



**Fraunhofer**  
MEVIS

Fraunhofer Institute for Digital  
Medicine MEVIS

Co-creative Participation: Integrating Science and Art

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# Experiential STEM+ in Digital Medicine



Medicine is a science  
of uncertainty and  
an art of possibility«

Sir William Osler (1849 - 1919),  
one of the founding professor of the  
Johns Hopkins Hospital

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# At the Core of STEM+

## Contextualization, Self-Efficacy, and Diversity

Fraunhofer MEVIS focuses on research-driven, deliberative, application-oriented, and participatory science communication with interested parties on a level playing field. Scientists can contribute individually or as part of a joint strategy according to their interests, talents, and expertise.

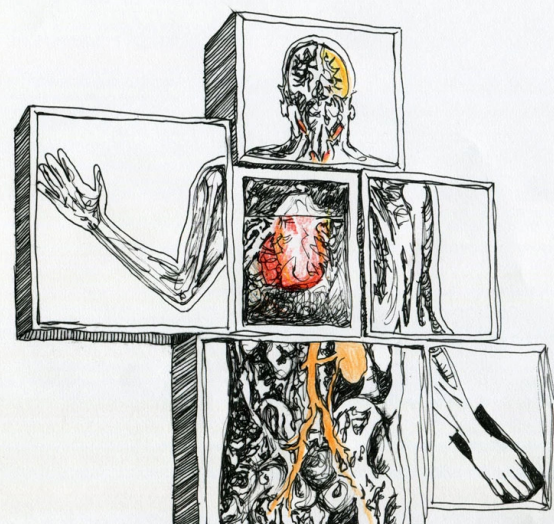
*»Innovation cycles have become so short that we need to strengthen the continuous, independent acquisition of new technologies and skills, which is true for adults in the workforce and students alike. Addressing the increasing complexity of healthcare requires integrating a broad range of disciplines and perspectives. This depends on broadening teams in R&D in terms of subject matter and representation, such as women or people of color. The first companies and institutions that clearly and uncompromisingly focus on building such diverse teams will be able to develop sustainable digital medicine and make a clear difference – they own the future.«*  
**Bianka Hofmann, Head of Science Communication, Fraunhofer MEVIS**

The goal is to engage in sustained dialogue with the broader community and, in the case of the presented projects of the strategic R&D Engagement team, to develop and co-create collaborative projects with partners, the next generation, and the community. The emerging interactions enable self-reflection among the researchers involved. Questioning how to create contemporary formats for an experiential understanding of difficult health topics and

complex technologies, we have initiated and implemented numerous projects in recent years. The aim is to build emotionally positive and critical relationships with these topics and to encourage people to engage in self-directed learning. We have reached out to new partners and participants, promoting cross-fertilization in discourse and creating spaces for self-efficacy and reflection. Both self-determined and intergenerational learning will gain increasing importance in the future.

Communicating new technological possibilities and discussing unintended side effects allows us to explore the values that ultimately lead to negotiations about the future we want to realize and live in as a society. Who needs to be involved in the research and development of products and services to shape the preferred future while considering the health, social, and economic impacts on our society? What can we contribute to advancements in social justice in digital medicine? How can we involve the coming generation in our work at an early stage? How can STEM studies, research, and, ultimately, MEVIS become more diverse and socially equitable? Artistic and design practices are increasingly entering the sciences to confront complex issues and address social, environmental, and economic challenges in new ways. The digital age has led to a trend toward the scientification of art. Scientists and artists increasingly use the same tools, methods, and





software. Art already plays a role in sounding out new technologies, applications, and possible problematic societal developments. Creative and artistic practice is foremost a way to find inner motivations, discover talents, and regenerate participation in collective action and a sense of belonging. It can help employees and citizens take an interest in new developments, be responsible, encourage individual responsiveness, and strengthen their capacity to adapt. Art and aestheticization allow positive emotional experiences and connections to STEM sciences and can support science communication.

To this end, we are integrating the participatory STEAM courses and workshops with students into collaborations with arts professionals, creative thinkers, and creators. We designed and developed the international creator-in-residency-program ‘STEAM Imaging,’ which will run in 2023 for the fifth time; we have realized ‘Inside Insight,’ a STEAM learning tool for medical imaging, STEAM workshops and courses, interactive exhibits, immersive audio-visual 2D and stereoscopic 3D short films, and

large scale and hemispheric installations to reach non-tech-savvy audiences at science centers, museums, galleries, and festivals. The projects address important health topics and new procedures through live performances, support for sound device development and sound installation, screen-based audio-visual installations, AR sculptures, interactive and immersive screen installations, and VR experiences. With international partners, they have been exhibited worldwide and received several awards. Networking, process-oriented implementation, and joint learning are at the heart of what we do. Ultimately, all activities of the communicating experts can strengthen the institute’s focus, perception, and communication of the R&D, internally and externally. With the help of artistic practices, the focus on working and learning is directed to inner motivations, talents, and resources. Innovation can thrive when people are equipped with knowledge about a field and have intrinsic motivation, creative space, and tools to approach, discuss, and communicate new technologies.

# Beauty of Blood Flow Analysis

Immersive video for 2D, stereoscopic 3D, or 360° hemisphere-dome, by Fraunhofer MEVIS (DE)

*»In the medical field, flow visualizations with color-coded virtual particles allow for a deeper understanding of complex physiological processes. They can reveal flow that does not behave as expected and give us hints on how to treat this. But they also show us the beauty of these repeating patterns of life – thousands of particles that shift through complex patterns, changing their color as they reveal vortices, swirls and streams with each heartbeat. A sight that always amazes me.«* **Mathias Neugebauer, Research Scientist, Fraunhofer MEVIS**

Artistic, immersive experiences enable emotional, positive engagement with digital medicine and the required STEM sciences. Driven by awe and curiosity, this SciArt work fuses technological prowess, digital art, and science. It is based on new research and technologies in digital medicine and conveys emerging possibilities for gaining knowledge and making predictions about the human body. The project allows the audience to witness the swirling flow of blood in the heart and gives an idea of the steadiness of the heartbeat.

