



Art and Science by Fraunhofer



ART AND SCIENCE BY
FRAUNHOFER

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FRAUNHOFER NETWORK "SCIENCE, ART AND DESIGN"

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FOREWORD

PROF. DR. JENS KRZYWINSKI
SPOKESMAN FOR THE FIELD OF DESIGN IN THE NETWORK
“SCIENCE, ART AND DESIGN” AND PROFESSOR OF INDUSTRIAL
DESIGN ENGINEERING AT TU DRESDEN

The number of renowned scientists who also had outstanding talent in the fine arts is impressive. Leonardo da Vinci illustrated his ingenious ideas in hundreds of drawings; Maria Sibylla Merian forged a unique bridge across the disciplines of entomology and botany with her artful depictions; Robert Hooke was known as a polymath, but also as the architect of The Monument in London; the lives of Max Planck, Albert Einstein, and Werner Heisenberg were equally rooted in physics and in music. All of them, representing different time periods, came particularly close to fulfilling this aspiration. As René Descartes noted in his book *Musicae Compendium*: “The most beautiful is that which is neither too simple nor too complicated for our senses to grasp.”

This quote could also serve as the motto for *Art and Science by Fraunhofer*. As the final volume of a trilogy, it focuses on the cooperation with artists, showing that the symbiosis of science and art has many facets here at Fraunhofer. Excellent research needs a home within an attractive building and an aesthetically pleasing environment. Many institutes use wall paintings, facade art, sculptures, or installations to reflect their research topics. Events such as the Fraunhofer Annual Assembly are framed by impressive room installations, dance performances as well as light and sound experiences – commissioned works, specifically designed by artists to respond to the theme. The effects of these formats of science communication and citizen engagement serve Fraunhofer’s identity development and are also highly valued outside the research organization.

The dialogue with the artists is not only an inspiration to creativity in science. Art can also act as an impactful counterpoint and accelerate the process of understanding as well as the transfer into practice. To visualize neuronal feedback of interacting test persons, to interpret quantum physical effects with the help of Buddhist Zen philosophy, to experiment with free-floating “light volumes”, or to detect nanostructures in ancient fossils – all of these are representative examples. These art installations address attributes such as uniqueness, applicability, and technological readiness.

With a heartfelt thank you to all artists and the authors of this beautifully designed trilogy, I wish everyone an inspiring read.



PREFACE

DOROTHÉE HÖFTER FOUNDER OF THE FRAUNHOFER-GESELLSCHAFT'S "ART MEETS SCIENCE" EVENT SERIES

What common features do science and art share? At first glance, not many are to be found. In our modern society, they sometimes even seem to be in stark opposition to each other. As Maxim Gorki once phrased it, "Just as science is the intellect of the world, art is its soul." Science is associated with technology, rationality and unambiguousness. Art, in contrast, is individual, speaks to our emotions, is subjective and ambiguous.

Historically, this has not always been the case. In Greek Antiquity, art and science still formed a union embodied by the goddess Athena. During the Renaissance, artists had a simultaneous understanding of themselves as scientists – Michelangelo and Leonardo da Vinci come to mind as examples.

However, even beyond the great masters, a deep connection existed between art and science that lasted until the 18th century but seemed to vanish after Johann Wolfgang von Goethe's time. In recent years, however, the two areas have again started to draw closer to each other. Artists reflect on subjects of natural science and technology or develop artistic experimental setups. Conversely, artistic activities are gaining in importance for natural scientists: Experimental and creative approaches result in surprising discoveries and findings.

Creativity, ideas, and innovation drive the day-to-day lives of both Fraunhofer researchers and artists. Creativity cannot be limited, it is an elementary ability, a special way of thinking; it is the desire to create objects and moments that have not existed in that form before.

Whether artist or scientist, being creative means going through life with a curious gaze and an urge to design.

At Fraunhofer, artistic diversity in interaction with science can be found not only in the programs launched by the "Science, Art and Design" Network, but also in the "Art Meets Science" event series. The Annual Assembly also offers an impressive stage for artists. Last but not least, a wide array of works of art are created in the context of construction activities at Fraunhofer.

Establishing a communicative and participatory process with people from different backgrounds, developing creative designs and realizing them collaboratively always fills me with happiness.

HARMONY IN OPPOSITES

Salted caramel and sweet chocolate with spicy pepper – these mixtures can be seductively delicious, thus aligning with the well-known saying that “opposites attract”. It is not just gourmet cuisine that receives its necessary flavor from opposites; our daily lives often benefit from them, too.

Human relationships in particular – within generations, in partnerships, or among siblings – often thrive because of the oppositeness of their protagonists and can last a lifetime if the differences are viewed as benefits, not burdens. They make our existence colorful and our lives worth living, although the right balance of characters is essential for creating a feeling of comfort.

Even Heraclitus the philosopher, born around 520 B.C., felt that “from differences results the most beautiful harmony”. But exactly what differences do we mean when art and science are mentioned in the same breath?

Looking at history, we can see the following: The unity of art and science as practiced until the Renaissance became the subject of a process of differentiation that began by the 17th century and bound science to the truth and art to aesthetics. This differentiation cannot be reversed, and yet it was never fully completed.

Today, it is well-known that the tension between them that has existed ever since is most productive when the two knowledge cultures observe and permeate each other, thus perceiving how strongly they each still participate in the other [1].

This book gives insight into the endeavors undertaken to provide creative space and a platform within the Fraunhofer-Gesellschaft for dialogue and exchange between the two disciplines. Numerous examples from diverse subject areas will illuminate how the seemingly opposite natures of science and art are interdependent and able to inspire the soul and the mind to the same extent.

Art Meets Science Residencies Artistic Stagings Art in Architecture

ART AND SCIENCE BY FRAUNHOFER

Communicating scientific findings is of utmost importance for a research organization such as Fraunhofer and a fundamental part of its responsibility towards society.

At Fraunhofer, we have realized that artists fulfill an important function in this context. They can contribute to the public's understanding of technology and its potential for the economy and society by conveying complex content in a clear, comprehensible way. What they need to accomplish this are formats enabling a productive dialogue between science and art. That is why Fraunhofer has taken on the task of inviting the two disciplines to join in an inspiring exchange.

The Fraunhofer Network "Science, Art and Design" plays a key part in this pursuit. It was established in 2018, and close to 30 institutes as well as the Fraunhofer Headquarters have joined the network to date.

With funding programs such as "Artist in Lab" and the "Art Meets Science" exhibition series, the network offers artists an opportunity to work closely with Fraunhofer researchers with the aim of developing joint projects and presenting them in a high-profile environment, thereby making technological innovations more tangible.

The mutual inspiration of both knowledge cultures also becomes apparent in other contexts at Fraunhofer. That is why this volume also focuses on artistic performances and stagings that are developed within the scope of the Fraunhofer Annual Assemblies and presented before prominent representatives from the economic, business, and political spheres.

Finally, realizing art in architecture is also part of Fraunhofer's public impact activities. With funding from the German federal government, the federal states, and the EU, diverse works of art have been installed in the institute buildings over the past years, highlighting their individual characters in both their exteriors and interiors.

Art Meets Science

Residencies

Artistic Stagings

Art in Architecture

ART AND SCIENCE BY FRAUNHOFER

ART MEETS SCIENCE

Art is a defining, communicative, and appealing part of our culture. It provides insights and creates sensual delights. Science also strives to gain and communicate insights, using acknowledged and valid methods and publishing as well as incorporating results. To a certain degree, both disciplines are unconditional, open-ended, and creative, always looking for the mysterious – or, as Albert Einstein put it, the “source of all true art and all science”.

In this spirit, the “Art Meets Science” event series offers a collaborative platform for researchers and artists – a stage on which they can communicate complex scientific topics in an impressive and comprehensible way. This facilitates a rewarding exchange for both disciplines.

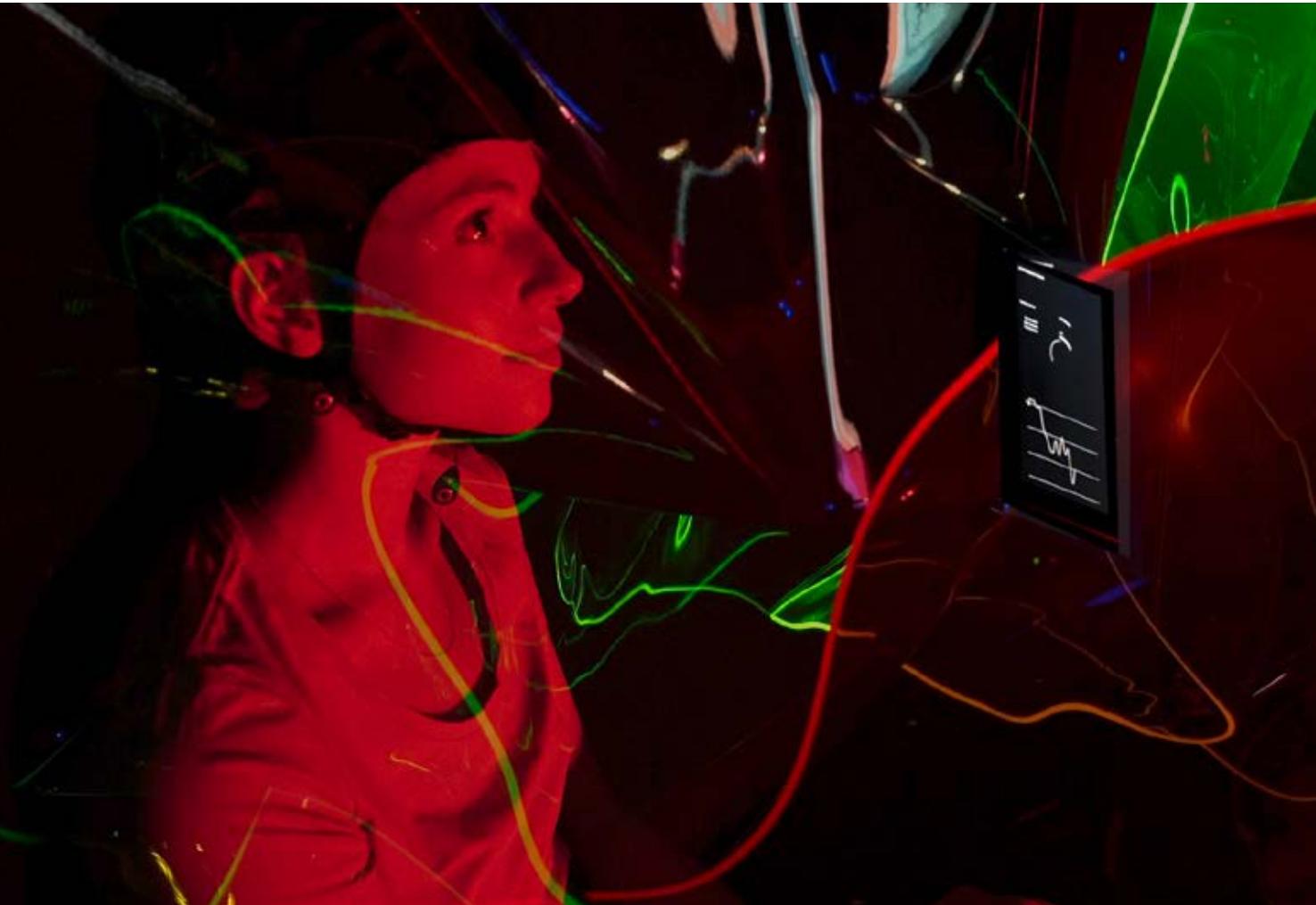
The interdisciplinary exhibition concept was developed more than 20 years ago, initially for the Fraunhofer Headquarters building in Munich. The idea was to create possibilities for artists to engage with topics from science in their work. The format later became the driver for the foundation of the Fraunhofer Network “Science, Art and Design”, which brings together the activities of the individual institutes in this field.

Artistic research projects must always be considered in the context of societal developments, political strategies, and the economic background in order to create ideal conditions for synergies. As an institution of applied research, it is essential for Fraunhofer to engage in a dialogue with the public as well as with business and industry.

The event series facilitates and inspires this dialogue and has become an established part of Fraunhofer’s science communication activities.

The event organizers are constantly engaging in creative processes to come up with new concepts for the interplay between artists and Fraunhofer researchers. Presentations include results from the Fraunhofer Network’s programs as well as selected individual projects.

In this context, Fraunhofer also cooperates with other research and art organizations, including Ars Electronica in Linz (Austria), WhiteBox in Munich, as well as STATE and LAS in Berlin.



1

1 EEG data collection for analyzing synchronicity.

2 Neurofeedback in art installations, research setup at STATE, Berlin.

“BRAINPALACE – BRAINPATTERNS” POWER AND PATTERNS OF THOUGHTS NEUROFEEDBACK IN ART INSTALLATIONS

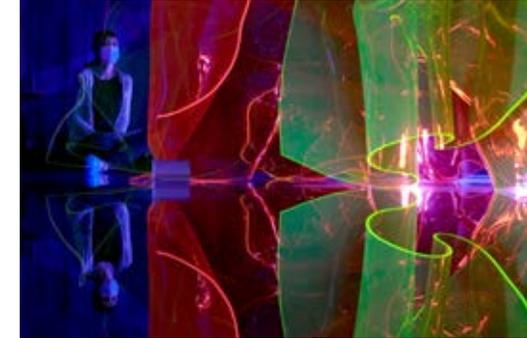
Fraunhofer Institute for Industrial Engineering IAO
Fraunhofer Institute for Industrial Mathematics ITWM

Motivation | Whenever we share a special experience with others or are engaged in an intense collaborative task, we perceive a strong feeling of connectedness. But how do we know when people are truly on the same wavelength? We often share our experiences directly and immediately with our partners. Could we somehow quantify our collective perception and shared experience to enable interpersonal dialogue through an art installation? The artistic research project “BRAINPALACE – BRAINPATTERNS” sought to tread the intersecting boundaries of art and science to explore novel impulses that can foster social connectedness and bring our brainwaves in harmony.

Methodology and implementation | The core of the project was an audiovisual, volumetric art installation that offered visitors a collective immersive experience. Electroencephalography (EEG) headsets were used to measure their brain signals simultaneously (a process known as hyperscanning). This data was analyzed for interpersonal synchronicity, i. e., similarities in the brain patterns of the interacting persons, followed by real-time feedback. The variations in synchronicity measures were coupled to the audiovisual installation: The colors of the art object gradually dissolved to become nearly transparent, while the room became bathed in a warmer light. The sound composition traced an emotive path that the visitors traversed together, thereby achieving group neurofeedback.

“BRAINPALACE – BRAINPATTERNS” POWER AND PATTERNS OF THOUGHTS NEUROFEEDBACK IN ART INSTALLATIONS

Fraunhofer Institute for Industrial Engineering IAO
Fraunhofer Institute for Industrial Mathematics ITWM



2

Artist | Tatjana Busch

Art form | Audiovisual installation

Media and sound design | Daniel Dalfovo, Christian Losert, ATELIER-E

Project management | Dorothee Höfter (until July 2022), Ingrid Breitenberger, Fraunhofer

Curation | Dr. Christian Rauch, Christina Hooge, STATE

Scientific support | Dr. Laura Kaltwasser, Berlin School of Mind and Brain; Dr. Alex Sarishvili, Tobias Wolf, Fraunhofer ITWM

Continued on page 17

Scientific background | The project investigated the opportunities and potentials of artistic interventions combined with EEG-based neurofeedback. Analysis of the brain signals (EEG) can be used to interpret mental states. Artistic, audiovisual feedback could modulate a person's brain activity in specific ways. Hyperscanning offers insights into the brains of the interacting persons by allowing the alignment effects to be measured. The challenge was to conduct the real-time analysis of complex EEG signals in an out-of-the-lab environment to simultaneously measure synchronicity of multiple people and thus subsequently enable a shared interactive interplay between the work of art, the space, and the visitors.

