

S+T+ARTS INSIDER

science
+ technology
+ the arts

An E-Magazine series
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ROBOTICS

N°4/6 | November 2026

www.starts.eu

European Commission

S+T+ARTS
INSIDER
N°4/6

EDITORIAL NOTE

ROBOTICS

As robots move beyond traditional industrial automation into increasingly diverse areas of work and everyday life, the relationship between humans and machines is being redefined. Industrial robots, collaborative robots (cobots), and emerging humanoid systems are opening new possibilities across manufacturing, construction, healthcare, and other sectors. Advances in engineering, artificial intelligence, and sensing technologies are making these systems more adaptable and capable of operating in complex environments. Yet their development raises questions that go beyond precision, productivity, and efficiency. Exploring new applications, rethinking established processes, and creating more intuitive and meaningful forms of human–robot interaction require approaches that combine technical expertise with experimentation, critical reflection, and an understanding of human needs and expectations.

Artists contribute to this exploration by challenging established conventions and experimenting with the capabilities and limitations of robotic systems. Working with movement, materials, programming, and interaction, they can reveal possibilities that might remain unexplored within conventional research and development processes. The projects featured in this edition illustrate how artistic engagement can open new directions: from alternative robotic fabrication methods and resource-efficient manufacturing to robotic augmentation of human capabilities, accessible technologies, and new forms of human–machine collaboration. Beyond advancing technical applications, these explorations also influence how robots are perceived, understood, and accepted in society. Together, they demonstrate how artistic thinking can inspire new approaches to engineering and industrial innovation, expand the potential of robotic technologies, and help shape their future role in industry and everyday life.

ABOUT S+T+ARTS

S+T+ARTS INSIDER

STARTS Insider is a **series of six e-magazines**, each dedicated to a specific field, showcasing how artistic thinking can actively shape innovation processes across sectors—from manufacturing and health to AI and the creative industries. Drawing on insights from nearly a decade of the STARTS Initiative, this series highlights lessons learned from collaborations that align artistic practice with European research, industry, and policy goals. Together, these editions demonstrate how alliances between art, science, and technology not only advance innovation, but also ensure it remains human-centred, culturally grounded, and publicly accountable.

ABOUT S+T+ARTS

Launched in 2016, STARTS (Science + Technology + Arts) is an initiative of the European Commission demonstrating that artistic practice is not an add-on to innovation, but a powerful driver of it. At a time of accelerating digital transformation, climate urgency, and social fragmentation, STARTS challenges the idea that technological progress alone can deliver meaningful solutions. Instead, it positions artistic inquiry as a catalyst that disrupts assumptions, reframes problems, and opens up new trajectories for systemic innovation.

STARTS is built on a clear philosophy. Interdisciplinarity lies at its core: artists work side by side with scientists, engineers, technologists, policymakers, and industry partners, introducing experimental thinking, critical reflection, and alternative ways of knowing into research and development processes. Societal relevance ensures that innovation is purpose-driven, addressing real-world challenges such as AI ethics, sustainability, biodiversity, health, and social inclusion. Systemic change guides the long-term vision: STARTS aims not just to produce projects, but to embed artistic methods into research cultures, innovation ecosystems, and governance frameworks.

Since its inception, STARTS has supported 21 large-scale collaborative projects, involving over 165 partners across 26 countries, spanning universities, research centres, SMEs, industry leaders, cultural institutions, and public bodies. At the heart of this ecosystem are 381 artistic residencies , embedding artists directly within laboratories, companies, factories, and policy environments. These residencies have generated new tools, methods, business models, and policy insights—often continuing well beyond their original timeframe.

Funded by more than €65 million in EU investment (2016–2025), STARTS represents a strategic commitment to culture-driven innovation. Its lasting impact lies not only in numbers, but in reshaping how innovation is imagined—showing that Europe's digital and green transitions are strongest when creativity, ethics, and technology evolve together.