Screened at Sparks! at CERN Future Technology for Health, 2022 (CH); Bright Festival Connect, 2020, Leipzig (DE); 9th International Festival of Science Visualization IFSV Dome Fest in Tokyo, 2019 (JP); STEAM art, Global LEAD Event World Tour New York City, Stanford LEAD Program, 2019 (US); 12th Fulldome Festival, 2018, Jena (DE); among others.

By looking at the flowing blood, various diseases can be detected; for example, turbulent vortices indicate a heart valve malfunction.

The starting point was exclusively real medical data for the dynamic reconstruction of the blood flow of a healthy human heart acquired at the MR laboratory of Fraunhofer MEVIS. Specially developed imaging techniques allow the local flow of motion to be depicted in the MR images. The highly detailed 4D flow data were processed with MeVisLab. To capture the complex temporal and spatial distribution of blood flow, special algorithms extracted 4D flow paths along which colored particle trajectories were visualized. The movements of the particles show the flow during the heartbeat and illustrate speed and direction of the blood flow. New flow visualization imaging techniques are being integrated into diagnostic software so that physicians can see how blood flow changes due to heart disease without the use of a catheter.

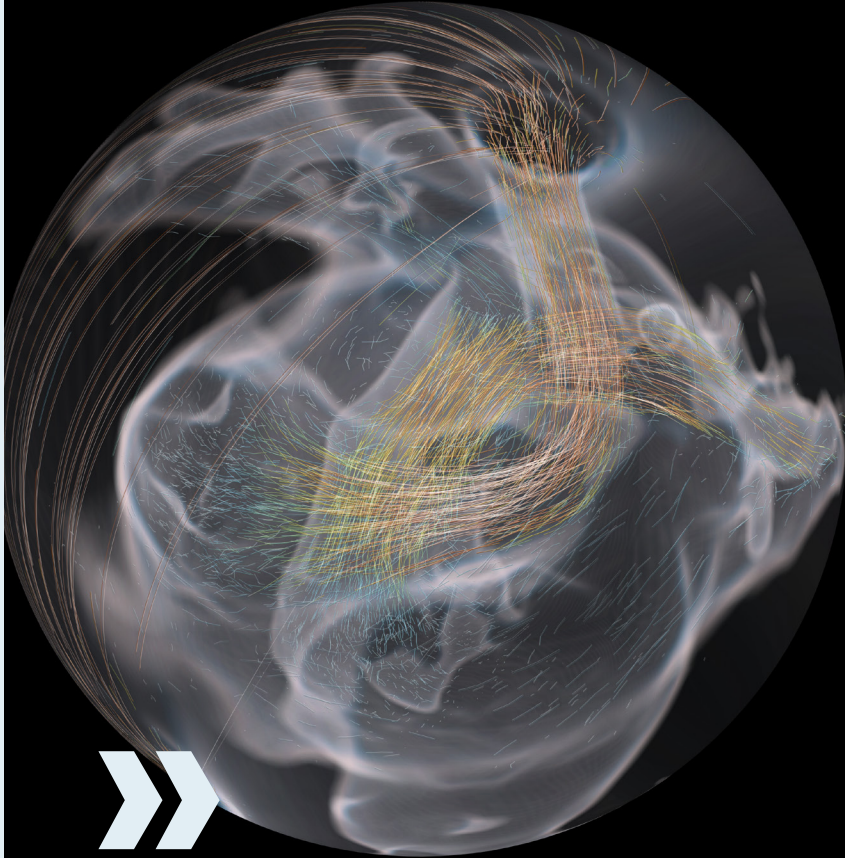
The project has been the starting point for further explorations with artists. The goal is to add educational programs to scientifically informed art exhibitions and engage diverse audiences in the wonders of the human body and the constructive possibilities of new technologies.

### Selected Highlights:

'Beauty of Blood Flow' was nominated as Finalist at Falling Walls Science Breakthroughs of the Year 2022 in Art and Science, Berlin (DE).

The SciArt work was recognized by the scientific documentary industry and won the 2018 Industry Award for Best Immersive Media at the Raw Science Film Festival, California (US).

The work was nominated at the 12th Fulldome Festival, 2018, Jena (DE).



## PREDICTIONS ABOUT THE HUMAN BODY«

# STEAM Workshops & Tools

The web-based interactive STEAM application 'Inside Insight' helps explain why computers are so important in analyzing medical image data and what methods can be used to analyze them. The tool helps to get a basic understanding of medical imaging and the required physics, mathematics, and computer science. It is based on over a decade of experience in hands-on workshops for school students and integrates real-world applications with explanatory visuals and sound files. It was created by MEVIS scientists in cooperation with artist Hannah Klatt (DE).

*»Interdisciplinarity is something that should be encouraged at an early age. I am committed to helping students and teachers gain a greater awareness of real-world applications in digital medicine beyond subject silos and with cross-disciplinary references.«* **Sabrina Tölken, Senior Project Manager, Deputy Quality Management Representative, Fraunhofer MEVIS**

Co-created STEAM workshops with school students to foster basic knowledge in digital medicine have been designed for many years with creators from different occupational backgrounds. The artist injects the artistic approach and skills into the engagement and

contributes to a broader approach to self-motivated interaction with new technology and challenging health issues.

Fraunhofer MEVIS partnered with the School Center Walle in Bremen, which has a thematic focus on health, to attract students from diverse backgrounds for the digital medicine of tomorrow while contributing to more educational equality. Alongside the teachers and students, MEVIS explores future educational models and expands ideas of what education could look like in the context of the digital transformation in health care. In vocational computer science, the students gain hands-on experience in digital medicine. School mentors give concrete insights into their workday. Further teachers of the class are involved in exploring interdisciplinary links and content-related references in the curricula and different perspectives on topics of digital medicine are discussed.

*»Science, mathematics, and technology on the one hand and art and creativity on the other, both fields had always particularly inspired me; but I could never combine these interests meaningfully. Working within the residency STEAM Imaging and artists like Zeynep Abes enabled inter- and transdisciplinary explorations and integrative problem solving.«* **Valentin Kraft, Mixed Reality Researcher & Software Developer, Fraunhofer MEVIS**

The application 'Inside Insight' is in regular use in numerous workshops and courses; it had been used at the course 'Art and Medicine' at Paris Lodron Universität Salzburg PLUS & Mozarteum 2021 (AT), at Sci Art NanoLab Summer School at UCLA in 2018 (US), among many other occasions.