Contact details |

Dr. Mathias Vukelić
Head of “Applied Neurocognitive Systems” team

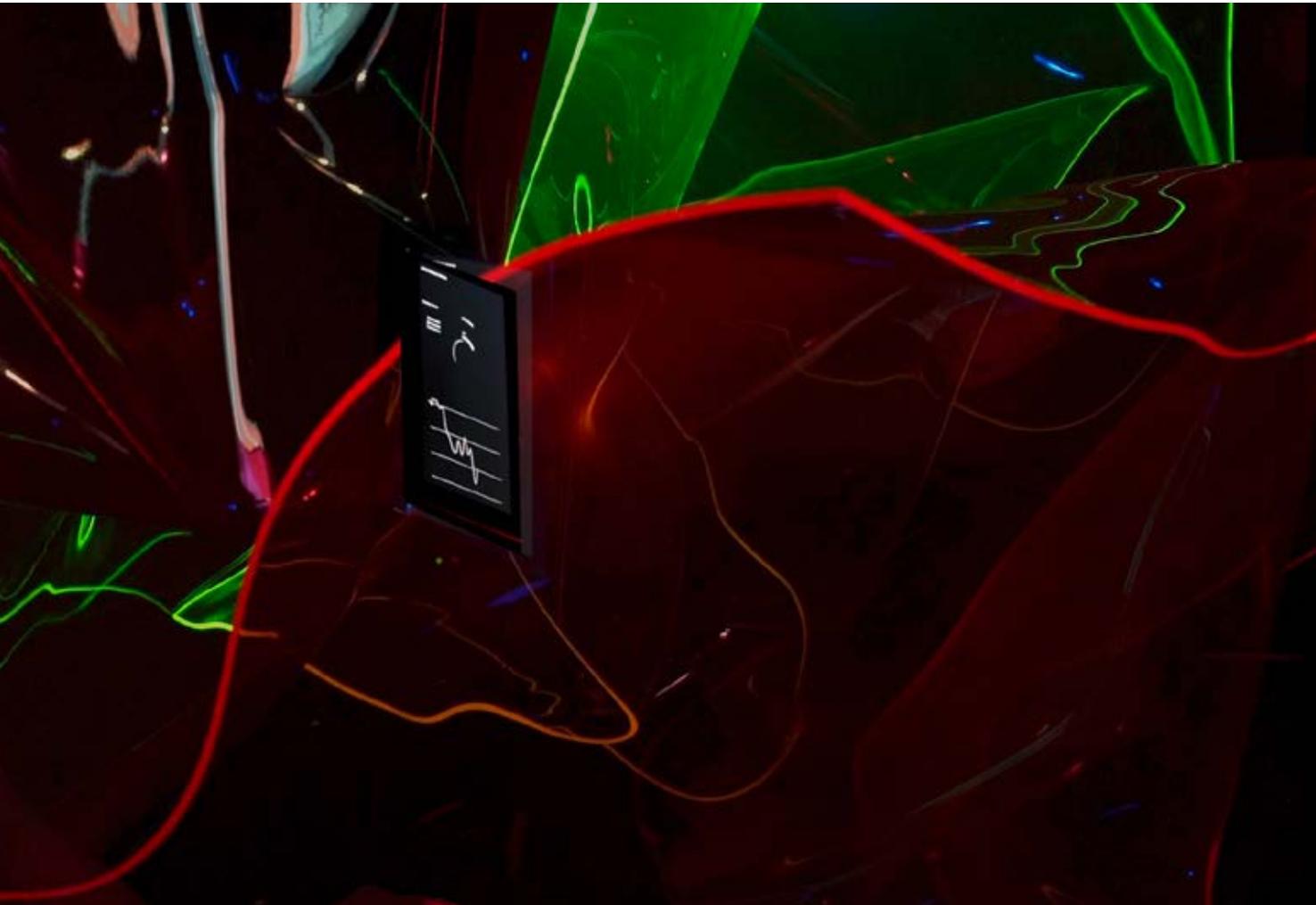
+49 711 970-5183
mathias.vukelic@iao.fraunhofer.de

Ravi Kanth Kosuru

+49 711 970-5126
ravi-kanth.kosuru@iao.fraunhofer.de

Fraunhofer Institute for Industrial Engineering IAO
“Applied Neurocognitive Systems”

Nobelstrasse 12
70569 Stuttgart
Germany



1

1 Collecting data from the interaction with the art installation.

2 Alternative visualizations in sacred buildings.

“BRAINPALACE – BRAINPATTERNS” POWER AND PATTERNS OF THOUGHTS

EXPLORING COMPLEX DATA FROM THE
INTERACTION WITH ARTWORKS

Fraunhofer Institute for Industrial Engineering IAO
Fraunhofer Institute for Industrial Mathematics ITWM

Motivation | In “BRAINPATTERNS”, the second project phase, the results from “BRAINPALACE” were investigated to determine how data streams from the interaction with the art installation can be used within other contexts.

“There are patterns – we just have to find them.” Based on this assumption, algorithms of a multifunctional monitoring system were adapted. Doctors use this system to assess the development processes of premature babies. By taking a hands-on, playful approach to transferring such methods in order to observe the individual perception of art installations, we can learn about the emergence of different levels of consciousness.

Methodology and implementation |

The project was presented as a temporary neuro lab at the Ars Electronica Center. The innovative SciArt research concept invited visitors to step into an immersive world and engage with the artwork using control elements of the brain-computer interface (BCI). Alongside the physical installation, multiple visualizations of recorded EEG signals were displayed on screens.

Beyond the installation setup itself, Fraunhofer ITWM is also searching for “patterns of thoughts” using cutting-edge visualization algorithms for data exploration. Experiments in various scenarios demonstrate how mathematics transcends seemingly unrelated domains and crosses borders.

“BRAINPALACE – BRAINPATTERNS” POWER AND PATTERNS OF THOUGHTS

EXPLORING COMPLEX DATA FROM THE
INTERACTION WITH ARTWORKS

Fraunhofer Institute for Industrial Engineering IAO
Fraunhofer Institute for Industrial Mathematics ITWM



2

Continued from page 15

Visual data exploration | Hans Trinkaus,
Fraunhofer ITWM

**“Art-Science-Research” concept at Ars
Electronica Center Linz** | Erika Mondria

Exhibition period | 2020 - 2022

Locations | STATE, Berlin; Kulturzentrum
Bremerhaven; Fraunhofer ITWM,
Kaiserslautern; Ars Electronica Center, Linz
(Austria); St. Blasius, Kaiserslautern

Scientific background | The beauty of mathematics and the wisdom of art – they both contribute to bridging the gap between universal and personal perceptions. Instead of relying on standardized “neuro program libraries” to analyze EEG data, specifically tailored algorithms generate static and dynamic structures that possess an artistic quality, making them visually and acoustically tangible.

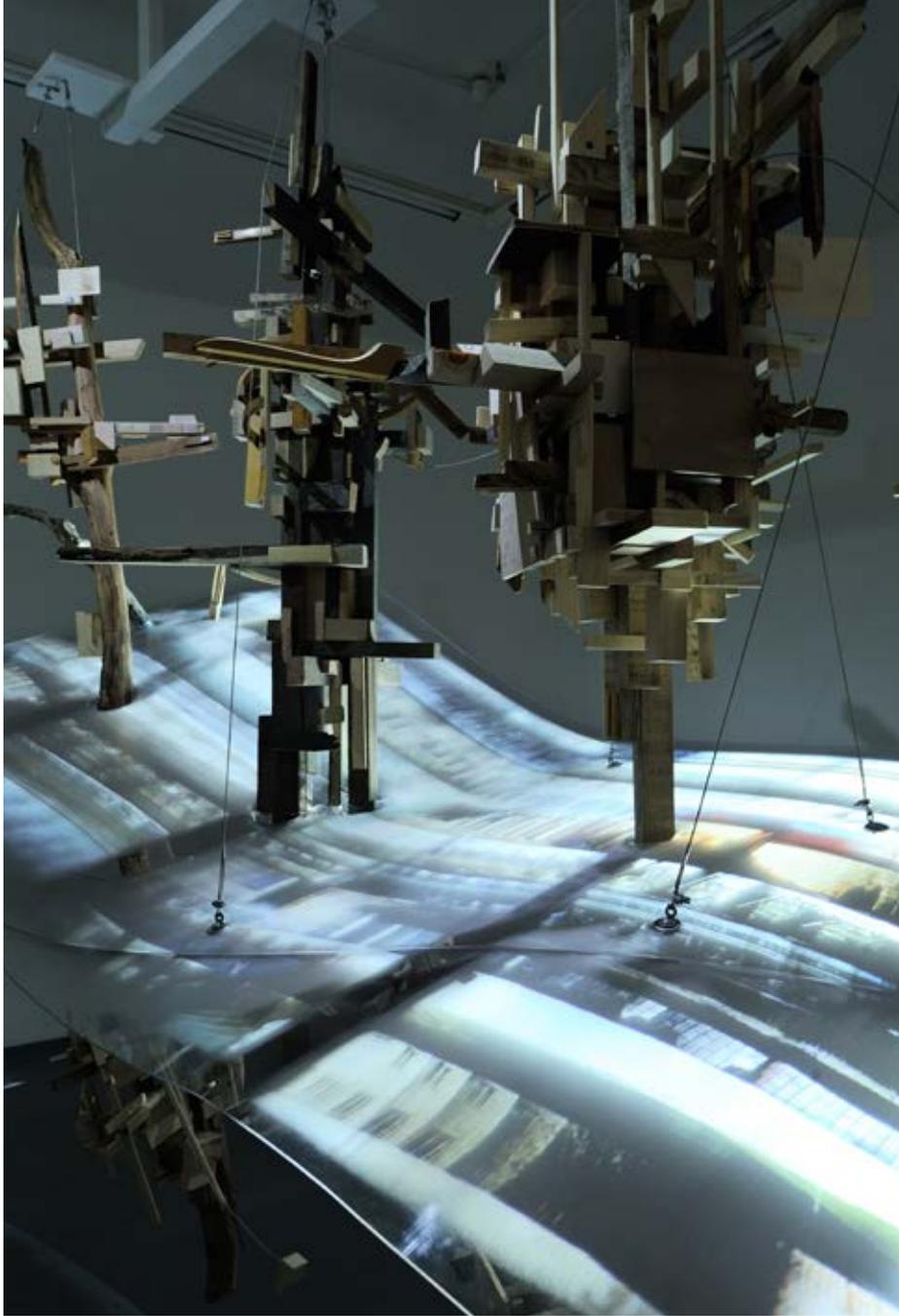
The concept of “alienation” offers fresh insights, such as connecting a set of electrodes placed on a subject’s head to a graphical user interface utilized for the multi-criteria control of an extrusion machine. These approaches provide completely new perspectives for labor research – but also for the realm of art.

Contact details |

Hans Trinkaus

Fraunhofer Institute for Industrial
Mathematics ITWM
*“System Analysis, Prognosis and
Control”*

Fraunhofer-Platz 1
67663 Kaiserslautern
Germany
+49 631 31600-4211
hans.trinkaus@itwm-extern.
fraunhofer.de



1 Wooden towers of the "Landscape" installation.

2 Video clips of well-known surroundings.

"LANDSCAPE"

VISIONS FOR THE CITY OF TOMORROW

Fraunhofer Institute for Building Physics IBP

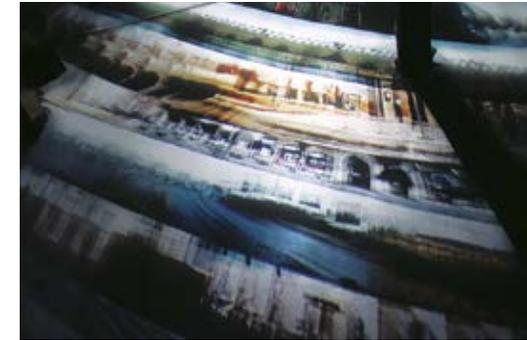
Motivation | What makes our city, what makes our world of tomorrow? "City of the Future" – the motto of the 2015 Science Year – is a topic that is being impressively explored by Jakub Nepraš' volumetric works. Technically elaborate installations portray our increasingly complex society and expressively provide new shapes representing the rapid changes in communication, technology, and everyday life. These works of art create their very own universes and invite viewers to share these ideas of the urban future or be inspired to develop their own visions. Striving to overcome outdated ways of thinking and awakening the interest in a new philosophy of life can drive human existence to evolve further and reach a more intelligent stage of evolution.

Methodology and implementation | The irregularly shaped wooden towers represent animate bridge girders, or symbolically, communities that are isolated from the "mainstream highway". The towers' structure calls to mind mechanical cranes or vertically standing fishing rods. They embody an alternative way of crossing that highway. The architecture suggests taking a look at the environment from a different perspective and trying to decode our fast-moving and sometimes monotonous daily life. Situations from everyday life, filmed from a moving point of view, provide the basis for the video. Viewed from a distance, the installation offers us the chance to take a break and reorder our own thoughts. It also tries to rise above everything that overwhelms us and threatens our existence.

“LANDSCAPE”

VISIONS FOR THE CITY OF TOMORROW

Fraunhofer Institute for Building Physics IBP



Artist | Jakub Nepraš

Art form | Installation

Exhibition period | September -
December 2015

Location | Fraunhofer Headquarters,
Munich

Concept and project management |
Dorothee Höfter, Fraunhofer

Introduction and discussion |
Dr. Elisabeth Hartung, cultural scientist
and cultural manager; Prof. Dr. Klaus Peter
Sedlbauer, Director of the Fraunhofer
Institute for Building Physics IBP (until
2022), Chair of Building Physics, TUM

Scientific background | Cities have been
seedbeds for innovation since ancient
times. Basic needs, such as food, health,
and security, but also the desire for a
higher quality of life and cultural exchange
determine the technological progress
of urban living. The townscapes of the
future will continue to change in line with
global challenges. Pressing issues related
to digitalization, new forms of mobility,
requirements of resilience, and growth in
cities must be addressed with innovative
answers. The visionary goal is the CO₂-
neutral, energy-efficient, and climate-
adapted city. The drastically changing
overall conditions require new approaches,
strategies, and infrastructures.

2

Contact details |

Andreas Kaufmann M. Eng.
*Group manager “Strategic Project
Management”*

Fraunhofer Institute for Building
Physics IBP
“Research Management”

Fraunhoferstrasse 10
83626 Valley
Germany
+49 8024 643-240
andreas.kaufmann@ibp.fraunhofer.de



1

1 *Aesthetically exploring smart materials.*

2 *Illustrating the properties of functional materials through the FÖNIKUS piece.*

“SMART³ | MATERIALS – SOLUTIONS – GROWTH” UNDERSTANDING SMART MATERIALS THROUGH ART

Fraunhofer Institute for Machine Tools and Forming Technology IWU

Motivation | Smart materials have the ability to autonomously adapt to varying environmental conditions. As a recipient of a three-month art scholarship from the smart³ initiative, jewelry designer Beate Eismann was entrusted with the task of developing a demonstrator that communicates the special characteristics of smart materials from the artist’s perspective. The aim was to engage an audience that is curious but not very familiar with the field of material engineering. In response, she crafted movable objects that explain in an aesthetically pleasing and original way how smart materials can transform existing products and give rise to new ones.

Methodology and implementation | As a jewelry designer, the artist is skilled at leveraging the physical properties of materials to achieve aesthetically captivating effects. Her task was to create an innovative and imaginative object that makes the materials’ properties tangible, such as shapeshifting in response to physical field parameters or the illustration of deformation processes and visual, tactile, and thermal effects. In addition, Eismann thoroughly studied the materials themselves, the corresponding industrial production processes as well as the social implications related to their design. The artworks were skillfully documented through photography and film by Sascha Linke.

“SMART³ | MATERIALS – SOLUTIONS – GROWTH”

UNDERSTANDING SMART MATERIALS THROUGH ART

Fraunhofer Institute for Machine Tools and Forming Technology IWU



2

Artist | Beate Eismann

Photography and graphic design |
Sascha Linke

Art form | Objects made from intelligent materials that change their shape through the application of heat and autonomously return to their original form

Exhibition period | October - November 2018

Location | Fraunhofer Headquarters,
Munich

Concept, curation, and organization |
Dorothee Höfter, Fraunhofer

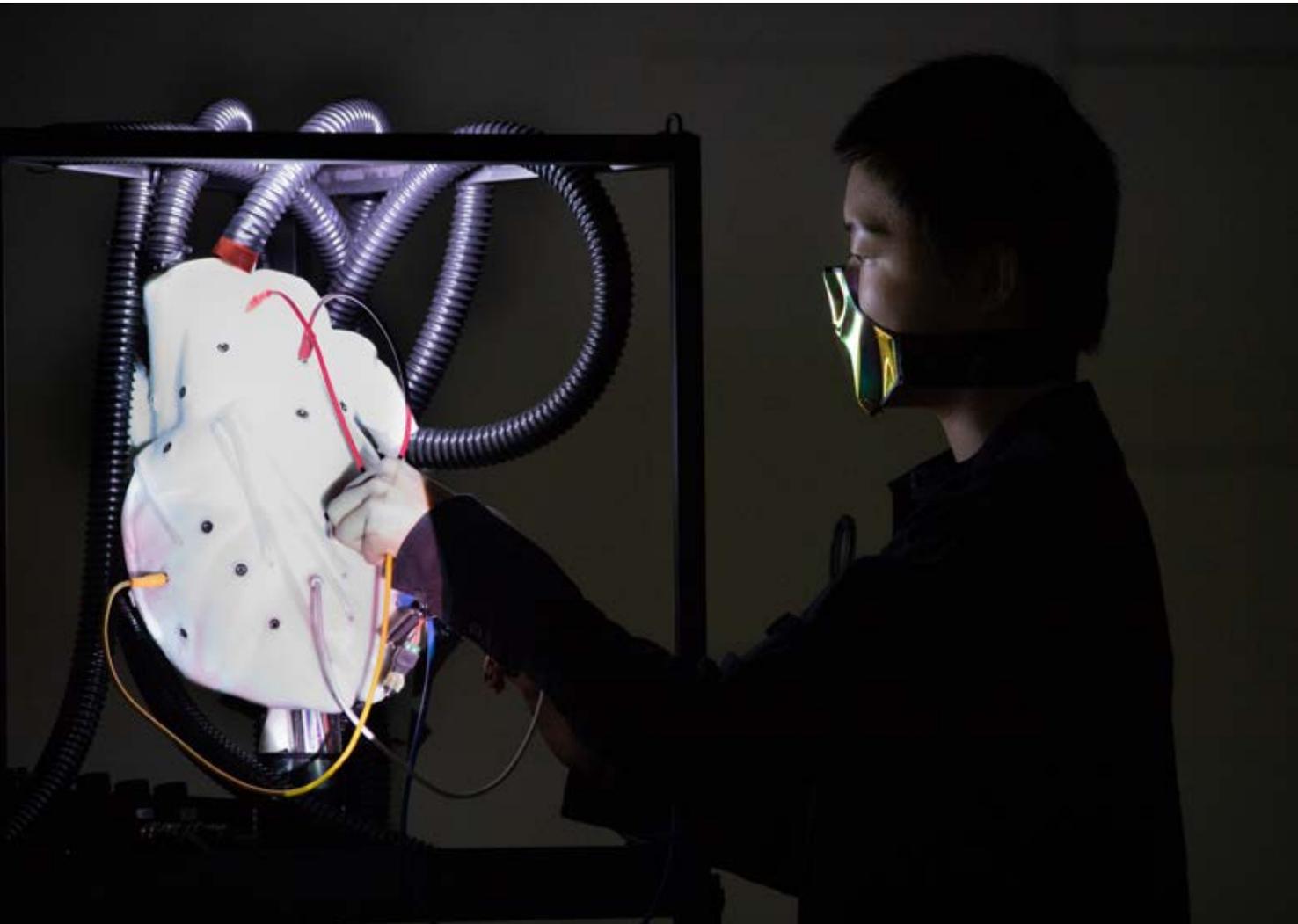
Scientific background | “smart³ | materials – solutions – growth” was created in cooperation with smart³, an initiative comprised of companies and scientific institutions that strive to develop innovative products based on smart materials for various applications. As with any other innovation endeavor, working in the field of future production processes calls for a mindset of radical openness and an interdisciplinary approach. By partnering with an artist, the smart³ innovation network was able to explore new frontiers and expand its horizons. Using design methods, it is possible to convey research findings and elucidate complex scientific concepts to the wider public.

