arti del XXI Secolo (Rome, 2015-16), *Every inclusion is an exclusion of other possibilities* SALT Beyoğlu (Istanbul, 2015), *Political Art and Resistance in Turkey* nGbK (Berlin, 2015), *Signs Taken in Wonder* MAK Museum (Vienna, 2013), Second Mediterranean Biennale, *Re-Orientation* (Sakhnin, Israel, 2013), *Second Exhibition* ARTER (Istanbul, 2010). *http://cengiztekin.blogspot.co.at*

Stefan Tiefengraber (AT), born 1981 in Baden bei Wien/ Austria. After working for six years in a film production company he changed his main place of residence to Linz, Austria. In 2015 he took part in the MMCA Changdong residency program in Seoul/Korea for six months. His artworks go from noise performances to interactive installations to time-based media such as experimental video. *http://www.stefantiefengraber.com*

Tomonaga Tokuyama (JP) works internationally in the fields of audiovisual art, architecture and graphics, with his insight into computer science. He developed video programs for works by Ryoji Ikeda and Cyclo, as well as CAD programs for architects such as Kengo Kuma and Junya Ishigami. Tokuyama received a one-year scholarship at Fabrica and recently participated in ENCAC's residency at Le Lieu Unique. *http://www.tomonagatokuyama.com*

Toyota Motor Europe / TME (BE) is the regional headquarters of Toyota in Europe. TME oversees the wholesale sales and marketing of Toyota and Lexus vehicles, parts and accessories, and Toyota's European manufacturing and engineering operations.

Stefano Trambusti (IT) is a performer and theater media solutionist based in Berlin. He holds a degree in both computer science and puppetry. He has performed in theaters and festivals in Germany/Austria/Australia/Italy and among others in: CUBE in the QUT (Brisbane/Australia), Oldenburgischen Staatstheater (Oldenburg), Franckeschen Stiftung (Halle/Saale), Dortmunder U (Dortmund), Puppentheater Magdeburg (Magdeburg) and in Berlin: Gorki Theater, HAU, Schaubude.

Pao-Chang Tsai (TW) graduated from National Taiwan University (drama and theater) and the Royal Central School of Speech and Drama (music theater). Since then he has been actively involved in Taiwanese theater as an actor, director and playwright. In 2009, he became the co-artistic director of the Tainaner Ensemble, one of the most esteemed theater companies in Taiwan. He has won awards from the Asian Cultural Council and studied at the American Repertory Theater and the Moscow Arts Theater.

Atsuro Ueki (JP) is a senior assistant professor and an experienced media artist.

Udayan Umapathi (IN) is an inventor and designer from Bangalore, India. His current work focuses on programmable matter, modular robots and digital fabrication, with the focus on creating meaningful human experiences. Inspired by the idea of "computation as a way of understanding the universe," his current work focuses on making physical materials compute. He is doing this while pursuing his MSc with Prof. Hiroshi Ishii at the Tangible Media Group, MIT Media Lab. Previously his work looked at turning digital fabrication tools into mediums for expression.

V2_, Institute for the Unstable Media (NL) is an interdisciplinary center for art and media technology in Rotterdam (NL). V2_ presents, produces, archives and publishes research at the interface of art, technology and society. Founded in 1981, V2_ offers a platform for artists, designers, scientists, researchers, theorists and developers of software and hardware from various disciplines to discuss their work and share their findings. In V2_'s view, art and design play an essential role in the social embedding of technological developments. V2_ creates a context in which issues regarding the social impact of technology are explored through critical dialog, artistic reflection and practice-oriented research. *http://www.v2.nl*

Iris van Herpen (NL), born in 1984, is a fashion designer. She studied fashion design at the ArtEZ Institute of the Arts Arnhem and interned at Alexander McQueen in London and Claudy Jongstra in Amsterdam. Van Herpen immediately caught the eye with notable shows. In 2007, she started her own fashion label. Since July 2011, she has been a guest member of the prestigious Parisian Chambre Syndicale de la Haute Couture, part of the Fédération Française de la Couture. She participates in many international exhibitions and creates two collections a year. *http://www.irisvanherpen.com*

Salvatore Vanasco (IT/DE) was born in Montalbano, Italy, and grew up in the German state of Hesse. He first studied literature at La Sapienza University in Rome in 1982, and then visual communication at HFBK–University of Fine Arts in Hamburg 1984-89. He was director of the European Media Art Lab from 1989 to 1998. In 2006, he made a name for himself as co-founder of xailabs GmbH in Berlin. Parallel to these activities, Salvatore Vanasco has long served as professor and dean at the Merz Academy in Stuttgart. The artist and software entrepreneur is also a German Media Art Prize laureate. In 2013, he produced the opening of the Festival Ars Electronica at Tabakfabrik. *http://www.xailabs.com*

Chompunuch Vanichayanguranon (TH) received her BSc in architectural design from Chulalongkorn University, Bangkok in 2010. After working in architect firms in China and Thailand for a few years, she realized that architecture is not only about function and space, but experience of that space. She is interested in interdisciplinary projects and is currently studying for a master's degree in Media Space at BTK, Berlin.