**Selected Highlights:**

Schnugg, Claudia.  
(2020). Evaluation  
STEAM Imaging III:  
Art Meets Medical  
Research Online  
STEAM course 'In-  
side Out:10 STEAM  
Evenings' 10.13140/  
RG.2.2.27760.38409.

The STEAM application  
'Inside Insight' was:  
+ nominated as  
Finalist Best Educa-  
tional Media 2018 at  
the Raw Science Film  
Festival, California (US)  
+ in use within the  
graduate course by  
Prof. Roger Malina  
at UT Dallas, 2018,  
Special Topics in Arts  
Technology and Emer-  
ging Communication  
– Art, Health, and  
Medicine (US).

Schnugg, Claudia.  
(2017). STEAM  
Imaging: Art Meets  
Medical Research:  
Evaluation Sum-  
mary. 10.13140/  
RG.2.2.11923.58403.



STEM+  
GOING BEYOND  
DISCIPLINES«



# Whose Scalpel

Performance & Sound Installation, by Yen Tzu Chang (TW)

»‘Whose Scalpel’ is a sound performance which combines several materials like sound, visuals, and an installation to present issues of the relationship between surgeons and medical machines. The idea of making a concert is inspired by the YouTube channel of Fraunhofer MEVIS and the description of the auditory guidance prototype for navigated liver surgery. In the video, the scientists make a prototype and sound example so that when the scalpel deviates from the correct cutting path, the device will make a different sound to notify the surgeon.«  
**Yen Tzu Chang, artist-in-residence at STEAM Imaging I**

New scientific developments are rapidly finding their way into our everyday life and require explanation and feedback from the public. Art is a suitable means of dialogue with different target groups to illuminate and discuss innovations and social changes. Do new developments such as artificial intelligence offer opportunities and motivation, or will humans become the losers of progress? Against this background, ‘Whose Scalpel’ addresses the complexity of art and medicine and possible consequences for our society. Last but not least,

the question is posed of what human beings lose when the computer takes over. The accompanying installation is based on a supersized 3D-printed replica of the artist’s heart, equipped with light sources and electronic sound generators. During the performance Yen Tzu Chang acted as a ‘surgeon,’ placing a bypass with the help of cables – presumably guided by artificial intelligence. Through the almost complete darkness and the industrial sounds, a futuristic, partly oppressive, but consistently exciting backdrop is created. The performance was created as part of ‘STEAM Imaging I,’ a residency program to link science, technology, and mathematics with the world of art. The project combined computational medicine with STEM issues, sound art, and ethical discussions. During her stay in Bremen, Yen Tzu Chang learned how to use a software platform for processing medical image data (MeVisLab). MR imaging and MeVisLab were also central topics of the STEAM school student workshops, which are an integral part of the residency program. The aim was to break down barriers between the disciplines and to explore flexible forms of learning and collaboration.

Exhibited & performed at Science and Art in Dialog, 2018, Berlin (DE); FRAMELESS16, MUG im Einstein, 2018, München (DE); Music Hackspace, Somerset House Studios, 2018, London (UK); Ars Electronica Festival, 2017, Linz (AT); among others.

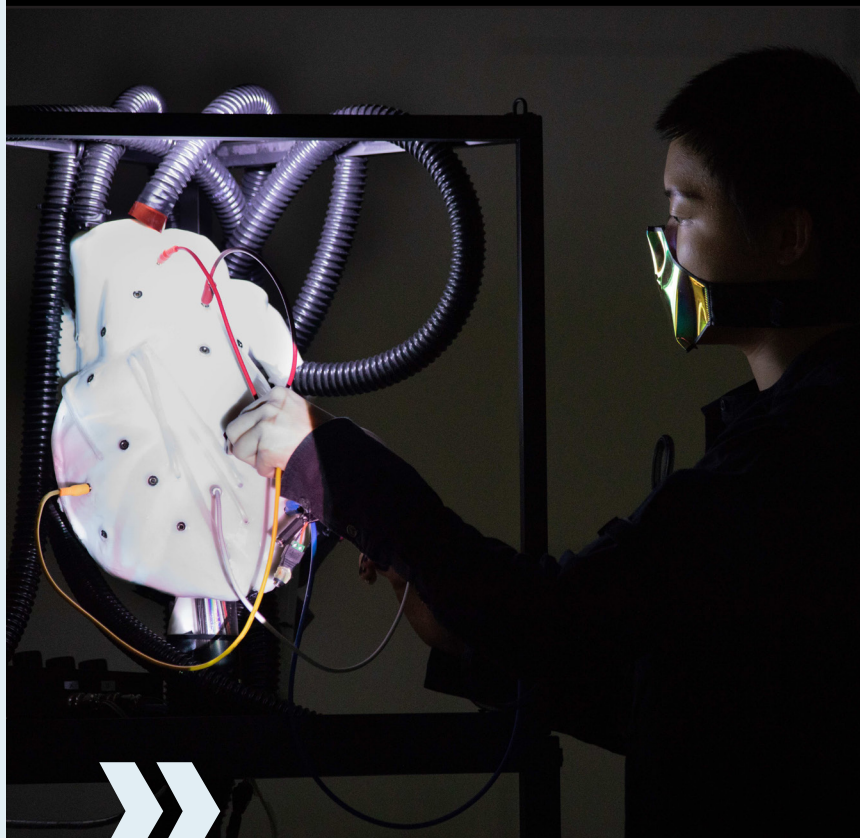
STEAM Imaging I was hosted by Fraunhofer MEVIS (DE) and Ars Electronica (AT), in collaboration with the International Fraunhofer Talent School Bremen; realized within the European Digital Art & Science Network.

### Selected Highlights:

Hofmann, Bianka.  
(2019). Linking  
Science and Techno-  
logy with Arts and the  
Next Generation—The  
Experimental Artist  
Residency "STEAM  
Imaging". Leonardo.  
54. 1-10. 10.1162/  
leon\_a\_01792.