Contact details |

Holger Kunze
*Head of “Symbiotic
Mechatronics” Business Unit*

Fraunhofer Institute for Machine Tools
and Forming Technology IWU

Nöthnitzer Strasse 44
01187 Dresden
Germany
+49 351 4772-2520
holger.kunze@iwu.fraunhofer.de



1

1 *The interactive 3D heart model of the artist Yen Tzu Chang.*

2 *Yen Tzu Chang and MEVIS experts at the MRI lab.*

THE ART OF COMPLEXITY PERFORMANCE “WHOSE SCALPEL” THE FUTURE OF THE HUMAN-MACHINE RELATIONSHIP IN SURGERY

[Fraunhofer Institute for Digital Medicine MEVIS](#)

Motivation | New scientific discoveries are rapidly emerging and significantly affecting our daily lives. They require thorough explanation to society and feedback from the public. Art can serve as a suitable tool for elucidating and discussing innovations and societal changes in dialogue with various target groups.

Do new developments such as artificial intelligence offer opportunities and drive motivation, or will humans lose out in this march of progress? The performance “WHOSE SCALPEL” tackled these developments, aiming to contribute to the understanding of the complexities in art and medicine as well as the possible consequences for our society. In particular, the performance raised the question of which skills humans will lose when the computer takes command.

Methodology and implementation |

The performance addressed the future human-machine relationship in the context of surgery. The accompanying installation was based on a 3D-printed replication of the artist’s heart, equipped with light sources and electronic sound generators. Yen Tzu Chang acted as a “surgeon” and placed a bypass with the aid of cables – and with the guidance of artificial intelligence.

A setting of almost complete darkness in combination with sounds that seemed industrial created a futuristic, partly even oppressive atmosphere, always keeping the audience in suspense.

THE ART OF COMPLEXITY PERFORMANCE “WHOSE SCALPEL” THE FUTURE OF THE HUMAN-MACHINE RELATIONSHIP IN SURGERY

Fraunhofer Institute for Digital Medicine MEVIS



2

Artist | Yen Tzu Chang

Art form | Performance with installation

Performance | June 2018

Location | Fraunhofer-Forum, Berlin

Concept, curation, and organization |
Dorothee Höfter, Fraunhofer

Scientific background | “WHOSE SCALPEL” was developed as part of “STEAM Imaging”, a residency program by Fraunhofer MEVIS that connects science, technology, and mathematics with the world of art. The project combined computer-aided medicine with STEM topics, sound art, and ethical discussions. During her residency in Bremen, Yen Tzu Chang learned how to work with MeVisLab, an advanced software platform for processing medical image data. The topics of magnetic resonance imaging and using the software for medical imaging were the main focus of the STEAM workshops with high school students. These workshops are an integral part of the residency, with the aim of breaking down barriers between disciplines and exploring flexible ways of learning and collaborating.

Contact details |

Bianka Hofmann
Head of Science Communication

Fraunhofer Institute for Digital
Medicine MEVIS

Max-von-Laue-Strasse 2
28359 Bremen
Germany
+49 421 218 59231
bianka.hofmann@mevis.fraunhofer.de

Yen Tzu Chang
New Media Art / Sound Art

yens.chang@gmail.com



1

1 *"Schwarm" ("Swarm") installation.*

2 *AI-based photographs on the subject of water.*

"HYDROSPHERES"

WATER AS A PRIMORDIAL ELEMENT AND PRECIOUS RESOURCE

Fraunhofer Research Institution for Individualized and Cell-Based Medical Engineering IMTE
Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB

Motivation | The exhibition addressed the element of water both scientifically and from an artistic and philosophical perspective: water as the origin of all living things, a primordial element and precious resource. With pieces such as "Schwarm" ("Swarm"), the artist Stefan Wischnewski not only demonstrated his profound interest in the symbiosis between humans and the sea, but also his deep concerns regarding the transformation of the oceans.

Engaging in a dialogue with teams from various Fraunhofer projects in the field of maritime research, the participants discussed the possibilities for using water and the oceans efficiently – while at the same time protecting them.

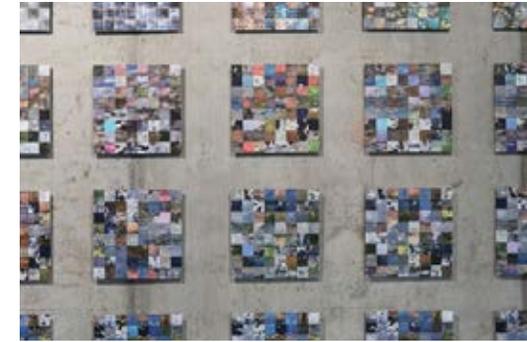
Methodology and implementation |

The "Hydrosphären" ("Hydrospheres") exhibition featured large-scale pieces by Stefan Wischnewski and AI-based photographs on the subject of water. Wischnewski's installation seemed to float above the visitors like a living swarm: a black umbrella frame, wrapped in nets, appearing as an anchor undergoing a metamorphosis, about to dissolve. The complex, thought-provoking artwork aims to evoke associations. In addition, photographs by Gabriele Neugebauer show water in its original shape. Her perspective on the element was given a technological twist by the AI agency Birds on Mars: An artificial intelligence used a generative adversarial network to learn the shapes, colors and spaces of the pictures and generated new images of water worlds.

“HYDROSPHERES”

WATER AS A PRIMORDIAL ELEMENT AND PRECIOUS RESOURCE

Fraunhofer Research Institution for Individualized and Cell-Based Medical Engineering IMTE
Fraunhofer Institute for Interfacial Engineering and Biotechnology IGB



2

Artist | Stefan Wischnewski

AI technology | Birds on Mars

Art form | Installation

Exhibition period | April - May 2019

Location | STATE, Berlin

Concept and organization | Dorothée Höfter, Fraunhofer

Concept and curation | STATE

Scientific background | Water is the origin of all living things – it is a source of fascination, but it also raises concerns when it comes to protecting this most precious of all resources. Water is not only the most important food, but also a suitable solvent for nutrients, for instance in agriculture. The global water cycle, however, is also responsible for the distribution of pollutants such as microplastics and pathogens. To tackle these challenges, Fraunhofer IGB develops new concepts for energy, waste, and water management.

Fraunhofer IMTE is one of the very few institutions to investigate the biotechnological and economic potential of algae biomass from nutrient-rich aquaculture wastewater. This biomass can serve as a raw material for cosmetics or medical substances.

Contact details |

Dr. Christian Rauch
Founder & Managing Director

STATE

Schönstedtstrasse 7
12043 Berlin
Germany
cr@state-studio.com



1

1 Artistic interpretation of the behavior of elementary particles.

2 Quantum computer at the "MATERIALIZE" exhibition.

"UNBORN – THE SECRET LIFE OF QUANTA" PARALLELS BETWEEN ZEN PHILOSOPHY AND QUANTUM PHYSICS

Fraunhofer Institute for Applied Optics and Precision Engineering IOF

Motivation | In his works, Andreas Jungk searches for the parallels between quantum physics and Zen philosophy. Quantum fields are unborn energy and matter. They are not even remotely bound to the laws of classical physics that are familiar and comprehensible to us. In Zen philosophy, the term "Mu" is used (Japanese for "emptiness"). The attempts by Zen masters trying to put "Mu" into words are surprisingly similar to the attempts by scientists to try to find a description for the quantum states of elementary particles. The Japanese Zen master Bankei described this state as "unborn" – a quality that is also suitable for characterizing quantum states, and thus the motivation for Jungk to choose this word as the title for his project.

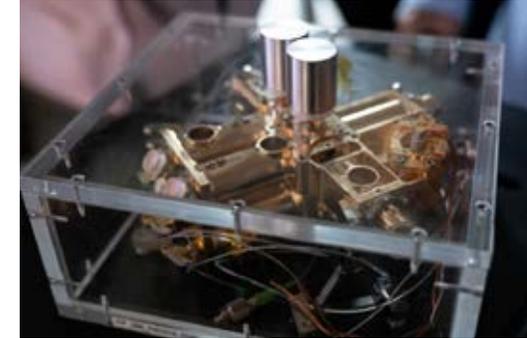
Methodology and implementation | The "Unborn" project follows the same principles as all of Jungk's works: They are unintentional and direct. In the first step, he decides on the material, shape, and colors. However, it is only in the very moment when the tool meets the material that the actual work starts to take form – just like a photon that meets a screen and becomes "real" or is "born".

The work consists of seven sheets of original Japanese unryu paper. It is an artistic interpretation of the quantum physical behavior of elementary particles such as photons and electrons. The paintings were presented as part of the "MATERIALIZE" exhibition at the STATE Studio gallery space in Berlin.

“UNBORN – THE SECRET LIFE OF QUANTA”

PARALLELS BETWEEN ZEN PHILOSOPHY AND QUANTUM PHYSICS

Fraunhofer Institute for Applied Optics and Precision Engineering IOF



2

Artist | Andreas Jungk

Art form | Painting

Exhibition period | September -
October 2019

Location | STATE, Berlin

Concept and organization | Dorothee
Höfter, Fraunhofer

Concept and curation | STATE

Scientific background | “UNBORN”

was developed in close collaboration with scientists from Fraunhofer IOF in Jena. The institute investigates quantum phenomena and explores their practical applications. These phenomena, such as entanglement, transcend measurable space, lacking a distinct beginning or an end. This characteristic is reflected in the artwork, where none of the painted lines emerge or terminate on the visible surface. The quantum world knows no colors, allowing Jungk’s works to embrace a limitless color spectrum. The octagonal arrangement calls to mind observations of elementary particles in a cloud chamber. In addition, the work also incorporates string theory, as a closer examination reveals string-like patterns in the structure of the unryu paper.

Contact details |

Dr. Falk Eilenberger
*Head of “Micro- and Nanostructured
Optics” department*

Fraunhofer Institute for Applied Optics
and Precision Engineering IOF

Albert-Einstein-Strasse 7
07745 Jena
Germany
+49 3641 807-207
falk.eilenberger@iof.fraunhofer.de

Art Meets Science Residencies Artistic Stagings Art in Architecture

ART AND SCIENCE BY FRAUNHOFER RESIDENCIES – THE ARTIST IN THE LAB

Science, art, and design possess great creative potential and are significant drivers of innovation. When researchers inspire artists to work with scientific content that they will make accessible to new audiences in their artworks, both sides win. In its residency programs, the Fraunhofer-Gesellschaft wants to foster collaboration between creative minds from the realm of art with experts from science.

The Fraunhofer “Science, Art and Design” Network created the “Artist in Lab” competition as an organization-wide funding opportunity for art residencies. In addition to receiving financial support, the successful applicants benefit from access to the expertise and infrastructure of the participating institutes.

With their project ideas, applicants must win over researchers as tandem partners at the institutes. The laboratory transforms into a studio, where artists draw inspiration from the research topics and, in return, enrich the world of science with their unique perspectives and methods. The winners are selected by an interdisciplinary jury of experts. At the end of each project, the results are presented to the public at the opening of an exhibition, an event that also includes expert talks.

The goal of these collaborations is to bring both knowledge cultures closer together. With this in mind, the main focus is on topics engaging with the concept of “duality”, suggesting, for instance, to reflect on the interplay of science and economy in the field of applied research.

In their approaches, the artists are expected to respond concretely to scientific and technical methods. Besides the artistic and methodological quality of the projects, the most critical selection criteria for the residencies therefore include their potential to transcend existing societal boundaries.

Beyond the “Artist in Lab” program, some highly committed institutes are constantly creating new formats to facilitate the collaboration of artists and Fraunhofer researchers. Initiatives such as the “STEAM Imaging” residency program impressively complement Fraunhofer’s “SciArt” activities and encourage a strong and lively interchange between both disciplines.



1

1 *New physical
"dimensions" of light.*

2 *Lightfields at the
STATE exhibition.*

"DETERMINISTIC AESTHETIC LIGHTFIELDS" NEW DIMENSIONS OF LIGHT

Fraunhofer Institute for Applied Optics and Precision Engineering IOF

Motivation | To experience light manifesting itself in minimalistic sculptures, floating freely through space: To investigate this new "solid condition" of light was the main focus of the collaboration between the artists Charlotte Dachroth and Ole Jeschonnek and Fraunhofer IOF in their projects "Deterministic Aesthetic Lightfields" and "Immersive Lightfields". Using micro-optic light field displays, the residency wanted to explore the physical and optical potential of working with light, fathoming its aesthetic qualities. Interacting with the latest technologies, artistic expression and human perception, the artists created installations that turn the medium of light itself into the subject.

Methodology and implementation | Creating designs for various 3D lightfield displays was the core part of the project. In the Fraunhofer IOF optics lab, the artists experimented with light in its new "solid condition," developing volumes without a surface. The impression of a three-dimensional, free-floating light volume is created – the light does not spread, but rather seems to linger in one place with an almost haptic consistency. The two artists integrated these fascinating displays into a specially made mounting used to show the final objects as part of the "Lichtfelder" ("Fields of Light") exhibition in the STATE Studio gallery space. It is possible to use the underlying principle in other technological applications, such as 3D signaling and touchless user interfaces.

“DETERMINISTIC AESTHETIC LIGHTFIELDS”

NEW DIMENSIONS OF LIGHT

Fraunhofer Institute for Applied Optics and Precision Engineering IOF



2

Artists | Charlotte Dachroth,
Ole Jeschonnek

Art form | Visual art

Exhibition period | September - December
2019

Location | STATE, Berlin

Concept and organization | Silke Köhler
and Dorothee Höfter, Fraunhofer

Concept and curation | Dr. Christian
Rauch, Johanna T. Wallenborn and
Christina Hooge, STATE

Scientific background | In 1908, Gabriel Lippmann developed the fundamentals of “integral photography” for capturing and reproducing three-dimensional images with microlens arrays. However, successful implementation eluded him at that time due to insufficient optical quality. With the advancements in modern micro-optics technologies, today we can create 3D lightfield displays using arrays of hundreds of thousands of lenslets and microimages. The microlens array is not captured photographically, but rather calculated in a design process and then produced as a microlithographically patterned chrome mask. The joint layout of the chirped microlens arrays (optimized across the array with varying lenslet parameters) and microimages enables optimal correction of imaging errors and effective straylight suppression.