Dean Verzel (SI), a visual artist living in Koper, Slovenia, is the author of large-scale ambient installations revolving around the question of death, linked and confronted with its counterparts, life and knowledge. Verzel's eternal theme is represented in the performance of the burning of the monument cross in Strunjan, *Sacred Cross* (2012), and also in his projects of freezing and creating photographs that are at the peak of his opus in terms of perfection and shock. The varieties of the procedures undertaken by Verzel condense metaphysical questions, and problematize the institution of art and the media code in the construction of communication.

Boštjan Vihar (SI) is a biomimmeticist with a PhD in biology from RWTH Aachen University. He is interested in the structure and properties of living things and how to transfer the underlying principles to new technologies. At IRNAS he is building an open laboratory for biological and biomedical research, using low cost and DIY equipment, optimized for research but still widely available. *http://www.irnas.eu*

Luke Vink (NZ/NL) is a hardware interface designer. His focus is on enhancing humanity through technology, blurring lines between the two through research that ranges from shape-changing interfaces, interactive physical installations and small tangible products. Luke follows an ethic in his work that sees a balance between intention, purpose and integrity. He has a BSc in industrial design from the Technical University of Eindhoven, the Netherlands, and is currently an MSc candidate at the MIT Media Lab under the Tangible Media Group.

Ei Wada (JP), born in 1987, is an artist/musician. Around the time where he began to understand things, he believed that a music festival is a place with a gigantic tower shaped like a leg of a crab with a television tube embedded in it. But at a certain moment, his friend pointed out that there was no such place on Earth. So he decided to make a virtue of necessity and to produce it himself. He started a group called Open Reel Ensemble and a project called the *Braun Tube Jazz Band*. He also created many installation art projects and in recent years he started his latest project called *Electronicos Fantasticos!* where he recycles second-hand home electronics and turns them into musical instruments. *https://eiwada.com*

Akira Wakita (JP) is a Japanese artist and engineer. In recent years, he has developed original software based on fluid-dynamic and thermodynamic models, striving for visualization across science and art. *http://www.akirawakita.com*

Rudolf Wakolbinger (AT) was born in Braunau am Inn, Upper Austria, in 1983. He started composing early in his youth, drawing inspiration from a broad range of musicians such as Frank Zappa, the industrial band Einstürzende Neubauten, Johann Sebastian Bach and Anton Webern.

Dr. Wen Wang (US/CN) is a bioengineer, entrepreneur and designer. Her research focuses on bio-fabrication and bio-manufacturing, involving interdisciplinary studies that combine the knowledge of biotechnology, advanced materials and design. Her vision is to fill the gap between bio-oriented research and the real-world applications, by making technology easy to access and products more affordable. She has worked on numerous research and commercial projects involving biological systems for various products, using living biological materials including the bioLogic garment.

Rüdiger Wassibauer (AT), creative director of Schmiede Hallein, was born in Salzburg in 1977. From 1996 to 2000 he studied international business and finance, French, economics and history at the James Madison University. In 2003 he was a founder of Schmiede Hallein, from 2008 to 2014 a member of the advisory council to the Austrian Ministry of Education, Art and Culture, and from 2007 to 2015 a member of the Salzburg State Culture Advisory Board. Since 2006 he has been a developer and coach of the Salzburg state scholarship for media art. Since 2008 he has been developing subnet. *http://www.schmiede.ca http://www.subnet.at*

Penny Webb (UK) is a research assistant in the Tangible Media Group, MIT Media Lab, specializing in the integration of technology within product design. Her main interests are in HCI, material advancements and digital craft. Concept development and future thinking are key aspects of her creative practice, which she combines with a passion for craft and communication.

Andreas Weixler (AT) born 1963 in Graz, Austria, is a composer of contemporary instrumental composition and computer music with a special emphasis on audiovisual interactivity, virtuoso chances and interactive score. He currently teaches computer music, music and media technology as an associate university professor at the Bruckner University, where he initiated the development of the computer music studios and intermedia multichannel computer music concert hall Sonic Lab. He is also a lecturer at the InterfaceCulture of the University of Arts in Linz and at the University of Music and Performing Arts–MDW in Vienna. Andreas Weixler founded intermedia concert series such as Sonic Intermedia (Ars Electronica Center Linz), electronic access and runs Atelier Avant Austria together with Se-Lien Chuang. Currently he specializes in intermedia concerts of improvisation and contemporary composition. *http://www.avant.mur.at*

Sebastian Wolf (DE) creates interactive video and light installations. His work explores the relationship between nature and humanity and employs a fundamental approach to artistic creation that seeks the inherent aesthetic and emotional potential of novel technologies. He currently lives and works in Berlin. *http://www.einsdreidrei.com*

George Philip Wright (UK) is an engineer, futurist designer and inventor from Leeds, UK. He is a graduate in engineering science from Oxford University and in innovation design engineering from the Royal College of Art/Imperial College London. Driven by a passion for invention, he has created projects on sleep analysis, virtual reality, machine learning and musical prototyping among others.