Schnugg, Claudia.  
(2019). Creating  
ArtScience Collabora-  
tion: Bringing Value  
to Organizations.  
10.1007/978-3-030-  
04549-4.

Ed. Ars Electronica  
Center Linz, The Prac-  
tice of Art & Science,  
The European Digital  
Art and Science Net-  
work (Hatje Cantz,  
2017), pp. 50–55.



WHAT DO HUMANS LOSE  
WHEN THE COMPUTER  
TAKES CHARGE?«

## Digital Medicine, Arts and STEAM: Before Us Lies ETERNEDY

Immersive stereoscopic 3D & large-scale 2D in-stallation, by Fraunhofer MEVIS (DE), in cooperation with Ina Conradi and Mark Chavez (SG)

*»Of course, medical data is a sensitive topic; finding a line in the technical production that still provides enough anchors for discussing real-world clinical problems as well as providing enough space for awe-inspiring artistic visuals is a central challenge.«* **Alexander Köhn, Senior Software Developer, Fraunhofer MEVIS**

Understanding and negotiating complex issues in digital medicine require expertise, time, and dedication. But who is developing new technological possibilities, telling their stories, and shaping the medical future? The immersive installation is based on reflections about researchers and their curiosity and creativity in dealing with issues that can only be penetrated through technical, scientific, and mathematical understanding. The installation shows a floating human body, and looks into an organ down to a layer of tissue that, when magnified, reveals itself as the space-like environment with star-like lights in which the body floats.

The project shows different scales of the human body, from digitized microscopic lymphoma

tissue examined with the molecular cytogenetic technique called fluorescent in situ hybridization (FISH) to detect abnormal changes in DNA, to 3D reconstructions of two vessel systems of a liver for patient-individual surgery planning as well as a whole-body MRI.

Fraunhofer MEVIS researches and develops MR sequences for clinical practice, software for automatic and precise analysis of tissue sections for digital pathology, and is a pioneer in combining and analyzing medical data for better information integration and decision support for medical professionals.

Immersive, interactive, and artistic experiences enable emotional, positive engagement with digital medicine and required STEM sciences. The goal is to add educational programs to scientifically informed art exhibitions and engage diverse audiences in the wonders of the human body and the constructive possibilities of new technologies.

Screened at Bright Festival Connect 2020, Leipzig (DE); CITY OF QUANTIFIED VISIONS, 2019 (SG), Raw Science Film Festival, 2019 (US), Ars Electronica Festival, 2018 Linz (A), Media Art Nexus NTU, Singapore, 2018 (SG); among others.



### Selected Highlights:

‘Digital Medicine, Arts and STEAM: Before Us Lies ETERNEDY’ was recognized by the scientific documentary industry and won the Industry Award for Best Infographic at the Raw Science Film Festival, 2019, California (US).

The work premiered simultaneously at the Deep Space 8K at the Ars Electronica Center & Festival 2018 (AT), and at the Media Art Nexus (MAN) at Nanyang Technological University Singapore (SG) with a life connection and Q&A with audiences.



## INTERPRETING THE HUMAN BODY«

# The Tides Within Us

Interactive immersive screens, by Marshmallow Laser Feast (UK)

The artists partnered with Fraunhofer MEVIS to create a series of stunning interactive screens that allow the audience to explore the human ecosystem. Scientific data sets that peer deep into the human body formed the starting point of the collaboration and the artwork. 'The Tides Within Us' is an ongoing exploration of the world beyond the limits of our senses and perception. The work investigates oxygen flow through the cardiovascular system, painting a picture of the human body as a fluid event, more like a whirlpool than a static object. This flow questions the boundary of where this living body begins and where it ends. To imagine blood flowing through a heart might conjure a wonderful image, but to actually see real blood flow heart data captured by an MR scanner reveals a complexity and beauty that is almost impossible to imagine.

'The Tides Within Us' was presented with Fraunhofer MEVIS as research partner at the launch program of The Reel Store, UK's first permanent immersive digital art gallery, opened in Coventry in 2022 (UK); SIGGRAPH Asia 2021 Art Galleries, 2021 (JP); Coventry City of Culture (co-commissioned and co-produced by Coventry City of Culture Trust and York Mediale, 2021); the Human Nature Exhibition at York Art Gallery, 2020/21; Ars Electronica Festival 2020: A behind-the-scenes look and Guided Online Tour to the MR Lab by artist and scientists involved.

The artists scaled the scientific data captured to create a human 600 feet tall; at this scale, lungs look like trees, arteries like river deltas, and neural pathways fire like lightning storms.

As immersive technology continues to evolve, offering new platforms for experiential and embodied learning, the potential for this collaboration grows too. The ultimate goal of the project is to change the way people learn and think about themselves in relation to the environment. Where does the human body end, and where does it begin?

*»Many different dynamic and complex processes occur within the human body every second. Gaining a deeper understanding of the details and variations of those processes helps us to understand diseases and optimize therapies. Measurement and imaging methods are utilized and developed every day. Even if those sensors are only capable of capturing a fraction of these processes, they generate a lot of complex data. To gain knowledge from this data, it needs to be understood and analyzed by experts. Visualization of this medical data is an important step in understanding. 'The Tides Within Us' is also a form of medical visualization, but with different goals and a much broader audience, who might not be medical experts. One goal is to convey information on an emotional level and generate a deeper understanding of complex human beings.«* **Matthias Günther, Deputy Institute Director, Head of MR Physics, Fraunhofer MEVIS**

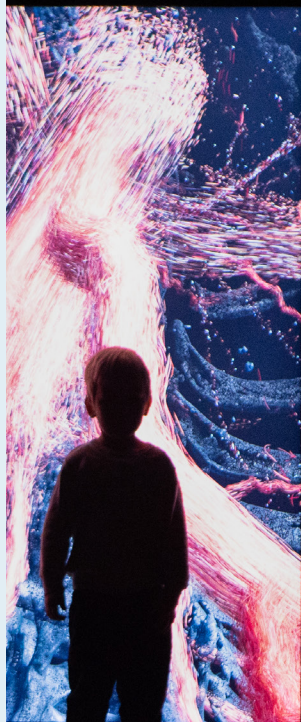
### Selected Highlights:

'The Tides Within Us' won the Industry Award for Best New Media Format at the Raw Science Film Festival, 2022 (US).