Contact details |
Dr. Peter Schreiber

Fraunhofer Institute for Applied Optics
and Precision Engineering IOF
“Optical and Mechanical System Design”

Albert-Einstein-Strasse 7
07745 Jena
Germany
+49 3641 807-430
peter.schreiber@iof.fraunhofer.de



1

1 *Rethinking the consequences of climate change in terms of urban development.*

2 *Models of the architectural visions of the artist.*

“PRIMORDIAL CITIES INITIATIVE” ULTRA-RESILIENT ARCHITECTURE AND INFRASTRUCTURE

Fraunhofer Institute for Building Physics IBP

Motivation | Humans can learn a lot by looking at Earth’s earliest biological communities. About three and a half billion years ago, these bacteria colonies began to create fine-layered sedimentary lime formations, called stromatolites. Their fossil remains show that these formations were the world’s first ecosystems. Various types of bacteria coexisted and cooperated with one another. Due to the complexity and adaptability of stromatolite structures, they were able to defy hostile environmental conditions. With the “Primordial Cities Initiative”, the artist Jonathon Keats proposes that our cities can adapt in the same way if they grow in height in the face of rising sea levels and use floods for cooling and generating energy.

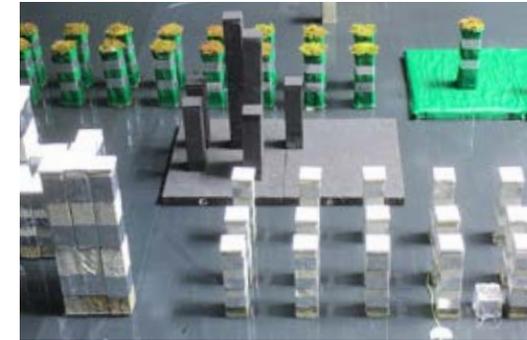
Methodology and implementation | Based on computer simulations of extreme flooding in Shanghai and Manhattan and the analysis of energy flow in tidal environments, the initiative developed technologies to make cities vertically extensible and functionally habitable in conditions of cyclical and permanent tidal flooding phenomena. The project’s architectural visions provide a framework to collectively reflect on possible future scenarios, fostering a culture of imaginative planning.

Keats’ philosophical approaches are complemented by Fraunhofer IBP’s developments in building physics and real constructions, such as those for highly adaptable buildings.

“PRIMORDIAL CITIES INITIATIVE”

ULTRA-RESILIENT ARCHITECTURE AND INFRASTRUCTURE

Fraunhofer Institute for Building Physics IBP



Artist | Jonathon Keats

Art form | Concept art

Exhibition period | December 2019 - February 2020

Location | STATE, Berlin

Concept and organization | Silke Köhler and Dorothee Höfter, Fraunhofer

Concept and curation | Dr. Christian Rauch, STATE

Scientific background | Due to climate change, the world’s population will be increasingly exposed to extreme weather conditions. Global warming will not only melt polar ice and cause sea levels to rise, but will also exacerbate the urban heat island effect. The initiative explored how cities can remain fully functional in the face of these challenges, drawing inspiration from the ancient stromatolites. Jonathon Keats, the artist, developed highly resilient forms of architecture and infrastructure based on the concept of paleobiomimicry – the biomimetics of early life forms. He drew inspiration from the structural, organizational, and metabolic innovations of stromatolite habitats.

2

Contact details |

Prof. Dr. Gunnar Grün
Deputy Institute Director

Fraunhofer Institute for Building
Physics IBP

Fraunhoferstrasse 10
83626 Valley
Germany
+49 8024 643-228
gunnar.gruen@ibp.fraunhofer.de



1

1 *Flies socializing with each other.*

2 *Image of the interaction display (for humans).*

“PARALLEL UNIVERSES”

TRANSLATING HUMAN SPEECH INTO THE LANGUAGE OF FRUIT FLIES

Fraunhofer Institute for Integrated Circuits IIS

Motivation | Flies sing to find a partner.

This song of flies differs significantly from their flying sounds, which we find annoying. By investigating this song, humans can learn about the ability of brains to remember, to process language and to manage mutual understanding. The “Parallel Universes” project wanted to explore if flies also react to human song. Using the support of audio mosaicing, a technology for synthesizing sounds, could it be possible for both species to learn how to communicate with each other? The “Drosophila Karaoke Bar” provided the impetus for the project. Having already been part of several international exhibitions, this installation helped gather experience about the audience’s reactions to this unusual communication proposal.

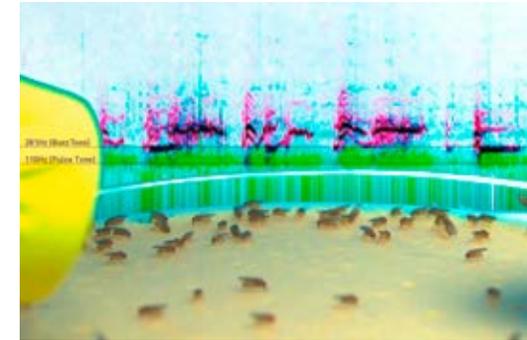
Methodology and implementation |

Using optimization methods from machine learning, audio mosaicing attempts to imitate human speech through overlapping with other sound sources. The project team applied this method in a creative and artistic way to connect the voice of flies with the human voice. An interface, consisting of a camera, a soundbox and software, was already available. The installation encourages visitors to produce their own sounds, which are then recorded and processed. A visualization interactively follows the changes in behavior and shows what is happening in the translation process. The technological basis was provided by the NMF toolbox from the International Audio Laboratories Erlangen, a joint organization of Friedrich-Alexander-Universität Erlangen-Nürnberg and Fraunhofer IIS.

“PARALLEL UNIVERSES”

TRANSLATING HUMAN SPEECH INTO THE LANGUAGE OF FRUIT FLIES

Fraunhofer Institute for Integrated Circuits IIS



2

Artist | Ursula Damm

Technical realization and programming | Felix Bonowski

Art form | Installation

Exhibition period | 2022-2023

Locations | resetNOW!, Munich;
Science Gallery Melbourne

Concept and organization |
Künstlerverband im Haus der Kunst
München; Ryan Jefferies, Science Gallery
Melbourne

Scientific background | In the pursuit of a deeper understanding of how we think, see and act, the artist has embraced the concept of biosemiotics. According to this discipline, each living organism creates its own unique inner world by communicating with the outside world, living in a self-constructed space. This environment is more than just an objective surrounding; there are as many distinct “environments” as there are individuals. Building on this perspective, a new aesthetic of exchange emerges, considering both the technical skills of the artist as well as her experience in the fields of machine learning and artificial intelligence. Through her approach, she aims to transform the human sensory experience using interfaces, thus laying the groundwork for the development of an empathetic connection with the realms of other living organisms.

Contact details |

Dr. Edwin Mabande
Group manager “Communication Acoustics”

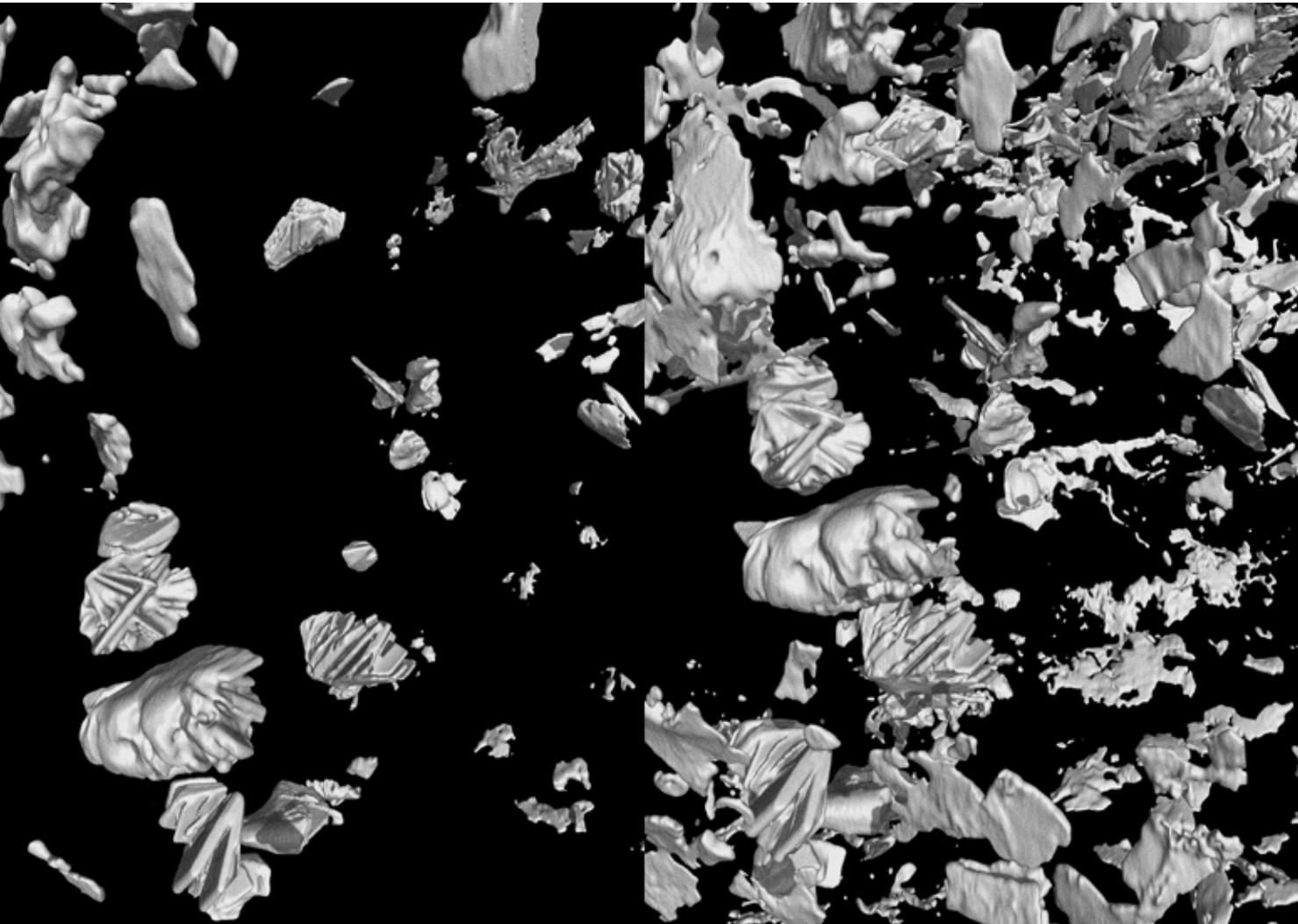
+49 160 93396609
edwin.mabande@iis.fraunhofer.de

Dr. Christian Dittmar
Group manager “Spoken Language Processing”

+49 176 24566391
christian.dittmar@iis.fraunhofer.de

Fraunhofer Institute for Integrated Circuits IIS

Am Wolfsmantel 33
91058 Erlangen
Germany



1

1 Inner nanoarchitecture of silica crystals.

2 Structural detail of horsetail spores.

“WHAT WE SEE”

NANOSTRUCTURES OF PLANT SEEDS, COAL, AND GRAPHITE

Fraunhofer Development Center X-ray Technology EZRT

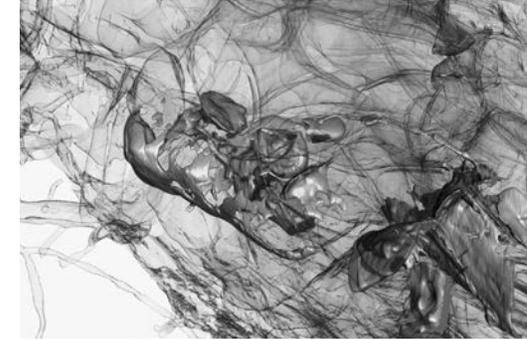
Motivation | With his detailed illustrations of the visual diversity of plants and microorganisms, derived from microscopic observations, Ernst Haeckel not only influenced the realm of science but also artists of the Art Nouveau movement at the turn of the century. Wilhelm Conrad Röntgen for the first time succeeded in unveiling the inner structures of intact bodies with the invisible beams of light that he had discovered in 1895. Over a century later, imaging technologies have evolved so remarkably that it is now possible to generate 3D data of particles as small as those in the nanometer range. Accessing these inner nanoarchitectures and making them visible presents immense potential for artistic exploration, forming the basis of Ilka Helmig's project, “Was wir sehen” (“What we see”).

Methodology and implementation | Using X-ray microscopy and computed tomography, the inner nanoarchitectures of horsetail spores, silica crystals, coal, and graphite are transformed into 3D data. The result is a visual atlas that compares the structures of seeds – the moment before the actual growth process – with coal and graphite, the plant material that has been compressed over millions of years. The work shows the beginning and the end, two state descriptions of a highly energetic substance. Through her collaboration with Fraunhofer, the artist received access to imaging technologies to investigate these structures in detail. The resulting exhibition objects will be presented as a site-specific installation.

“WHAT WE SEE”

NANOSTRUCTURES OF PLANT SEEDS, COAL, AND GRAPHITE

Fraunhofer Development Center X-ray Technology EZRT



2

Artist | Ilka Helmig

Art form | Drawing, photography,
installation

Scientific background | Thanks to significant advancements in methods and processes for three-dimensional X-ray imaging, achieved on a scale rarely seen in the laboratory, problems spanning numerous scientific disciplines can now be addressed. 3D nano-computed tomography is a method which, in comparison to other imaging analysis methods, allows the visualization of the inner structures of samples on a nanometer scale, which had not been possible before. In their joint research initiative, the artist Ilka Helmig and Fraunhofer EZRT are aiming to make the design language of these abstract nanoscale structures from everyday life tangible through artistic editing and confrontation.

Contact details |

Dominik Müller

Fraunhofer Development Center X-ray
Technology EZRT, a division of the
Fraunhofer Institute for Integrated
Circuits IIS
“NanoCT Systems”

Campus Hubland Nord
Josef-Martin-Weg 63
97074 Würzburg
Germany
+49 931 31 82494
dominik.mueller@iis.fraunhofer.de



1

1 *Vagina and ovaries, derived from diffusion-weighted images.*

2 *Close-up of the heart, derived from diffusion-weighted images.*

“INTRABEING”

EXPLORING THE BOUNDARIES OF IMAGING IN DIGITAL MEDICINE

Fraunhofer Institute for Digital Medicine MEVIS

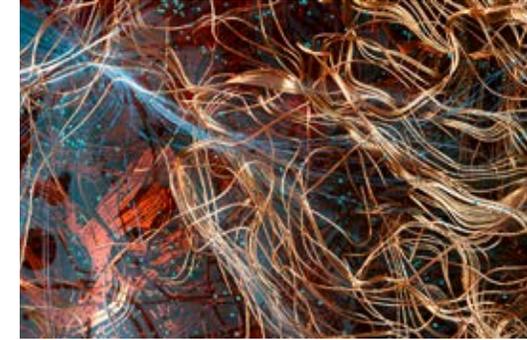
Motivation | Using imaging methods to explore spaces that we are unable to perceive with our senses – this idea of crossing existing boundaries inspired Eli Joteva to collaborate with Fraunhofer MEVIS in the “STEAM Imaging III” residency. The starting point of the program was to bring artists together with scientists, school students and their parents to create broad access to a self-motivated exploration of topics in digital medicine through events and workshops. The acronym STEAM stands for science, technology, engineering, art, and mathematics. Boundaries of individual disciplines are crossed, flexible forms of learning and collaboration are developed, and skills are taught to deal effectively and critically with new technologies in digital medicine.

Methodology and implementation | Eli Joteva performed a series of diffusion tensor imaging (DTI) scans, which are usually only used to visualize connectivity in the brain, to instead reveal nerve fibers in the chest, pelvic region and feet of her body. She was inspired by the fact that hydrogen atoms, on which MRI processing relies, are also in constant nanosecond flux and thus elude precise measurement. These components are key elements of the three-screen installation, complete with an AR extension. It shows an oscillating internal landscape of hydrogen atoms, the nerves they flow along, and the magnetic potentials generated between them.

“INTRABEING”

EXPLORING THE BOUNDARIES OF IMAGING IN DIGITAL MEDICINE

Fraunhofer Institute for Digital Medicine MEVIS



2

Artist | Eli Joteva

Art form | Immersive installation and AR extension

Exhibition period | September 8-12, 2021

Location | Ars Electronica Festival, Keplers Gärten, Linz (Austria), and online as an augmented reality experience (intrabeing.joteva.com)

Concept and organization | Veronika Liebl, Ars Electronica

Concept and curation | Karla Spiluttini, Ars Electronica

Scientific background | What lies within the boundaries of being? “IntraBeing” explores the limitations of imaging the human body to imagine a limitless and intra-active sense of being. Eli Joteva worked remotely with researchers at Fraunhofer MEVIS to develop the work, exploring the capacities of medical imaging and simulation techniques to locate the enigmatic spaces that emerge at the limits of resolution and computation.

“STEAM Imaging III” was hosted by Fraunhofer MEVIS in collaboration with Ars Electronica, the International Fraunhofer Talent School Bremen, the Schulzentrum Walle, Bremen, and the UCLA Art|Sci Center in Los Angeles (USA).