XCEED (HK) is a new-media art collective based in Hong Kong, focusing on digital art installation, spatial experience design and interactive and audiovisual performance. Its work has been shown at various international art festivals, showcased in the countries including Germany, Italy, Argentina, Brazil, the US, UK and Asian cities. XCEED is about transcending boundaries and going beyond limitations. *http://www.xceed.hk*

Junichi Yamaoka (JP) is an assistant professor working for a research group led by Yasuaki Kakehi at Keio University. *http://www.junichiyamaoka.net*

Lining Yao (CN/US) is a designer and maker of novel materials and interfaces. She is currently a PhD candidate at the Tangible Media Group, MIT Media Lab, where she focuses on pushing human-computer interaction toward human-material interaction. Her research revolves around the intersection of novel materials, digital fabrication and interaction design. Rather than computing the virtual data, she tries to compute the physical material. Programming the physical states of materials' shape, color, stiffness, texture and density is her long-term research goal.

Mahir Yavuz (TR/US) is an interdisciplinary creative and researcher based in New York City. He works in the fields of data science, visualization and artificial intelligence. Yavuz was lead creative in various projects in Turkey, Austria, Canada and the USA. His work has been exhibited internationally including at the Festival Ars Electronica, Siggraph, Istanbul Biennial and ISEA among others. *http://mahiryavuz.com*

Nilufer Zakirova (RU) was born in Moscow. She defines herself as a multimedia artist with a simple but significant approach and way of expressing her work. Currently, she is studying in the Media Space master's program at the BTK University of Art and Design in Berlin.

Simone Zaunmair (AT) was born in Wels, Upper Austria. She studied composition with Gunter Waldek and Erland Freudenthaler at the Anton Bruckner Private University, and oboe at the Carinthian State Conservatorium in Klagenfurt. She is currently working on her master's degree; her advisor is Carola Bauckholt. She also received composition instruction from Albin Zaininger, Thomas Doss and Alois Wimmer. In addition to numerous commissions—above all compositions for wind instruments and choral works—collaboration with soloists and instrumentalists occupies the focal point of her artistic endeavors. Simone Zaunmair founded the Wösblech Delüx big band in 2009 and currently serves as its musical director. She also performs as a musician in various ensembles. *http://www.simonezaunmair.com*

Prof. Siegfried Zielinski (DE) was born in 1951. He lives in Berlin and Karlsruhe, is Chancellor of the Karlsruhe University of Arts and Design, professor of media theory (research focus: archeology and variantology of the arts and media) at Berlin University of the Arts; Michel Foucault Professor of Media Archeology and Techno-Aesthetics at the European Graduate School in Saas Fee, Switzerland; Chancellor of the Academy of Media Arts Cologne from the institution's founding until 2000; member of the Berlin Academy of the Arts and of the North Rhine-Westphalia Academy of the Sciences and Arts.

Andreas Zingerle (AT) is a media artist. He is a PhD candidate at the Time-Based Media Department in Linz. He is researching vigilante online communities of scammers and anti-scam activists and implements their strategies in interactive narratives and creative media workshops. In recent years he has worked on several installations exploring a creative misuse of technology and alternative ways of human-computer interaction. *http://www.andreaszingerle.com*

ZoopTEK (US) was founded in 1999 with the release of its first game, *Paint Ball 3 EXTREME*. Since then, ZoopTEK has released a wide variety of games, from the hilarious *Super Cat Herding: Totally Awesome Edition*, to the tough-as-nails abstract shooter *Coniclysm*, and many more. Its latest project, *Knight Light*, combines everything it has learned into the ultimate immersive live gaming experience. *http://www.zooptek.net*

Amit Zoran (IL) is a senior lecturer at the School of Engineering and Computer Science at the Hebrew University, Jerusalem, Israel. In his research, he explores the two divergent realms of emerging computational technologies and classical hand-hewn skills, seeking a new way of thinking about these polarities: the digital machine and the human hand. He received a BSc in communication system engineering from Ben-Gurion University, Israel, an MDes from the Bezalel Academy of Arts and Design, Jerusalem, Israel, and an MSc and PhD from the Media Lab at the MIT. *http://www.amitz.co*

http://www.aec.at/radicalatoms

RADICAL ATOMS and the alchemists of our time

What comes after self-driving cars and the Internet of Things? Who are the alchemists of our time and what can they contribute to changing our world? What kinds of constellations and collaborative arrangements are they working in? And what characterizes the locations where their ideas and projects are taking shape?

Artists, designers, scientists, engineers, activists and, communicators from all corners of the earth gather in Linz to be part of the extraordinary laboratory that is RADICAL ATOMS and the alchemists of our time. They are teaming up to employ the neurosciences and biotechnology, digital hardware and software, and to bring together old handicraft traditions with 3D printers and laser cutters. Their work between art and science is not only setting a course for new frontiers, it is also opening up completely new ways of looking at the role of art and science in our society and the interplay of technology and nature.

This catalog documents the many inspiring projects that are part of Ars Electronica 2016 and offers an insight into its exciting discussions and unorthodox approaches.

400 pages, 754 illustrations