The cross-sectoral project received an Honorary Mention at the STARTS Prize 2021 as unique and pioneering artwork.

An introduction on the artwork was given at First Star Scholars UK, University of Winchester 2021 by artist Barnaby Steel, followed by a hands-on online workshop from MEVIS scientists on medical imaging, based on the tool 'Inside Insight.'

The work found its way into the compelling book 'Imagining Imaging' by radiologist Michael R. Jackson.



LUNGS LIKE TREES, ARTERIES  
LIKE RIVER DELTA, NEURAL  
PATHWAYS FIRE LIKE LIGHTNING  
STORMS.«



# IntraBeing

Immersive Installation & AR Extension, by Eli Joteva (BG/US)

*»Women are commonly excluded from research studies due to the reluctance to investigate and account for the variability that their hormonal cycles can introduce. Research that includes women often fails to check for differences between women and men. I hope that the chosen artwork from the project 'IntraBeing,' featuring the vagina and ovaries as an AR sculpture, installed in an international research institution like Fraunhofer MEVIS, will inspire discussions on the dire need for more scientific inquiry and a better understanding of the female reproductive system!«*  
**Eli Joteva, artist in residence at STEAM Imaging III**

What lies within the boundaries of being? 'IntraBeing' explores the limitations of imaging the human body to imagine a limitless and intraactive 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. Artist-in-residence Eli Joteva performed a series of full-body MRI scans and diffusion tensor imaging (DTI) scans, which are usually only used to visualize connectivity in the brain, to instead reveal nerve fibers in the chest and pelvic regions and the 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 AR extension, which shows an oscillating internal landscape of hydrogen atoms, the nerves along which they flow, and the magnetic potentials generated between them. The starting point of the 'STEAM Imaging III' residency was to bring artists together with scientists and school students to create broad access to a self-motivated exploration of topics in digital medicine through '10 STAM Evenings'. The course was jointly created by artist Eli Joteva and scientists at Fraunhofer MEVIS. 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. The residency allows artists to exchange intensively with MEVIS experts and link their work with the latest scientific methods and approaches in digital medicine.

'STEAM Imaging III' was hosted by Fraunhofer MEVIS (DE) and Ars Electronica (AT), in collaboration with the International Fraunhofer Talent School Bremen and the Schulzentrum Walle (DE), and UCLA Art|Sci Center in Los Angeles, (US); partner of the European Platform for Digital Humanism.

Exhibited at UCLA Art | Sci Center 2023; Ars Electronica Festival 2020; among others.

### Selected Highlights:

'IntraBeing Expanded View' is shown as a permanent exhibit at Fraunhofer MEVIS Institute's building at the main location in Bremen.

Eli Joteva designed and held the course '10 STAM Evenings' jointly with MEVIS scientists with the school students from MEVIS partner school SZ Walle.



ON SPACES AT THE LIMITS  
OF RESOLUTION AND  
PERCEPTION«

# Anniversary Campaign

Integrated medical hand-drawing, volume renderings and moving images based on real medical data, by Fraunhofer MEVIS (DE)

*»Traditional drawing provides a good basis for understanding anatomy and complex medical issues. Pencil and paper force the artist to understand an object in order to represent it correctly and meaningfully. Likewise, medical drawing is a good bridge to introduce people to medical images and physiological processes. Digital and multi-dimensional representations are often developed from drawn sketches. I use medical drawing techniques from my practice to provide patient information in my daily clinical work as a radiologist. In the images of the anniversary campaign, the drawings serve as anchors for the conceptual presentation of various medical computing skills.«* **Susanne Diekmann, Medical Expert, Fraunhofer MEVIS**

Fraunhofer MEVIS accompanied the 25th anniversary with a campaign comprised of illustrations, moving images, articles, and audio podcasts on selected key issues and essential work targets.

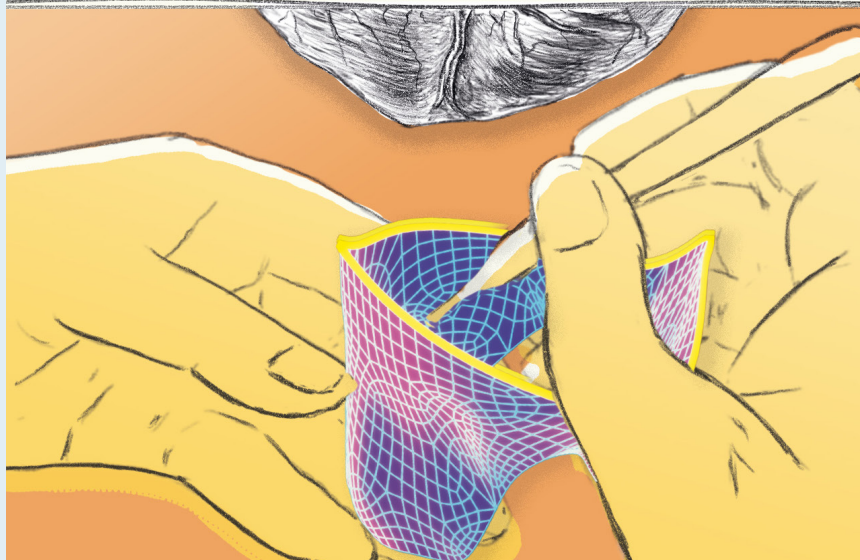
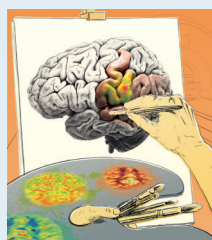
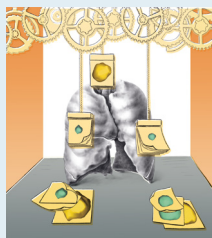
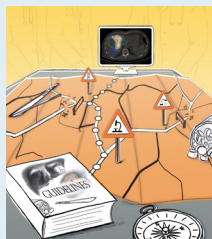
By utilizing medical computing competencies – image acquisition and reconstruction, image processing and analysis, mathematical modeling and simulation, machine learning, and human-computer-interaction and user experience engineering – Fraunhofer MEVIS strives to

improve the accuracy, safety, and efficiency of diagnostic and therapeutic procedures, bridging integrated diagnostics, intelligent interventions, multimodal imaging, and healthcare informatics.