Contact details |

Bianka Hofmann
Head of Science Communication

Fraunhofer Institute for Digital
Medicine MEVIS

Max-von-Laue-Strasse 2
28359 Bremen
Germany
+49 421 218 59231
bianka.hofmann@mevis.fraunhofer.de

Art Meets Science Residencies Artistic Stagings Art in Architecture

ART AND SCIENCE BY FRAUNHOFER ARTISTIC STAGINGS

One of the most important dates in the Fraunhofer calendar is undoubtedly the Annual Assembly. This format unites the general assembly and the meetings of the Senate as well as the Scientific and Technical Council (STC) of the Fraunhofer-Gesellschaft with the honoring of excellent research results. Several hundred guests from the political, business and economic spheres and society are invited to this event every year.

The highlight of the event is the festive award ceremony in which excellent contributions by researchers from the Fraunhofer institutes are distinguished.

A jury of experts decides on the awarding of several Joseph von Fraunhofer Prizes each year. These awards honor outstanding scientific achievements with practical applications. In addition, the Fraunhofer Prize for Human- and Environment-Centered Technology and the Stifterverband Science Prize are awarded every two years in alternation.

Speeches by high-ranking politicians and representatives from the economic, business and science sectors – including the former Chancellor Angela Merkel, Minister-Presidents of the German states as well as Federal Ministers from various departments – complement the program.

The setting is provided by the research activities of the institutes themselves. The motto of each Annual Assembly reflects topics that will shape our society in the future. To bring the scope of these challenges closer to the audience, the event uses different forms of artistic stagings.

Musical interpretations of the theme, stagings with actors, and sophisticated technical installations with light and sound – there are no limits to creativity when it comes to inspiring the participants to think and engage in discussions.



1

1 *The protagonists of the staging.*

2 *Perfect interplay of light, color, and sound.*

“LIGHTING CREATES”

LAMPS AS PERFORMERS IN UNESCO’S YEAR OF THE LIGHT

Fraunhofer Annual Assembly 2015

Occasion | In choosing the theme “Lighting creates” for its 2015 Annual Assembly, Fraunhofer joined the International Year of the Light that had been proclaimed by UNESCO. Light does not only undergo a dramatic development on its way from the analog to the digital world; with the Fraunhofer lines discovered by its namesake, a direct connection to the organization’s genesis was established. The award ceremony offered the audience exciting insights into current research topics. Formal addresses by then Federal President Joachim Gauck and the Minister-President of Hessen, Volker Bouffier, rounded out the program. In addition, the “LIGHT” exhibit created interesting references to optical technologies in production engineering and demonstrated a Fraunhofer core competence with its generative manufacturing process.

Theme and artistic inspiration |

The event was marked by the topics “knowledge” and “light”. Since the age of Enlightenment, or perhaps even earlier, light has been the symbol for knowledge, as Joachim Gauck explained in his speech. The light design by onliveline in cooperation with Björn Hermann helped portray these ideas and their realization in the right light: A swarm of spotlights mounted on the walls, ceilings, pillars and on stage immersed the neoclassical Friedrich-von-Thiersch hall of the Wiesbaden Kurhaus in color. The staging of the lamps and their interaction with video sequences and the sound design by musician Matt Flores was a precise interplay of all components and symbolized the collaboration of individual scientists and institutes within the Fraunhofer-Gesellschaft.

“LIGHTING CREATES”

LAMPS AS PERFORMERS IN UNESCO’S YEAR OF THE LIGHT

Fraunhofer Annual Assembly 2015



2

Performed on | June 9, 2015

Location | Wiesbaden

Concept and organization | onliveline GmbH, Büro für Konzeption & Storytelling

Awards | Opus 2016 – Deutscher Bühnenpreis, FAMAB Award (Best Corporate Event, Gold), ADC*E Award (Sound Design, Gold), EUBEA Award (B2B, Bronze), ADC Award (Storytelling, Corporate Event, Light, Silver and two times Bronze)

Methodology and implementation |

“Light! And no actors! But no technology show, either!” The staging had to fulfil all of these ambitious requirements. Lamps became performers – like an orchestra, 45 Sharpy spotlights acted on stage. Every movement was set to music, each ray of light had its own sound, each rotation its own subtext. The lamps searched the hall, looking for innovations, “opening” walls or stirring up a thunderstorm. The most challenging part of working with light sources was the exact interplay of all crafts and trades – a “language of lights”, specifically invented for this event, had to be precisely synchronized with the movements. Videos extended and widened the rays of light, increasing their significance.

Contact details |

Astrid Kraft
Head of department
“Events and Trade Shows”

Fraunhofer-Gesellschaft

Hansastraße 27c
80686 München
Germany
+49 89 1205-1373
astrid.kraft@zv.fraunhofer.de



1

1 Scenic introduction of the award-winning innovations.

2 Symbolic development of solutions on stage.

“HUMAN IN THE CENTER”

A LOOK INTO THE FRAUNHOFER LABORATORIES

Fraunhofer Annual Assembly 2016

Occasion | The success of the Fraunhofer-Gesellschaft would not be possible without the people working at the institutes. The motto of the Annual Assembly was therefore striking in two ways: because human beings play a significant role in science, and because Fraunhofer scientists align their research with the benefit for humanity. Following this idea, the program of the evening provided insights into the work at Fraunhofer through a multimedia staging – an interactive research laboratory. The awarding of the three Joseph von Fraunhofer Prizes and the Stifterverband Science Prize were at the center of the event. High-ranking speakers included then Federal Minister Johanna Wanka and Hannelore Kraft, Minister-President of North Rhine-Westphalia at the time.

Theme and artistic inspiration | The scenery on stage was a laboratory with a large table in the center, where the performers acted with light projections. Different scenes showed how people come together in a shared world, symbolically exchanging ideas on relevant topics. Human beings arrange, collect, and process these topics. They move through different ages and therefore change their needs accordingly. From this world, a projection at the rear wall of the stage, themes stream into the laboratory. Researchers pick them up, analyze, and solve them. In the end, they put their solutions back into the world, making it a better place for humans. This staging gave the audience insights into the Fraunhofer laboratories and the constant search for innovations.

“HUMAN IN THE CENTER”

A LOOK INTO THE FRAUNHOFER LABORATORIES

Fraunhofer Annual Assembly 2016



2

Performed on | May 10, 2016

Location | Essen

Concept and organization | onliveline GmbH, Büro für Konzeption & Storytelling

Actor and choreographer | Takao Baba

Awards | Galaxy Award (Silver), EUBEA Award (Best B2B Event, Bronze)

Methodology and implementation |

To make the contents and work processes transparent for the guests, the three performers worked with boards on which video was projected. The movements on stage were directly put to music and interacted with the video, playfully enlarging the images. The projection technology in its interplay with the 3D light installations gave the impression of holography. Each award winner received a scenic introduction: the scenery introduced the awarded solutions in an artistic way and visualized them impressively. Interactive scans of people, tunneling, double mirror foil and gauze in front with lighting intervention – the innovations presented by the researchers made them tangible for the audience.

Contact details |

Astrid Kraft
Head of department
“Events and Trade Shows”

Fraunhofer-Gesellschaft

Hansastraße 27c
80686 München
Germany
+49 89 1205-1373
astrid.kraft@zv.fraunhofer.de



1

1 *History of science coming alive.*

2 *Confrontation with the winning projects in dance.*

“#REAL_DIGITAL”

FRAUNHOFER RESEARCH AND DRESDEN’S HISTORY CONNECTED

Fraunhofer Annual Assembly 2017

Occasion | In 2017, the Fraunhofer-Gesellschaft celebrated its 25th anniversary as an innovative research partner, forward-looking employer, and technological, economic and social catalyst in the new federal states of Germany. Fraunhofer honored this milestone with 800 guests at the Annual Assembly in Saxony’s capital. The highlights of the event included an exhibition, the awarding of the research prizes, and a public event held in the center of Dresden with the theme “#real_digital: experience research – how science changes the world”. The high-ranking guest speakers at the festive event included Stanislaw Tillich, Minister-President of Saxony at the time, Czech Deputy Prime Minister Pavel Bělobrádek, and former Federal Minister Johanna Wanka.

Theme and artistic inspiration | The mission of the staging was to strengthen Fraunhofer as a brand and bring the campaign closer to different audiences: the Dresden public, invited guests, but also employees and customers. In a public interactive tour of the city, the history of Dresden was connected to the “stories” from the Fraunhofer institutes. Actors playing eager, curious journalists took the visitors on a journey through time to learn about the innovations. Mobility research at the Dresden Transport Museum, ceramics research in front of the world’s largest porcelain picture, and technologies for first responders as a laser projection at the police headquarters – in many different ways, the Fraunhofer solutions came alive for the visitors.

"#REAL_DIGITAL"

FRAUNHOFER RESEARCH AND DRESDEN'S HISTORY CONNECTED

Fraunhofer Annual Assembly 2017



2

Performed on | May 29-31, 2017

Location | Dresden

Concept and organization | onliveline GmbH, Büro für Konzeption & Storytelling

Actors | Nadine Geyersbach and others

Awards | FAMAB Award 2017 (Best Integrated Brand Campaign; Bronze); BEA Award (Best Corporate Event and Best PR-/Medien-Event; Bronze); Galaxy Award (Award Ceremony, Corporate and Publicity; Bronze and Honors)

Methodology and implementation |

In six locations, significant inventions from history were staged together with the research results from the institutes – partly narrated by the actors, displayed as projections on facades or explained directly in conversations. In addition, a traveling exhibition provided insights into the work at the individual Fraunhofer research institutions. Projects, products, milestones, and future topics were made tactilely accessible to the visitors. All of the exhibited contents were displayed on a dedicated website which provided theme-based access to the Fraunhofer institutes for the first time. An impressive show on stage provided the artistic background to the award ceremony, portraying selected projects in a “real-digital” way with video projections, dancers, and actors.

Contact details |

Astrid Kraft
Head of department
“Events and Trade Shows”

Fraunhofer-Gesellschaft

Hansastraße 27c
80686 München
Germany
+49 89 1205-1373
astrid.kraft@zv.fraunhofer.de



1

1 *“Explora” projected on acrylic threads.*

2 *The artificial intelligence interacting with the performers and the audience.*

“EXPLORA”

PERSONIFIED ARTIFICIAL INTELLIGENCE

Fraunhofer Annual Assembly 2018

Occasion | The Fraunhofer-Gesellschaft held its 2018 Annual Assembly in Berlin with the theme “#Cognitivesystems: human and artificial intelligence shaping the future” and honored exceptional projects by its researchers. Three Joseph von Fraunhofer Prizes for outstanding scientific achievements in solving challenges from practice as well as the Stifterverband Science Prize were awarded.

Distinguished guest speakers included the former Minister of the Chancellor’s office, Prof. Dr. Helge Braun, then Federal Minister for Education and Research Anja Karliczek, and former State Secretary for Science and Research in the Berlin Senate, Steffen Krach.

Theme and artistic inspiration | Rarely, if ever, has research and development had such a rapid and profound impact on our lives as strongly as it does today. Thanks to digital technologies, considerable progress is being achieved in many application fields that shape our everyday lives: health, mobility, communication, security, and many more. Cognitive systems, artificial intelligence, and machine learning expand the possibilities of these technologies immensely. Applications such as autonomous mobility, individualized medicine, and self-learning security systems could soon become part of our lives. To acknowledge the Fraunhofer-wide efforts in these fields and make cognitive systems tangible for the guests at the assembly, the interactive personification of artificial intelligence, named “Explora”, was created.

“EXPLORA”

PERSONIFIED ARTIFICIAL INTELLIGENCE

Fraunhofer Annual Assembly 2018



Performed on | May 15, 2018

Location | Berlin

Concept and organization | onliveline GmbH, Büro für Konzeption & Storytelling

Awards | BrandEX Award (Silver, Best Crafts)

Methodology and implementation | As a virtual co-host, the personified artificial intelligence Explora, played by cabaret artist Sonja Kling, interactively led the guests through the program. Through a scenic dramaturgy, she was able to learn, co-create, take over and in the end engage with the human performers in a visionary way. The character was presented as a projection on sculptures of acrylic threads, as a laser amplitude, and as a 3D sound installation moving through the hall. Using different techniques and effects, such as audio and visual laser, Pandora's Box keying, and a specifically designed visual landscape, the staging showed the possibilities of artificial intelligence, but also the fears associated with it.

2

Contact details |

Astrid Kraft

Head of department

“Events and Trade Shows”

Fraunhofer-Gesellschaft

Hansastraße 27c

80686 München

Germany

+49 89 1205-1373

astrid.kraft@zv.fraunhofer.de



1

1 *The interplay of music and color gradients.*

2 *The symphony as a holistic room experience.*

“FRAUNHOFER SYMPHONY OF THE FUTURE”

STAGING WITH 3D SPACIAL AUDIO

Fraunhofer Annual Assembly 2019

Occasion | “70 years of Fraunhofer, 70 years of future – What’s next?” That was the motto of the Fraunhofer-Gesellschaft’s Annual Assembly in May 2019. The anniversary year served as the occasion to celebrate the achieved success and to look towards the future. Due to the high quality of the submissions, four Joseph von Fraunhofer Prizes were awarded in addition to the Fraunhofer Prize for Human- and Environment-Centered Technology.

Official speeches were given by Dieter Reiter, Lord Mayor of the City of Munich, as well as former Chancellor Dr. Angela Merkel. The specifically composed “Fraunhofer Symphony of the Future” served as the artistic setting and became the key element of the event.

Theme and artistic inspiration | A symphony, staged in three dimensions, was combined with a vivid cyclorama in which the stage and the award winners seemed to float – a 360° sound production that created a holistic room experience. The individual scenes were designed to build on one another, creating the impression that the elements of the symphony kept interweaving around the guests until they came together as a complete work of art. To achieve this, the musicians were placed all around the hall and projections of color gradients on the cyclorama in front of the audience adapted to the music and reacted to it. In this way, the seemingly infinite depth of the room was reflected both visually and in the music itself.

“FRAUNHOFER SYMPHONY OF THE FUTURE”

STAGING WITH 3D SPACIAL AUDIO

Fraunhofer Annual Assembly 2019



2

Artists | Maurice Mersinger, kling klang klong; Leo Siberski

Performed on | May 8, 2019

Location | Munich

Concept and organization | onliveline GmbH, Büro für Konzeption & Storytelling

Music production | QoSono

Musicians | Taiko Seiko (vibraphone), Ashia Bison Rouge (cello), Tilmann Dehnhard (bass flute, contrabass flute), Nora Becker (voice)

Methodology and implementation |

One of the most challenging tasks when creating the symphony was to integrate the live musicians (vibraphone, cello, bass flute, and voice) with the highly complex multimedia system. The composers Maurice Mersinger and Leo Siberski acted as two designers on an equal par. Even though, as artists, they come from different genres – one from the analog-digital sphere of sound sources and the other from the experimental, but “straightforward” realm of composing – they managed to view each other as points of contention that provided mutual inspiration. To generate the 3D sound effect within the room, the producers used a complex digital matrix with numerous speakers installed all around the room and in the ceiling. As a result, the performance gave the audience a spatial experience at all times.