The amount of available digital medical data and the growing number of therapy options provide increasing complexity that must be managed in the daily medical routine – digitization adapted to the working human being can make this complexity visible, explain it, and manage it. The aim is to bring together the specific skills of computers and humans and adapt technological processes to real-world requirements in medical routines. True human-centered tech takes the embodied physical reality of humans into account. In addition, computer-generated data and digitized processes contain imperfections, and digital extensions of human decision-making can be incomplete or biased. If we want to base the digital transformation on human and social needs, we must merge diverse knowledge, digital and physical skills, and applications in a new way. In addition to humans' essential cognitive, perceptual, and emotional modalities, the social realities reflected in the data in use have to be considered.

With the anniversary campaign, the institute started the MEVIS podcast channel in German and English language, describing key working fields and accomplishments.





# EVOLVER

Virtual Reality Journey of Life and Breath, by Marshmallow Laser Feast (UK); key scientific collaborator Fraunhofer MEVIS provided data sets and bodily scanning techniques that have informed every aspect of the project.

*»If you could explore yourself, you would discover that just under your skin you are a branching being made of rivers, whirlpools, and ripples in the tides of existence. The world flows into you and you flow into the world.«* **Barnaby Steel, Co-Founder Marshmallow Laser Feast**

The internationally renowned experiential artist collective, Marshmallow Laser Feast, presents 'Evolver,' a collective virtual reality experience which drops audiences deep inside the landscape of the body, following the flow of oxygen through our branching ecosystem, through to its origin, a single 'breathing' cell among trillions within our body. This deep dive takes viewers through the processes that sustain all life, as air travels from the mouth into the lungs, whirling like a tornado, before circulating around the complex rivers and tributaries of our cardiovascular system. As this life force reaches the outer extremities, from the billowing synapses of the brain to our fingers and toes, the interior blooms into a forest of branching

pathways, suffused by a fog of life-bringing oxygen. Through this transcendental narrative, it becomes clear that breath not only sparks life, but also connects us to the natural world through the cycle of respiration. Executive produced by Edward R. Pressman and Terrence Malick, with music by Jonny Greenwood, Meredith Monk, Jóhann Jóhannsson, and Howard Skempton. If you could explore yourself, you would discover that just under your skin you are a branching being made of rivers, whirlpools, and ripples in the tides of existence. The world flows into you and you flow into the world. The atmosphere is a co-creation of all breathing bodies, threading us together as cells within the body of the earth. 'Evolver' observes the movement of oxygen through the respiratory and cardiovascular systems, the experience is formed from a collage of different scientific datasets and blood flow simulations and informed by our close collaborations with leading scientists. From an inbreath all the way to cellular diffusion, 'Evolver' aims to challenge the myth of separation by inviting audiences to voyage beneath the sensorial boundary of skin, to make visible our inner branching being. By journeying inwards and exploring the beauty and mystery of human beings, and just how inseparable the outside world becomes from our ecosystems within, we hope to awaken the realization that we are nature, and what we do to nature we do to ourselves.

Presented at 2022 Geneva International Film Festival (CH), European Premiere of 'EVOLVER,' 2022 Tribeca Festival (US) EVOLVER – A Virtual Reality Journey of Life and Breath.



**Selected Highlights:**

'EVOLVER', narrated by Cate Blanchett, received the Jury Mention for Storyscapes Award at Tribeca Festival 2022 (US).



THE WORLD FLOWS INTO  
YOU AND YOU FLOW INTO  
THE WORLD«

# Moments Within

Video Installation, by Zeynep Abes (TR)

*»I'm fascinated by how memories change over time and the role old photos, videos, and sound recordings play in reconstructing the past in our minds. And I wonder what role can play art-makers in preserving memories.«* **Zeynep Abes, artist-in-residence at 'STEAM Imaging IV'**

Our identity, who we are, and what we do today are closely tied to our past or what we remember. But how trustworthy is our memory? Our recollections are fluid, subject to alteration every time they are retrieved. That is, we do not remember our past the exact same way each time. 'Moments Within' explores memory deteriorating over time and the change in the way we retrieve a fading past, whether with naturamemory loss or patients with Alzheimer's.

Using a 7-Tesla MRI scan of a brain as a poetic and practical tool, the continuously disfigured visualizations focus on the parts of the brain that are crucial in determining the stability of memory, such as the amygdala, hippocampus, and neocortex. As a one-channel video installation, 'Moments Within' visualizes our cerebral vascular system as dreamlike landscapes in 3D space to create an immersive experience of remembering and forgetting.

Exhibited at UCLA Art | Sci Center 2022; screened online at: Ars Electronica Festival 2020; among others.

'STEAM Imaging IV' allowed artist Zeynep Abes to engage in intensive exchange with Fraunhofer MEVIS experts to examine current methods, developments, and results of research in their works critically. A key component of the program was the shared encounter with pupils and their parents from the School Center Walle. In doing so, Fraunhofer MEVIS took an original approach: the art and research alliance enabled prospective university students and their parents to approach scientific and technical topics from a new and unexpected perspective and encouraged them to engage with science, technology, and art in a self-determined, creative way.

'Moments Within' was created during the 'STEAM Imaging IV' residency program hosted by the Fraunhofer MEVIS (DE), in collaboration with Ars Electronica (AT), the International Fraunhofer Talent School Bremen and the School Center Walle (DE), and the UCLA ArtSci Center (US); partner of the European Platform for Digital Humanism.