Contact details |

Astrid Kraft
Head of department
“Events and Trade Shows”

Fraunhofer-Gesellschaft

Hansastraße 27c
80686 München
Germany
+49 89 1205-1373
astrid.kraft@zv.fraunhofer.de

Art Meets Science Residencies Artistic Stagings Art in Architecture

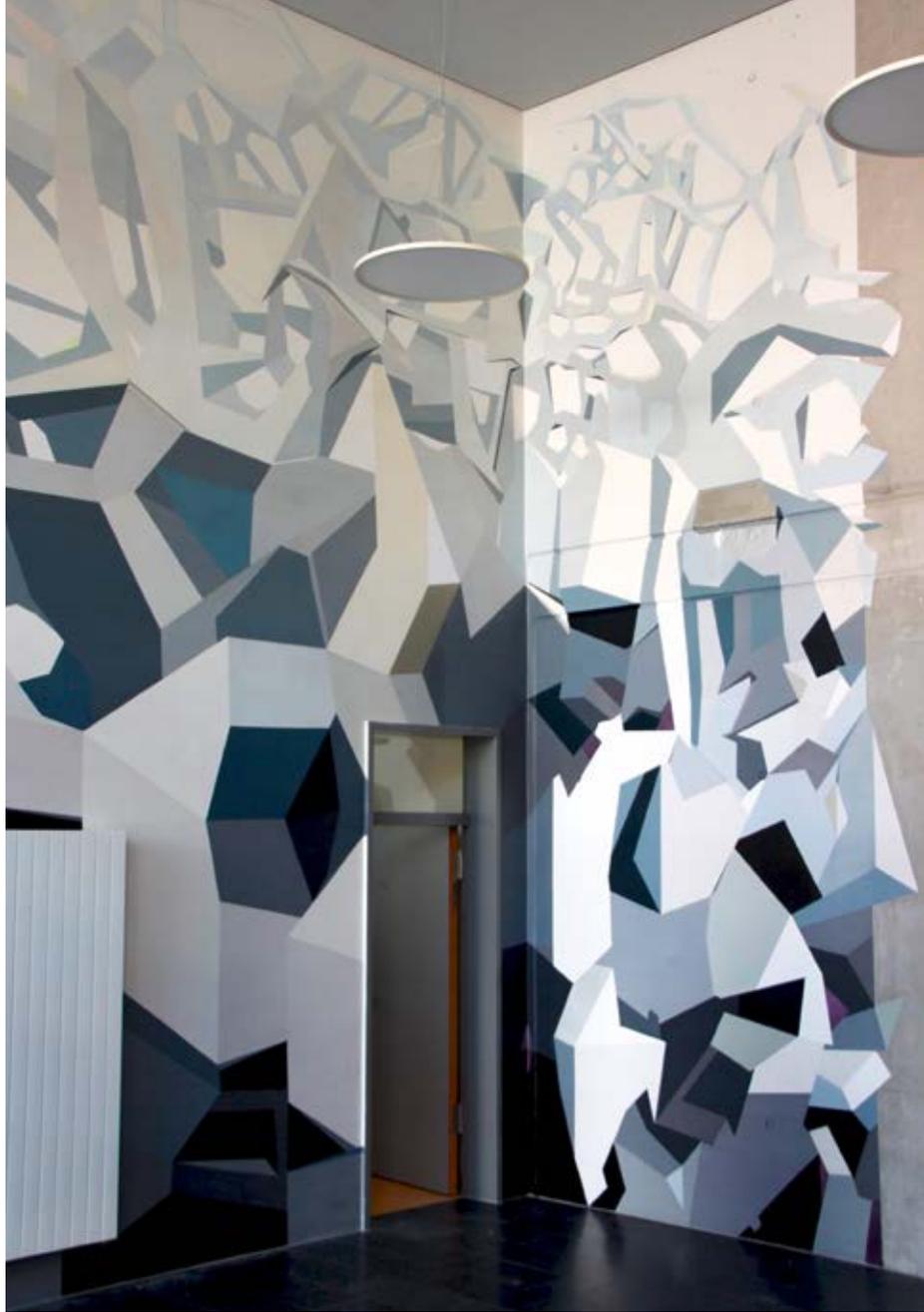
ART AND SCIENCE BY FRAUNHOFER ART IN ARCHITECTURE

Our present-day concept of art in architecture was developed about 100 years ago – triggered by modernism, a movement that declared objectivity and functionality to be the new ideals in architecture. Later on, especially in Germany and under the pressure of reconstruction, the holistic values of the Bauhaus and its predecessor, Arts and Crafts, were decoupled, if not eliminated, from the building process.

For many centuries, Vitruvius' ideal in architectural theory had been valid: the principles of "firmitas, utilitas, venustas" (Latin for strength, utility, and beauty) should be equally represented in buildings. The peaks of integral architecture were marked by religious buildings in the French Gothic style and the palaces created by the Renaissance and Baroque artist-cum-architects at the Florence and Rome courts.

In accordance with the international style and the rationality that arose from a concern about efficiency, the need for intentionally using art in buildings grew – as inspiration, but also as a means of identity development in the design of interior and exterior spaces. The social aspect of the artist being able to earn a living has thereby always been a core idea of the concept. Not only the public sector, but also private developers have recognized the added value of art in architecture and designate part of the budget for it. Architects are aware today that architecture and art are not in competition with one another – rather, both aesthetic forms can reinforce each other. Even if the artwork is now mostly an addition to buildings, it is a great success when it establishes a dialogue with the interior or exterior, with its users and visitors. At best, a unique space is created – genius loci.

Art in architecture is a task of direct public relevance. It expresses a public building culture and is an integral part of public construction projects. The German federal government supports this relevance and emphasizes its architectural-cultural aspirations by providing funding and a firm commitment to art in architecture ("Kunst am Bau"). With this in mind, Fraunhofer seeks out advice from external experts to launch a call for every major construction project. Around 40 works of art of various kinds and materials have been realized over the past years. Each work is highly distinctive and has been carefully designed to fit with its location. The artworks shape the quality and expressive power of the buildings, projecting their self-image and the spirit of their users into the public sphere.



1

1 *Painting in the entrance hall.*

2 *Detailed view.*

“TOPOLOGIEOPTIMIERTE STRUKTUR” (“TOPOLOGY-OPTIMIZED STRUCTURE”) WALL PAINTING TRAINING THE VIEWER’S PERCEPTION

Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM

Concept | The origin of the painting’s subject was a small model in the entrance hall of the institute. It symbolizes the concept of topology optimization, a computer-aided method which calculates an optimized layout for components under mechanical strain. The model shows the result of this process: a holey, rugged, branched-out object. This structure, which seems to be chaotic despite the exact mathematical calculation, epitomizes the concept of research in its complexity and subjectivity. By realizing these ideas as a wall painting, the artist had the chance to stimulate the viewer’s perception by using shades of color as well as illusionistic layers and playing with the “point of view”. To observe and to realize – these are the foundations of research and, in this work of art, the connecting element of the interplay between art and science.

Methodology and implementation | The painted structure gets its three-dimensional feel from the light-dark modeling and the modules reminiscent of forms in perspective. The slight distortion and the inherent narrowing of the structure towards the ceiling visually expands the room, creating a contrast with the static architecture of the building. The choice of colors evolved as a result of an artistic process on site. The color spectrum consists of various shades of gray, symbolizing rejuvenation and the border between the known to the unknown. The endings, tapering towards the ceiling, have been painted with fluorescent color in places so that they glow at nighttime. Using effect paint, the artist created different color impressions which seem to be either metallic gray, green or violet, depending on the position of the viewer.

“TOPOLOGIEOPTIMIERTE STRUKTUR” (“TOPOLOGY-OPTIMIZED STRUCTURE”)

WALL PAINTING TRAINING THE VIEWER’S PERCEPTION

Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM



2

Artist | Tim Trantenroth

Art form | Wall painting

Completed | 2015

Architects | ATP N+M Architekten und Ingenieure GmbH

Funded by | BMBF, Free Hanseatic City of Bremen

Profile of the institute | Fraunhofer IFAM

is one of Europe’s most important independent research institutes in the fields of adhesive bonding technology, surfaces, shaping and functional materials. Products and technologies primarily address industries of particular importance for future viability: mobility, aviation, energy, maritime technologies as well as medical technology and life sciences. Currently, around 700 employees from 20 departments and numerous working groups pool their broad technological and scientific expertise in seven core competencies: metallic materials, polymeric materials, surface technology, adhesive bonding, shaping and component manufacturing, energy storage and converters, and automation and robotics. The institute has many years of experience in professional training.

Contact details |

Michael Heims
Construction Representative

Fraunhofer Institute for Manufacturing
Technology and Advanced Materials
IFAM

Wiener Strasse 17
28359 Bremen
Germany
+49 421 2246-132
michael.heims@ifam.fraunhofer.de



1

1 Light scenes on the Fraunhofer ILT facade.

2 Light scenes on the facades of both buildings – night view.

“NETZWERKE DES WISSENS” (“NETWORKS OF KNOWLEDGE”)

ANIMATED FACADE IMAGES PROVIDING
INSIGHTS INTO THE INSTITUTES

Fraunhofer Institute for Laser Technology ILT

Fraunhofer Institute for Production Technology IPT

Concept | This work focuses on the topics of “light” and “network”. Due to their diverse layers of meaning and high level of abstraction, neither topic is ever in danger of becoming outdated. They are equally important for both institutes. As their mission statements show, the notion of the network as the underlying structure of work is very important. The images on the facade are therefore an abstraction of this inner structure – just like a neural network. Light is not only the original subject of the organization’s namesake Joseph von Fraunhofer, but also at the center of the research conducted at Fraunhofer ILT and Fraunhofer IPT. The shape of the network lines on the Fraunhofer ILT building reflect the straight course of a laser beam. On the Fraunhofer IPT facade, the lines circle, denoting grinding and material removal processes.

Methodology and implementation |

The artist integrated two large network graphics into the glass facades, transforming them into landmarks visible from afar. Animated by light, these graphics become a dynamic image, constantly changing, resembling a pulsating organism. The impulses for these light scenes are generated by the institutes themselves, as the light system is indirectly linked to the intranet. In this way, the facade visualizes the internal activities in an abstract manner. The glass has been modified to make the graphics visible even in bright daylight, offering numerous interesting views – ever-changing, depending on the weather and the ambient light conditions. Additional mirrored lines in the white glass of Fraunhofer ILT create nearby projections of the network when illuminated by sunlight.

“NETZWERKE DES WISSENS” (“NETWORKS OF KNOWLEDGE”)

ANIMATED FACADE IMAGES PROVIDING
INSIGHTS INTO THE INSTITUTES

Fraunhofer Institute for Laser Technology ILT

Fraunhofer Institute for Production Technology IPT



2

Artist | Annette Sauermann

Art form | Light installation

Completed | 2014

Architects | JSWD ARCHITEKTEN GmbH
& Co. KG

Awards | Deutscher Lichtdesign-Preis 2018

Funded by | BMBF, North Rhine-
Westphalia

Profiles of the institutes | Fraunhofer ILT stands for pooled expertise in the field of laser technology. The institute's numerous customers come from industries such as automotive and mechanical engineering, chemistry, electrical engineering and aircraft construction. With over 550 employees and more than 40 spin-offs, it is one of the most important contract R&D institutes in its field worldwide.

At Fraunhofer IPT, around 500 employees develop system solutions for the networked, adaptive production of sustainable and resource-efficient products and the services associated with them. The focus is on process technology, production machines, production quality, metrology and technology management, and ranges from the fundamentals to the digital transformation of production.

Contact details |

Achim Bauer
Construction Representative

Fraunhofer Institute for Laser
Technology ILT
Steinbachstrasse 15
52074 Aachen, Germany
+49 241 8906-8043
achim.bauer@ilt.fraunhofer.de

Dirk Nehr
Construction Representative

Fraunhofer Institute for Production
Technology IPT
Steinbachstrasse 17
52074 Aachen, Germany
+49 241 8904-239
dirk.nehr@ipt.fraunhofer.de



1

1 Sculpture from corrugated iron and corrugated floor slab at the Hanau site.

2 The artwork and planted areas merge together at the Alzenau location.

“COULEURS TORDUES” (“TWISTED COLORS”)

SCULPTURE SIBLINGS CONNECTING TWO SITES OF AN INSTITUTE

Fraunhofer Research Institution for Materials Recycling and Resource Strategies IWKS

Concept | The artwork was not only supposed to reflect the research topics, but also establish a clear connection between the institute’s two sites in Alzenau and Hanau, which are about 8 kilometers apart from each other. In line with this idea, the artist created “Couleurs tordues”, the “Twisted Colors”, as a pair of outdoor sculptures for both new buildings. The core idea of the sculptures is to open a closed system. Different layers fan out, set off from each other, intertwined – inviting the viewer to observe it anew. The mundane material of corrugated iron is “bewitched” by the contortion, turning into something precious and coming alive. The sculpture visually introduces the institute’s activities: to analyze, to unwrap, to split, and to merge. The theme of the ecological footprint is reflected in the haptics of the sculptures.

Methodology and implementation |

The metal sculpture, with a height of about four meters, stands on a corrugated concrete floor slab, from which it seems to rise. In the square in front of the building, a strong dynamic unfolds. It can be seen both by passers-by as well as by visitors approaching the institute’s entrance.

At the Hanau site, the floor slab extends as far as the paved road, going beyond the boundaries of the areas that are usually reserved for art. In a way, it comes out to greet the visitors. At the Alzenau location, the floor slab plays with the surrounding planted areas and merges with the square. Both the charcoal facade in Hanau and the light shade in Alzenau soak up the strong colors of “Couleurs tordues” like a canvas.

“COULEURS TORDUES” (“TWISTED COLORS”)

SCULPTURE SIBLINGS CONNECTING TWO SITES OF AN INSTITUTE

Fraunhofer Research Institution for Materials Recycling and Resource Strategies IWKS



2

Artist | Manuel Franke

Art form | Two outdoor metal sculptures

Completed | 2020

Hanau site architects | hammeskrause
freie architekten bda

Alzenau site architects | BHBVT
Gesellschaft von Architekten mbH

Hanau site sculpture funded by |
BMBF, State of Hessen, European Regional
Development Fund (ERDF)

Alzenau site sculpture funded by |
BMBF, Free State of Bavaria

Profile of the institute | Fraunhofer IWKS
researches and works at two locations
with an interdisciplinary team of around
100 employees. Materials cycles and
efficient and sustainable resource strategies
are at the center of its research work. It
focuses on establishing a closed circular
economy and avoiding waste by recovering
and recycling valuable raw materials
or replacing them with sustainable
alternatives. The research institution
develops innovative processes in the fields
of magnetic materials, energy materials,
separation and sorting technologies,
bioeconomics as well as digitalization of
resources, aiming for the efficient handling
of raw and other materials. The institute
cooperates closely with the Technical
University of Darmstadt.

Contact details |

Prof. Dr. Anke Weidenkaff
Director

Fraunhofer Research Institution for
Materials Recycling and Resource
Strategies IWKS Hanau

Aschaffener Strasse 121
63457 Hanau
Germany

Fraunhofer Research Institution for
Materials Recycling and Resource
Strategies IWKS Alzenau

Brentanostrasse 2a
63755 Alzenau
Germany
+49 6023 32039-817
anke.weidenkaff@iwks.fraunhofer.de



1

1 *“Filament” installation in the atrium, first floor.*

2 *“Gelege” installation at the back wall of the entrance hall, ground floor.*

“STABWERK” (“LATTICEWORK”)

ARTISTIC INTERPRETATION OF PROCESSES AND MATERIALS IN LIGHTWEIGHT CONSTRUCTION

Fraunhofer Institute for Applied Polymer Research IAP,
Polymer Materials and Composites PYCO research division

Concept | The “Stabwerk” (“latticework”) design consists of two floor-to-ceiling installations that are thematically and formally related to each other. They are made from clusters of transparent and colorfully painted fiberglass and carbon fiber tubes and represent autonomous sculptural arrangements.

The subject of both installations is the textile production aesthetics of composites and their major significance in lightweight construction. An artistic interpretation of textile processes and materials evolves, starting from the individual fiber – the filament – through to its metamorphosis into a thread, a cluster, and a textile surface. The work playfully refers to the materials, technologies, and applications that are at the center of Fraunhofer IAP PYCO’s research and development work.

Methodology and implementation | In front of the elevator wall that spans both upper levels, a floor-to-ceiling, slender and transparent hyperboloid-shaped installation, constructed from long rods, winds its way up: the “Filament”. The shape refers to a hyperbolic paraboloid – a construction principle that plays a prominent role in lightweight developments.

The “Gelege” (“woven fabric”) installation is made of three layers of clusters of GRP rods, painted in various colors. The coloration of the strings causes the effect of the layers being visually folded into a pattern. The beginnings and endings of the strings are invisible. They seem to originate in the ceiling and disappear in the floor of the entrance hall, indicating the potential infinity of textile fibers and structures.

“STABWERK” (“LATTICEWORK”)

ARTISTIC INTERPRETATION OF PROCESSES AND MATERIALS IN LIGHTWEIGHT CONSTRUCTION

Fraunhofer Institute for Applied Polymer Research IAP,
Polymer Materials and Composites PYCO research division

Artist | Barbara Wille
in cooperation with Adriaan Klein

Art form | Installation, in two parts

Completed | 2021

Architects | Burckhardt + Partner GmbH

Funded by | BMBF, State of Brandenburg,
European Regional Development Fund
(ERDF)

Profile of the institute | The Polymer Materials and Composites PYCO research division of Fraunhofer IAP focuses on all matters and questions related to polymer-based lightweight construction with fiber-plastic composites. Their holistic approach includes not only novel construction methods, material design, structures, and associated manufacturing technologies but also the development of sustainable recovery and recycling strategies for end-of-life scenarios. Spanning the development of special polymers and fiber composite semi-finished products, the design of prototypes, and the planning and implementation of manufacturing processes suitable for large-scale production, all of the key lightweight construction competencies in the value chain can thus be mapped under one roof, from monomers to energy-efficient high-performance composite components.