*»Linking science, technology and art holds great potential for addressing our social, environmental, and economic challenges in Europe. STEAM Imaging is a program that has been unleashing this power for years, creating an international lighthouse project focused on knowledge transfer and learning through art. We need more programs like this!«*  
**Veronika Liebl, Managing Director Festival Prix Exhibitions at Ars Electronica Linz GmbH & Co KG**

### Selected Highlights:

Zeynep Abes discussed in evening dialogs jointly with MEVIS scientists topics around Alzheimer's, quality assurance, AI and the future in digital medicine with the school students of MEVIS partner school SZ Walle and their family & friends.



## ON FORGOTTEN FEELINGS AND FALSE MEMORIES«



# Credits & List of Images & Illustrations

## Title, Back and Pages

### **Beauty of Blood Flow Analysis**

Credits: Directors and Science & Art Producer: Bianka Hofmann, Alexander Köhn, Mathias Neugebauer; Scientific Advisor: Anja Hennemuth; Sound: David Black; Fraunhofer MEVIS (DE)  
Image Copyright: Fraunhofer MEVIS

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## Pages

### **Digital Medicine, Arts and STEAM: Before Us Lies ETERNEDY**

Credits: Directors and Science & Art Producer: Bianka Hofmann, Alexander Köhn, Mathias Neugebauer; Scientific Advice: Henning Höfener, Andre Homeyer; Sound: David Black; Fraunhofer MEVIS (DE). In cooperation with Ina Conradi and Mark Chavez, Media Art Nexus, Nanyang Technological University Singapore (SG); Fluorescent in situ hybridization (FISH) data kindly provided by ZytoVision; special thanks to Volker Diehl, Jochen Hirsch, Julian Haase, and Dagmar Weiß  
Image Copyright: Quek Jia Liang

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## Page

### **Image Man**

Fraunhofer MEVIS has developed an interactive exhibit for the Science Center Universum® Bremen that showcases the capabilities of modern medical imaging methods; a picture of it and its drawn mirror works as the entrance screen of the web-based interactive STEAM application Inside Insight.  
Drawing Copyrights: Hannah Klatt  
Image Copyright: Fraunhofer MEVIS

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## Pages

### **The Tides Within Us**

Credits: Concept: Marshmallow Laser Feast. Directed by: Barnaby Steel, Ersin Han Ersin, Robin McNicholas. In collaboration with Natan Sinigaglia. Scientific Partner: Fraunhofer Institute for Digital Medicine MEVIS. The Tides Within Us was co-commissioned by York Museums Trust, Mediale and Coventry City of Culture. Funded by Arts Council England.  
Image Copyright: Marshmallow Laser Feast

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## Pages

### **Inside Insight**

Sabrina Tölken (née Haase) conducts a STEAM workshop, using the STEAM application Inside Insight.  
Image Copyright: Fraunhofer MEVIS

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## Pages

### **Whose Scalpel**

Credits: Artist & Sound & Performance: Yen Tzu Chang (TW), Fraunhofer MEVIS team: Bianka Hofmann, Sabrina Tölken (née Haase), Alexander Köhn, David Black. Ars Electronica team: Veronika Liebl, Jessica Galirow, Maria Pfeifer, Peter Freudling, Erwin Reitboeck. Technical support of medical images: Alexander Köhn. Technical support for 3D models and printing: Peter Freudling, Erwin Reitboeck, Benjamin Krux. Special thanks: Interface culture, Fabricio Lamoncha Martinez, Jie Ting Jiang, Yin-Wen Lin  
Image Copyright: Fraunhofer ICT Group

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## Pages

### **IntraBeing**

Credits: Eli Joteva, (BG/US), 2022. MRI scanning was acquired with the help of USC Loni. The project was made possible with the generous help of Bianka Hofmann, Alexander Köhn, Jochen Hirsch, Matthias Günther, Danny JJ Wang, Katherin Martin, James Stanis, and Victoria Vesna.  
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Pages 18/19  
**Anniversary Campaign**

Illustration Credits: Susanne Diekmann, Bianka Hofmann, Alexander Köhn, Valentin Kraft, Mathias Neugebauer in collaboration with Nora-Josefin Breutigam, Anja Hennemuth, Henning Höfener, Daniel Christopher Hoinkiss, Bianca Lassen-Schmidt, Johannes Lotz, Hans Meine, Jan Hendrik Moltz, Sven Rothlübbers, Andrea Schenk, Jan Strehlow, Markus Wenzel  
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Pages 20/21  
**EVOLVER, Virtual Reality Journey of Life and Breath, by Marchmallow Laser Feast (UK)**

Credits: Producers: Marshmallow Laser Feast; Atlas V, Pressman Film. Key Creative Collaborators: Natan Sinigaglia; Imaginary Friends; James Bulley & Henrik Oppermann; Daisy Lafarge. Key Scientific Collaborators: Fraunhofer Institute for Digital Medicine MEVIS; Jennifer Garrison, Buck Institute for Research on Ageing; The Allen Institute for Cell Science; Kinda Studios. Sponsors: Bia-Echo (Sponsor for Evolver); Orange (Sponsor for Evolver Prologue)  
Image Copyright: Pail McGeiver

Pages 22/23  
**Moments Within**

Credits: Zeynep Abes (TR). Sound Designer: Arman Ataman. Special Thanks to Bianka Hofmann, Sabrina Tölken, Matthias Günther, Valentin Kraft, Susanne Diekmann, Victoria Vesna, Devin Embil  
Image Copyright: Zeynep Abes

Pages 27/28  
**R&D Engagement Visual**

Illustration Credits: Susanne Diekmann, Bianka Hofmann, Alexander Köhn, Valentin Kraft, Mathias Neugebauer in collaboration with Sabrina Tölken (née Haase), Hanne Ballhausen  
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# Impressum

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## Authors:

Pages 1-13, 16, 17, 22-27:

Bianka Hofmann

Pages 14, 15:

Bianka Hofmann,  
Marshmallow Laser Feast

Page 18:

Susanne Diekmann, Bianka Hofmann,  
Mathias Neugebauer

Pages 20, 21:

Marshmallow Laser Feast

## English Editor:

David Black

## Editing & Layout:

Bianka Hofmann

## Publisher:

Fraunhofer MEVIS

Max-von-Laue-Str. 2

28359 Bremen

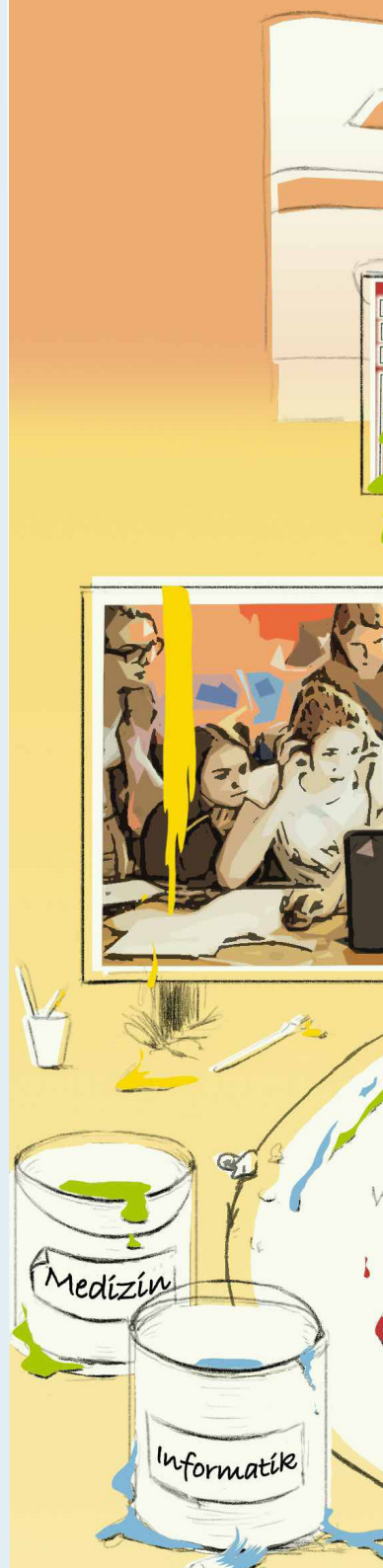
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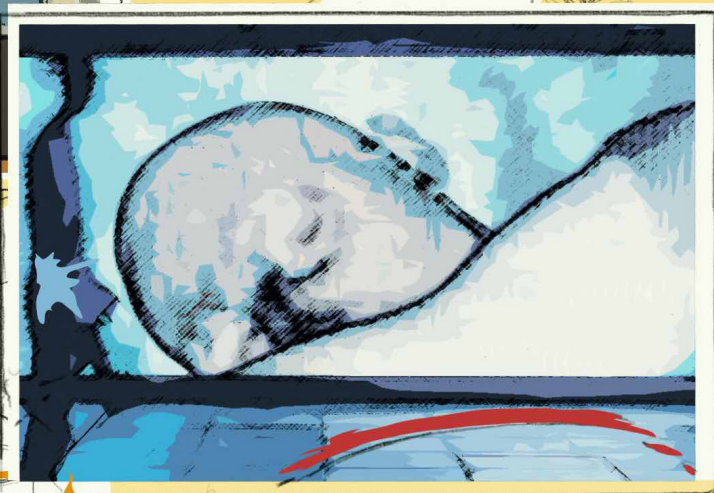
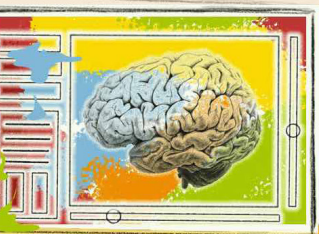
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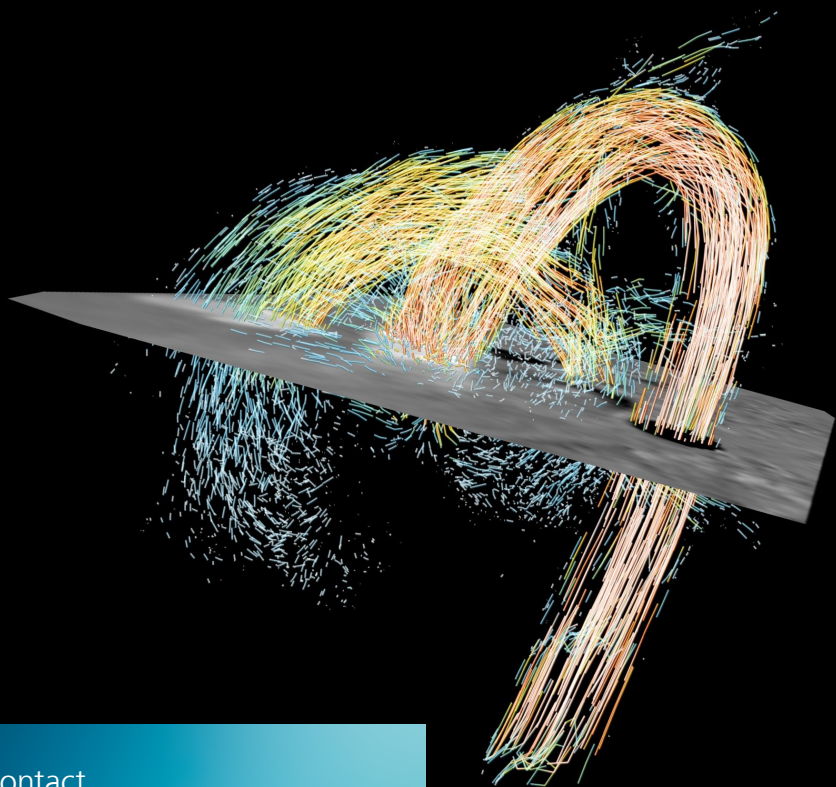
office@mevis.fraunhofer.de

www.mevis.fraunhofer.de

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## Contact

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Head of Science Communication

Bianka Hofmann

Tel. +49 218 59 231

[bianka.hofmann@mevis.fraunhofer.de](mailto:bianka.hofmann@mevis.fraunhofer.de)

Fraunhofer MEVIS

Max-von-Laue-Str. 2

28359 Bremen

[www.mevis.fraunhofer.de](http://www.mevis.fraunhofer.de)