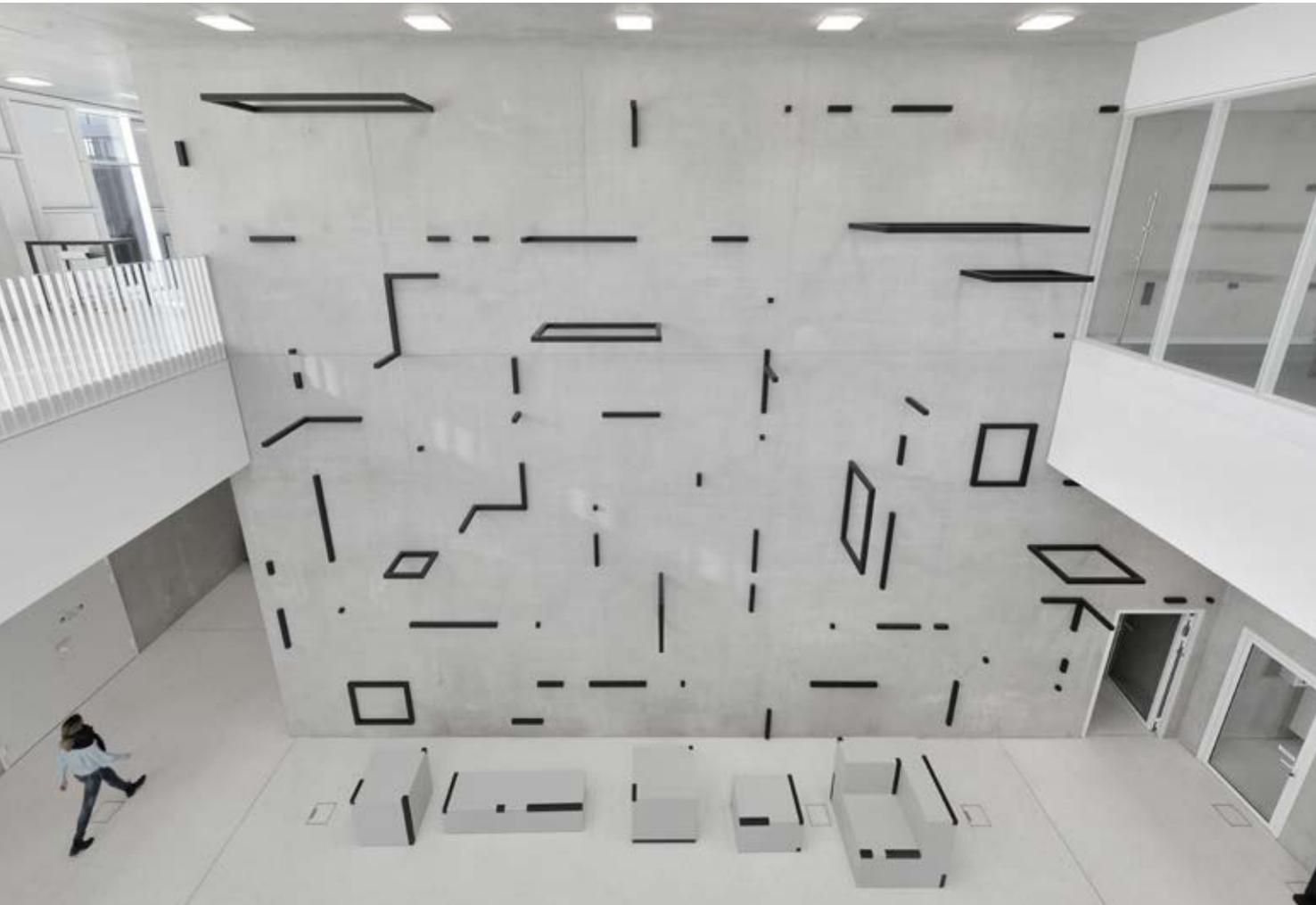


2

Contact details |
Prof. Dr. Holger Seidlitz
Division director PYCO

Fraunhofer Institute for Applied
Polymer Research IAP, research division
Polymer Materials and Composites
PYCO

Schmiedestrasse 5
15745 Wildau
Germany
+49 3375 2152-361
holger.seidlitz@iap.fraunhofer.de



1

1 Wall sculpture installed in the entrance hall.

2 Detailed view.

“OHNE TITEL” (“UNTITLED”)

WALL SCULPTURE INVITING OBSERVERS TO TAKE A SEAT AND LINGER

Fraunhofer Institute for Casting, Composite and Processing Technology IGCV

Concept | The concept of the sculpture is based on a geometric drawing that resolves into a grid, depicting a multipart and spatial representation. Esther Stocker transferred the mental experience of stepping into a picture to the real world. The themes of her work are freedom and the ability to change within the system. Thanks to their perceptive and cognitive skills, human beings can detect and alter structures and principles of organization. In addition, the sculpture invites the observers to undergo a change of perspective. By actively changing their position, they can get different spatial insights and lines of sights interacting with the existing architecture. Thought, sight, encounter, conversation, and aesthetics – all of these are intended to converge here. The wall sculpture has therefore been aesthetically and functionally completed with mobile elements in the entrance area.

Methodology and implementation | The wall sculpture consists of 75 individual elements made from square, hollow steel tube sections. The core idea of the design was to take a two-dimensional structural approach and create a spatial view as diverse as possible from it, with the intention of reinforcing and transforming the existing architecture. The artist treated the three-dimensional space like a pictorial space. The additional, usable mobile elements enable observers to take the mental experience of stepping into a picture to the extreme: They can take a seat, linger, get up again, and continually discover new aspects of the space by moving around. Since the cubic floor elements are mounted on wheels, their position within the entrance hall can be freely chosen.

“OHNE TITEL” (“UNTITLED”)

WALL SCULPTURE INVITING OBSERVERS TO
TAKE A SEAT AND LINGER

Fraunhofer Institute for Casting, Composite and Processing Technology IGCV



2

Artist | Esther Stocker

Art form | Wall sculpture and usable elements

Completed | 2020

Architects | Henning Larsen GmbH

Funded by | BMBF, Free State of Bavaria, European Regional Development Fund (ERDF)

Profile of the institute | Fraunhofer IGCV stands for application-driven research with a focus on efficient engineering, networked production, and smart multi-material solutions. The institute drives innovation on the level of manufacturing processes and material sciences, machines and process chains, as well as factory and enterprise networks. Around 120 researchers generate interdisciplinary solutions from the fields of casting, composite, and processing technology. As part of the Fraunhofer Group for Production, and with locations in Augsburg and Munich/Garching, Fraunhofer IGCV is a reliable partner for SMEs, large companies, and corporations.

Contact details |

Helene Scheben
Construction Representative

Fraunhofer Institute for Casting,
Composite and Processing Technology
IGCV

Am Technologiezentrum 10
86159 Augsburg
Germany
+49 821 90678-235
helene.scheben@igcv.fraunhofer.de



1

1 Light signal in excited state, main entrance.

2 Light signal in resting state, main entrance.

“...RIGHT NOW, OVER ME”

LIGHT INSTALLATION VISUALIZING THE INTERFERENCE OF SIGNALS

Fraunhofer Institute for Physical Measurement Techniques IPM

Concept | The work consists of 65 spherical light globes of different sizes – distributed throughout the entire building. The optical table, a central element of many experimental setups at the institute and an important tool in the institute’s research work, served as inspiration for the light installation. Just as the various prisms, lenses, or mirrors of an experimental set-up on an optical table are traversed by a signal, the spheres are connected to each other via a control signal. The signals of the individual strands gradually converge in the entrance hall, where a colorful scene emerges. The successive illumination refers to the phenomenon of interference or non-simultaneity of signals. At the same time, it picks up – in a humorous way – the idea of the employees coming together one by one to join in the daily coffee break in the entrance hall.

Methodology and implementation |

The globes are arranged in eight strands of different lengths, each of which is assigned a different color. All strands converge in the entrance hall. The LEDs are controlled via Wi-Fi. The globe farthest from the entrance hall lights up first, followed by the next globe, until all globes successively light up in the entrance hall. This process is a symbolic reference to the excited state of a body receiving energy. The signal of the shortest strand arrives first, “waiting” for the other signals. Only when the signal of the longest strand has arrived, the lights go out simultaneously. In addition, each strand of light can also be triggered individually using freely accessible switches installed throughout the building.

“...RIGHT NOW, OVER ME”

LIGHT INSTALLATION VISUALIZING THE INTERFERENCE OF SIGNALS

Fraunhofer Institute for Physical Measurement Techniques IPM



2

Artist | Tobias Rehberger in cooperation with Gabi Schirmmacher, Lutz Bantel, David Berens (Studio Tobias Rehberger)

Art form | Light objects

Completed | 2020

Architects | kister scheithauer gross architekten und stadtplaner GmbH

Funded by | BMBF, State of Baden-Württemberg, European Regional Development Fund (ERDF)

Profile of the institute | Fraunhofer IPM develops tailor-made measuring techniques and systems for efficient industrial processes. Many years of experience with optical technologies form the basis for high-tech solutions in the fields of production control, object and shape detection, gas and process technology, as well as thermal energy converters. With scientific expertise and engineering creativity, around 270 employees work towards project success with partners from research and industry. With its pooled expertise in measurement and optical techniques as well as system construction, the institute enables its customers to minimize their use of energy and resources while at the same time maximizing quality and reliability.

Contact details |

Clemens Faller
Construction Representative

Fraunhofer Institute for Physical
Measurement Techniques IPM

Georges-Köhler-Allee 301
79110 Freiburg
Germany
+49 761 8857-214
clemens.faller@ipm.fraunhofer.de



1

1 Freestanding sculpture by night.

2 Detailed view.

“AUF EMPFANG” (“ON RECEPTION”)

HYBRID SYMBOLIZING THE COMPATIBILITY OF TECHNOLOGY AND THE ENVIRONMENT

Fraunhofer Institute of Optronics, System Technologies and Image Exploitation IOSB,
Advanced System Technology branch AST
Fraunhofer Institute for Integrated Circuits IIS,
Electronic Measurements and Signal Processing department EMS

Concept | The sculpture depicts a deer made from antennas – a hybrid that oscillates between a technoid impression and an image of nature. The deer, a positively connoted, equally shy and curious wild animal, is transferred to a new web of meanings by its special shape and specific location, allowing for different associations. The analogies between nature and technology reflected in expressions like “to extend sensors”, “prick up your ears”, “put out feelers” and “tune the antennas” enter into a surprising symbiosis in the sculpture. These analogies can be a metaphor for the interaction and expected synergies between different topics and actors as well as for the responsible and sustainable compatibility of technology and the environment.

Methodology and implementation | The antenna tower is unique in Europe. With its immediate proximity to the test track for autonomous small vehicles, the work is put into a concrete thematic context. The precise proportions and the position and angles of the individual parts to each other create vitality and emotionalism. The clear design language and the monumental size create a landmark, widely visible and readable. The vertically erected tail has concealed spotlights that illuminate the sculpture by night. It engages in a direct dialogue with the horizontally structured building facade. When looked at from inside the offices, the sculpture is perceived against the background of the mountain range on the other side of the valley. This open connection to the surrounding landscape intensifies the reference to nature even more.

“AUF EMPFANG” (“ON RECEPTION”)

HYBRID SYMBOLIZING THE COMPATIBILITY OF TECHNOLOGY AND THE ENVIRONMENT

Fraunhofer Institute of Optronics, System Technologies and Image Exploitation IOSB,
Advanced System Technology branch AST
Fraunhofer Institute for Integrated Circuits IIS,
Electronic Measurements and Signal Processing department EMS



2

Artists | Inges Idee G.b.R.

Art form | Outdoor sculpture

Completed | 2020

Architects | Beeg Lemke Architekten
GmbH

Funded by | BMBF, Free State of Thuringia,
European Regional Development Fund
(ERDF)

Profiles of the institutes | The Advanced System Technology branch AST of Fraunhofer IOSB develops and researches tailored, resilient, and future-oriented systems engineering solutions for complex and time-varying processes in the fields of energy and water supply, cybersecurity, land and underwater robotics, data spaces and ICT ecosystems, and disinfection.

The employees of Fraunhofer IIS's Department of Electronic Measurement Technology and Signal Processing work on research related to mobile communication and signal processing. Notably, the department houses the FORTE (Facility for Over-the-Air Research and Testing) experimental facility, which offers exceptional capabilities for measuring, reproducing, and developing wireless communication technologies.

Contact details |

Elke Möller
Group manager "Administration"

Fraunhofer Institute of Optronics,
System Technologies and Image
Exploitation IOSB, Advanced System
Technology branch AST

Am Vogelherd 90
98693 Ilmenau
Germany
+49 3677 461 119
elke.moeller@iosb-ast.fraunhofer.de



1

1 Cuneiform labyrinth as an immersive drawing.

2 Mosaic on the forecourt of the new institute building.

“GLOBE OF GLASS”

MOSAIC EXPRESSING THOUGHTS ON THE FUTURE OF OUR ENERGY SUPPLY

Fraunhofer Institute for Energy Economics and Energy System Technology IEE

Concept | Just as the Mesopotamian culture used to experiment, innovate, and celebrate their achievements thousands of years ago, today’s cutting-edge ideas should be appreciated and developed – in technological respects, but in other areas as well. This also applies to the future of our energy supply, in which solar energy plays a significant role. The artist used the Mesopotamian symbol for sun in her mosaic on the forecourt of the new institute building. Choosing cuneiform as the first known writing to exist is a symbol itself. It marks the point in time when prehistory ends and history begins. It is a metaphor for progress, enlightenment, experimentation and invention, but also for orientation, decision-making, and courage.

Methodology and implementation | The mosaic includes a large-scale complete sun character and numerous abstract wedge-shaped symbols. The forecourt becomes a canvas, showing a labyrinth of wedges that all relate to the sun symbol. Many of the shapes in the floor mosaic are abstract, which leaves room for interpretation. The drawing also includes a symbol that stands for both the eye and the outline of a solar eclipse. Here, the artist drew her inspiration from the description of a total eclipse of the sun in an essay by Virginia Woolf. In this work, the sentence “We had fallen” feels alarmingly prophetic if the climate crisis is not solved in the near future. Davar realised the work as an immersive drawing in the hope that children will play on the mosaic forecourt.

“GLOBE OF GLASS”

MOSAIC EXPRESSING THOUGHTS ON THE FUTURE OF OUR ENERGY SUPPLY

Fraunhofer Institute for Energy Economics and Energy System Technology IEE



2

Artist | Katja Davar

Art form | Floor mosaic on the forecourt,
outdoor area

Completed | 2022

Architects | HHS Planer + Architekten AG

Funded by | BMBF, State of Hessen

Profile of the institute | Fraunhofer IEE in Kassel was established in 2018 from the Energy System Technology branch of Fraunhofer IWES. The institute conducts research for the national and international transformation of energy systems. It develops technical and economic solutions in order to further reduce the costs of using renewable energies, to secure the supply despite volatile generation, to ensure grid stability at a high level, and to promote the success of the energy transition business model. They offer companies from the energy supply, grid operation, energy electronics, energy informatics, wind energy, photovoltaics, bioenergy, and investment sectors an extensive portfolio of services, expertise and products that can be adapted to the needs of the customers.

Contact details |

Uta Werner
Communications, Marketing

Fraunhofer Institute for Energy
Economics and Energy System
Technology IEE

Joseph-Beuys-Strasse 8
34117 Kassel
Germany
+49 561 7294-241
uta.werner@iee.fraunhofer.de

SHORT BIOS OF THE ARTISTS



www.atelier-e.net

ATELIER-E (CHRISTIAN LOSERT, DANIEL DALFOVO)

"BRAINPALACE – BRAINPATTERNS", page 15

Christian Losert and Daniel Dalfovo, media artists and founders of the interdisciplinary studio ATELIER-E, work and teach at the intersection of art, technology, and research. ATELIER-E develops multimedia spaces and audiovisual narratives and collaborates with artists, research institutes and design studios.

2022 | LOOM – immersive light and sound installation, FUTUR_21 Festival, Bocholt

2021 | ZECHE – environmental sound for virtual exhibition, Zeche Zollverein, Essen

2021 | ATELIER-E studio founded



www.tatjanabusch.com

TATJANA BUSCH

"BRAINPALACE – BRAINPATTERNS", page 15

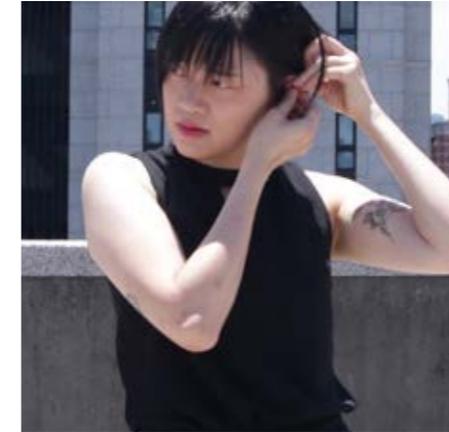
Tatjana Busch works with the intuitive shape of objects, exploring their potential with different media. Numerous exhibitions, including Pallazzo Bembo (Venice, Italy), White Box, and EVI LICHTUNGEN Light Art Biennial. Represented in the Sal. Oppenheim collection / Deutsche Bank and others.

2010 | Scholarship at ISCP, New York (USA)

2007 | "Haus der Kunst Preis" award

2003 - 2005 | Akademie der Bildenden Künste München, Munich

1981 - 1986 | Free University for Graphic Design & Fine Arts, Freiburg



www.changyentzu.com

YEN TZU CHANG

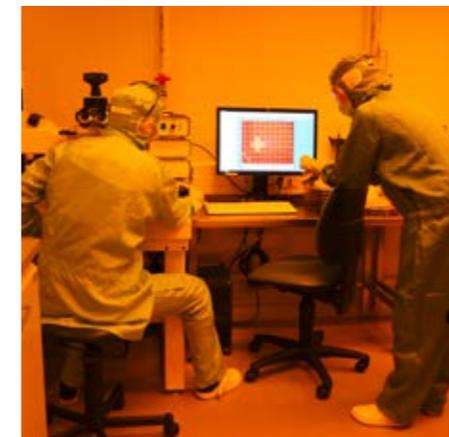
The Art of Complexity performance "WHOSE SCALPEL", page 23

The media artist works in the fields of interdisciplinary art and experimental sound art performance. Appeared internationally at exhibitions and numerous conferences and festivals, including Ars Electronica, roBOT 08 Festival, Linux Audio Conference, and Digital Design Week in London.

2017 | Artist in residence, STEAM Imaging I, Fraunhofer MEVIS & Ars Electronica

2014 - 2018 | University of Arts Linz, Austria

2010 - 2014 | Taipei National University of the Arts



www.olejeschonnek.de

DACHROTH + JESCHONNEK

"Deterministic Artistic Lightfields", page 31

Charlotte Dachroth and Ole Jeschonnek jointly work on projects at the intersection of science, art, and design. They share a common fascination for light. Appeared in numerous exhibitions, including in Düsseldorf and Berlin.

2018 | International Light Art Award

2015 | CreativeTech Award

from 2012 | Teaching engagement at weißensee academy of art, Berlin

SHORT BIOS OF THE ARTISTS



URSULA DAMM

"Parallel Universes", page 35

In her installations, Ursula Damm engages with biocybernetic processes. Several solo exhibitions, including at the Goethe-Haus New York. Numerous festivals and exhibitions, such as Ars Electronica, CyberArts, Chronus Art Center Shanghai, and House of Electronic Arts Basel. Several scholarships, e. g., Cité des Arts, Paris.

www.ursuladamm.de

from 2008 | Professor, Chair of Media Environments, Bauhaus-Universität Weimar

1995 - 1998 | Academy of Media Arts Cologne

1981 - 1989 | Kunstakademie Düsseldorf



KATJA DAVAR

"Globe of Glass", page 69

Katja Davar works at the intersection of drawing and animation. Exhibitions including Kunstmuseum Gelsenkirchen, Skulpturenmuseum Glaskasten Marl, Tabakalera, Donostia-San Sebastian, and The Drawing Room London. Winner of the sponsorship award for media arts by the State of North-Rhine Westphalia.

www.katjadavar.com

from 2012 | Professor of Drawing, Mainz University of Applied Sciences

1997 - 1999 | Academy of Media Arts Cologne

1987 - 1993 | Central Saint Martins School of Art, London & Kunstakademie Düsseldorf



BEATE EISMANN

"smart³ | materials – solutions – growth", page 21

The artist's works build bridges between nature, art, design, crafts, architecture, and technology. Numerous exhibitions, including smac (Staatliches Museum für Archäologie Chemnitz) and CODA Museum Apeldoorn. Winner of awards such as the Hallescher Kunstpreis and the Grassi Award of Gallery Slavik, Vienna (Austria).

www.beate-eismann.de

2000 - 2006 | Artistic assistant, Burg Giebichenstein University of Art and Design Halle

1998 - 1999 | Teaching engagement, Staatliche Zeichenakademie Hanau

1990 - 1995 | Burg Giebichenstein University of Art and Design Halle (jewelry)



MANUEL FRANKE

"Couleurs tordues" ("Twisted Colors"), page 59

Manuel Franke is known for his large-scale works in public spaces and art in architecture. Numerous solo and group exhibitions. Scholarships from Kunstfonds Bonn, one-year scholarship from Villa Massimo, and others. Teaching engagements at University of Wuppertal, Kunstakademie Düsseldorf, and others.

www.manuelfranke.de

1991 - 1992 | Institut des hautes études en arts plastiques, Paris (France)

1990 - 1992 | École Nationale Supérieure des Beaux Arts, Paris (France)

1985 - 1990 | Kunstakademie Düsseldorf

SHORT BIOS OF THE ARTISTS



www.ilkahelmig.de

ILKA HELMIG

"Was wir sehen" ("What we see"), page 37

Ilka Helmig's pieces focus on the phenomena of growth, compression, and dissolution. Exhibitions include Biennale Dak'Art, National Museum of Kenya, Ludwig Forum Aachen, and KARST Gallery, Plymouth. Winner of Red Dot Design Awards, if Design Award, and the Design Award of the German Federal Republic.

2018 | Artist in Residence, Styria (Austria)

from 2007 | Professor of Visual Conceptualization and Drawing, Aachen University of Applied Sciences

1990s | Studies of Communication Design and Fine Arts in Nuremberg and Bonn



www.ingesidee.de

INGES IDEE

"Auf Empfang" ("On Reception"), page 67

The Inges Idee artistic collective comprises the four artists Hans Hemmert, Axel Lieber, Thomas A. Schmidt, and Georg Zey. Since the collective was founded, they have been exclusively working on projects in the field of art in public spaces. All members are also active in their own individual artistic practices.

2022 | "Vorausschauende Maßnahme" ("Anticipatory Measure") project, Inselkunst Stadtblänke, Minden

2021 | "Funker" ("Radio Operator") project for the Bildungscampus Funkerberg, Königs Wusterhausen

1992 | Artistic collective founded



www.joteva.com

ELI JOTEVA

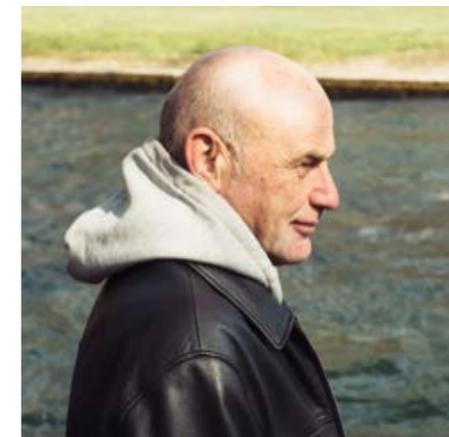
"IntraBeing", page 39

Eli Joteva incorporates influences from quantum mechanics and neurophysiology into her work, using sophisticated imaging techniques for her installations. Numerous international exhibitions, including Ars Electronica, Fischer Museum, Rijksmuseum Twenthe, Photon Gallery, and Queensland Center for Photography.

2020 | Artist in residence, STEAM Imaging III, Fraunhofer MEVIS & Ars Electronica

2016 - 2018 | University of California, Los Angeles, MFA in Design & Media Arts

2010 - 2013 | University of Southern California, BFA (with a focus on Intermedia)



www.andreasjungk.de

ANDREAS JUNGK

"UNBORN – THE SECRET LIFE OF QUANTA", page 27

Andreas Jungk's painting is based on the concept of intentionlessness and immediate presence. Various solo and group exhibitions, including at Galerie schnitzer & Studio in Munich, STATE in Berlin, Galerie Weise in Chemnitz, and Galerie Benjamin Eck in Munich.

1995 - 2000 | Studies in Zen calligraphy

1977 - 1982 | Studies in law at Ludwig-Maximilians-Universität, Munich

SHORT BIOS OF THE ARTISTS



JONATHON KEATS

"Primordial Cities Initiative", page 33

Conceptual artist and experimental philosopher Jonathon Keats is a research associate at the University of Arizona and a fellow at the Berggruen Institute. His transdisciplinary projects investigate aspects of society, using methods from science and humanities. Numerous exhibitions, multimedia projects, and publications.

[www.modernisminc.com/
Jonathon_KEATS](http://www.modernisminc.com/Jonathon_KEATS)

2015 | Installation of a camera with an exposure time of 1000 years, ASU (USA)

2000 | Installation debut at Refusalon Gallery, San Francisco (USA)

until 1994 | Studies in philosophy, Amherst College, Massachusetts (USA)



SASCHA LINKE

"smart³ | materials – solutions – growth", page 21

Sascha Linke works as self-employed photographer and graphic designer for gd&ph – Heimat visueller Ideen in Halle. Participation in exhibitions at Künstlerhaus 188 Halle, Galerie alte Schule Berlin, Warsaw Festival of Art Photography, and Stadtmuseum Halle, among others.

www.gdph.de

2011 - 2016 | Lectureship "Basics of Photography", Burg Giebichenstein University of Art and Design Halle

2005 - 2011 | Studies in photography and communication design, Burg Giebichenstein University of Art and Design Halle



MAURICE MERSINGER

"Fraunhofer Symphony of the Future", page 51

Maurice Mersinger is co-founder, creative director, and head of production at Kreativstudio kling klang klong, which creates artistic sound experiences in real and virtual environments. Awarded with numerous prizes for kling klang klong, such as the ADC Grand Prix and Gold, iF Design Award, and Red Dot Design Award.

www.klingklangklong.com

2020 | Sound design for the Luxembourg pavilion, Expo Dubai 2020

2018 | 3D sound installation "I AM NOT A ROBOT", Futurium Berlin

2003 - 2009 | Studies in cultural sciences and media philosophy



JAKUB NEPRAŠ

"LANDSCAPE", page 19

Jakub Nepraš blends traditional materials with the art of film. Frequent single and group exhibitions in the Czech Republic and on an international scope. Awarded with several prizes, such as the Euromobile Prize at Arte Fiera Bologna, 3rd place prize at International Florence Biennale, and the Essl Award 2nd place.

www.jakubnepras.com

2000 - 2006 | Academy of Fine Arts, Prague (Czech Republic)

2003 | Residency at FAMU, Prague (Czech Republic)

1996 - 2000 | Václav Hollar School of Art, Prague (Czech Republic)

SHORT BIOS OF THE ARTISTS



TOBIAS REHBERGER

»...Right now, over me.«, page 65

By establishing unexpected relationships between everyday objects and spatial structures, Tobias Rehberger opens up new perspectives on both. Numerous exhibitions at Kunstmuseum Stuttgart, Rockbund Art Museum Shanghai, and others. Awarded with prizes such as the Golden Lion (Venice Biennale) and the Otto Dix Prize.

[www.instagram.com/
studio_tobias_rehberger](https://www.instagram.com/studio_tobias_rehberger)



ANNETTE SAUERMANN

“Netzwerke des Wissens” (“Networks of Knowledge”), page 57

Annette Sauermann creates “spaces of light” and is known for her large-scale works in public environments. Numerous national and international exhibitions. Winner of DGB Cultural Award, German Award for Light Design, Prize of the International Biennale of Paper Art, City of Aachen promotional award, and others.

www.annette-sauermann.de

from 2001 | Professor, State Academy of Fine Arts – Städelschule, Frankfurt/Main

1987 - 1992 | Studies under Thomas Bayrle and Martin Kippenberger at Städelschule, Frankfurt/Main

from 1994 | Art in architecture – realization of many projects, among others for the Ministry of Economics in Berlin

from 1988 | Freelance artist

1978 - 1987 | Visual communication studies, Aachen University of Applied Sciences



LEO SIBERSKI

“Fraunhofer Symphony of the Future”, page 51

Leo Siberski works as an orchestra musician for the Staatskapelle Berlin, the Bayreuther Festspielorchester, and many international musical ensembles. Projects as a conductor with the Semperoper, the London Philharmonic Orchestra and many radio orchestras. Collaboration with Misha Maisky, Klaus Doldinger, Anett Fritsch and many more.

www.leosiberski.com

from 2017 | Chief musical director of Plauen-Zwickau Theater

from 1999 | Management of productions at several different theaters as an opera conductor

1996 - 2003 | Studies at Hochschule für Musik Hanns Eisler Berlin



ESTHER STOCKER

“ohne Titel” (“Untitled”), page 63

Esther Stocker uses geometrical shapes for her voluminous art installations, works of art in architecture, and paintings. Many solo and group exhibitions in Austria and worldwide. Winner of the Otto Mauer Prize, the Anton Faistauer Prize, and others. Featured in museums in the USA, Japan, France, Italy, and other countries.

www.estherstocker.net

1996 | Accademia di Belle Arti di Brera, Milano (Italy)

1994 - 1997 | Studies at Akademie der Bildenden Künste, Vienna (Austria)

1990 - 2000 | Art Center College of Design, Pasadena (USA)

SHORT BIOS OF THE ARTISTS



TIM TRANTENROTH

"Topologieoptimierte Struktur" ("Topology-Optimized Structure"), page 55

In addition to his independent artistic activities, Tim Trantenroth has primarily been realizing art-in-architecture projects since 2006. Numerous scholarships, including from Hans und Charlotte Krull Stiftung and Kunstfonds Bonn. Several lectureships, such as at Leibniz Universität Hannover and Berlin College of Fine Arts.

www.timtrantenroth.de

from 2017 | Professorship in painting, Hochschule der Bildenden Künste Essen

1996 | Master student under Prof. Jan Dibbets

1993 - 1998 | Kunstakademie Düsseldorf



BARBARA WILLE

"Stabwerk" ("latticework"), page 61

Barbara Wille's works include wall-mounted objects, art installations, art in architecture, and photographic objects. Winner of many prizes, including the Villa Romana Prize and Prize of Universität Mainz. Scholarships from Stiftung Kunstfonds Bonn, Künstlerhaus Schloss Balmoral, and Cité Internationale des Arts Paris, among others.

www.barbarawille.de

from 2014 | Professorship at Dresden University of Fine Arts

1997 - 2000 | Artistic employee, Johannes Gutenberg University Mainz

1990 | Johannes Gutenberg University Mainz, master student under Ansgar Nierhoff



STEFAN WISCHNEWSKI

"Hydrosphären" ("Hydrospheres"), page 25

Projects pertaining to art in architecture and activities in public spaces are at the center of Stefan Wischnewski's work. Numerous exhibitions and art installations in Den Haag, Porto, Vienna, Berlin, and others. Several scholarships and awards, such as the Bayerischer Kunstförderpreis 2007. Member of Munich Secession.

www.stefanwischnewski.de

2013 - 2020 | Research Fellow, Chair of Visual Arts, TU Munich

2004 - 2005 | Konsthögskolan Göteborg (Sweden)

1997 - 2003 | Akademie der Bildenden Künste Munich



AFTERWORD

ELKE SÄHN,
EDITOR OF THE BOOK SERIES AND
GROUP MANAGER SCIENCE COMMUNICATION AND DESIGN
AT FRAUNHOFER IVI

Visionary ideas and future-oriented research projects contribute to the fact that Fraunhofer is well known in Germany, Europe, and throughout the world. What business partners and funding institutions mainly have in mind are innovative technologies that sustainably generate added value.

But research also needs a home, products need an aesthetically pleasing design, and clients need a professional and emotional connection. These requirements can be fulfilled by design aspects that also characterize Fraunhofer but are much less prominent. This broader view – the exciting interaction of artistic work with findings from research activities – provides an opportunity to look at scientific content from a different perspective and make it tangible for a wide audience.

The book series that concludes with this volume addresses precisely this topic: the discussion of aesthetics and functionality in the areas of design, architecture, and art. “Designed by Fraunhofer”, the series’ first volume, presents a variety of developments by the institutes, proving emphatically that design is an integral part of research work. The second volume, “Architecture by Fraunhofer”, not only introduces Fraunhofer research buildings from the early days to the present, but also discusses the exciting question: How are these buildings perceived?

This third volume deals with the diverse links between research and the different artistic disciplines.

The idea of joining scientific aspects with design aspects is not a new one. Even back in 1800, Johann Wolfgang von Goethe described this concept in his poem “Natur und Kunst” (“Nature and Art”) as a seeming paradox with separating elements that nevertheless inspire each other.

Today, much more is required to be successful than just a perfect product. The harmony of function and form is just as important as target group-relevant communication, client retention, and employee satisfaction. If this book series succeeds in showing that life at Fraunhofer is not limited to scientific excellence and economic success, then it was worth the effort of everyone who contributed so enthusiastically to its creation. I would like to extend my personal gratitude to all of them.

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Forschungspreise 2019: 70 Jahre Zukunft, #WhatsNext. Brochure, Fraunhofer-Gesellschaft, 2019

Wissenschaft und Kunst im Dialog, Art Meets Science – the Art of Complexity. Brochure, Fraunhofer-Gesellschaft, 2018

Wissenschaft und Kunst im Dialog, Neurofeedback in Kunstinstallationen.

Brochure, Fraunhofer-Gesellschaft, 2020

Wissenschaft und Kunst im Dialog, smart³ | materials – solutions – growth. Brochure, Fraunhofer-Gesellschaft, 2018

Wissenschaft und Kunst im Dialog, State Studio Berlin April - December 2019.

Brochure, Fraunhofer-Gesellschaft, 2019

(2) Documentation and individual information provided by the artists

(3) Documentation provided by the Headquarters of the Fraunhofer-Gesellschaft, "Research Buildings" department

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Prof. Dr. Matthias Klingner

Zeunerstrasse 38
01069 Dresden
Germany
Phone +49 351 4640-800
info@ivi.fraunhofer.de
www.ivi.fraunhofer.de

Concept and editing

Elke Sähn
Bettina Kölzig

Translation

Bettina Kölzig
Kathy Bettina Lindt

Design concept

Konrad Löschner

Consultants

Dorothee Höfter
Christian Langfeld
Uta Kamps

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