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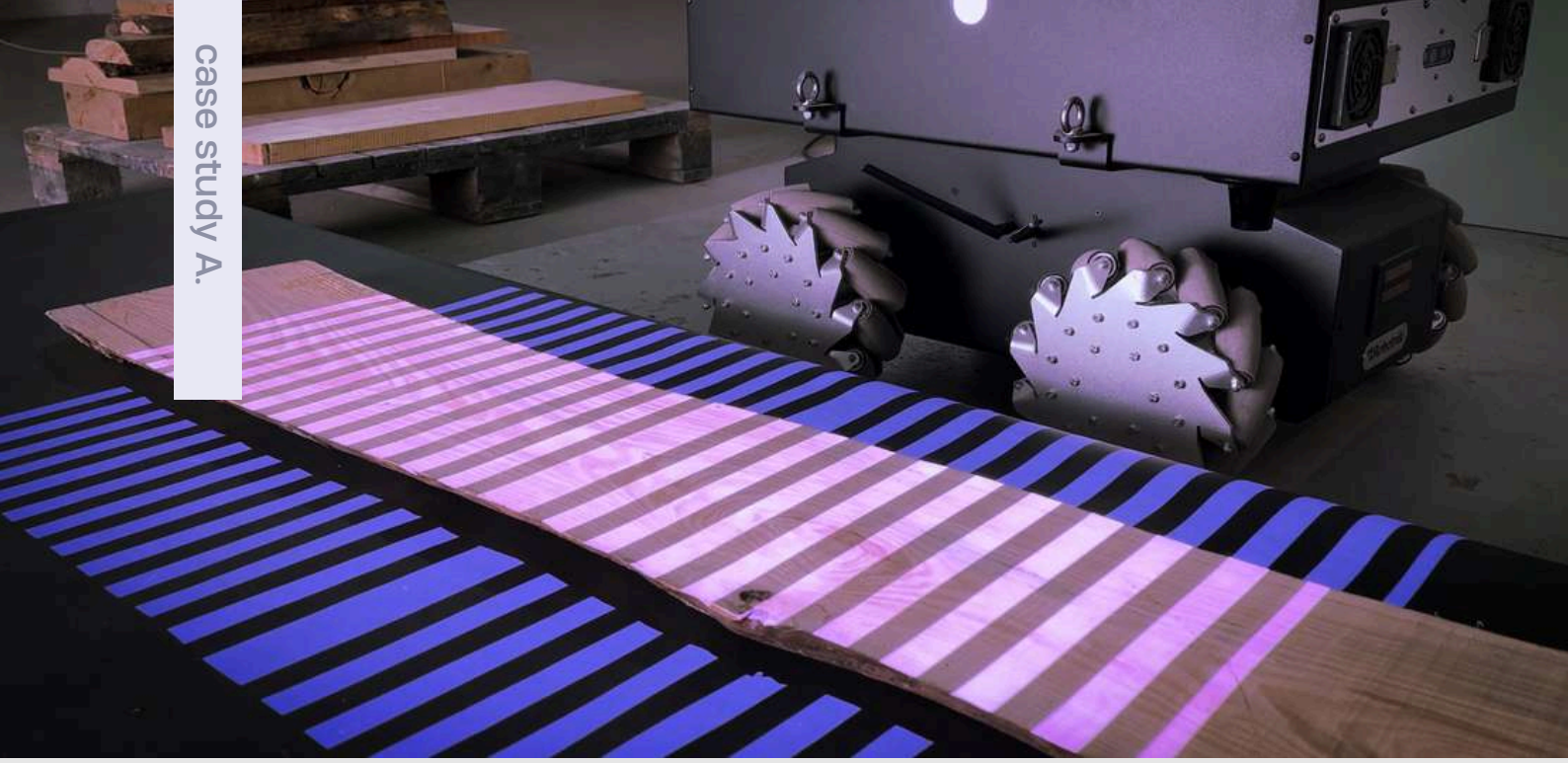
Reinhard Nagler
CEO of KUKA Austria,
Slovenia and Switzerland

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CASE STUDIES





GR-AI-N

MARIELENA PAPANDREOU (GR)

VOJEXT S+T+ARTS RESIDENCY + STARTS PRIZE INOMINATION, 2024]

GR-AI-N is a robotic fabrication project that explores how artistic approaches can expand the capabilities of robotics in sustainable manufacturing. Developed by artist Marielena Papandreou in collaboration with Robotnik, the project transforms discarded timber offcuts into new wooden objects by combining computer vision, AI analysis, and robotic manipulation. A dual robotic end-effector equipped with vacuum grippers and a high-resolution depth camera scans each piece of wood, capturing its geometry, grain pattern, texture, and imperfections. AI tools interpret this data to propose forms that follow the wood's natural contours rather than cutting against them.

Instead of relying on standardized materials, the system assembles irregular fragments into three-dimensional mosaics, using robots to position, join, and finish them with minimal manual effort.

The project's innovation lies in bringing an artistic, material-sensitive approach into robotic production, challenging conventional manufacturing processes designed around uniformity and predictability. By teaching robotic systems to respond to the unique characteristics of each material, *GR-AI-N* expands their potential to work with irregular, non-standardized resources. This collaboration between artistic research and engineering demonstrates how robotics can move beyond repetitive industrial tasks towards more adaptive, resource-conscious forms of production, opening possibilities for applications in furniture design, woodworking, and circular manufacturing.



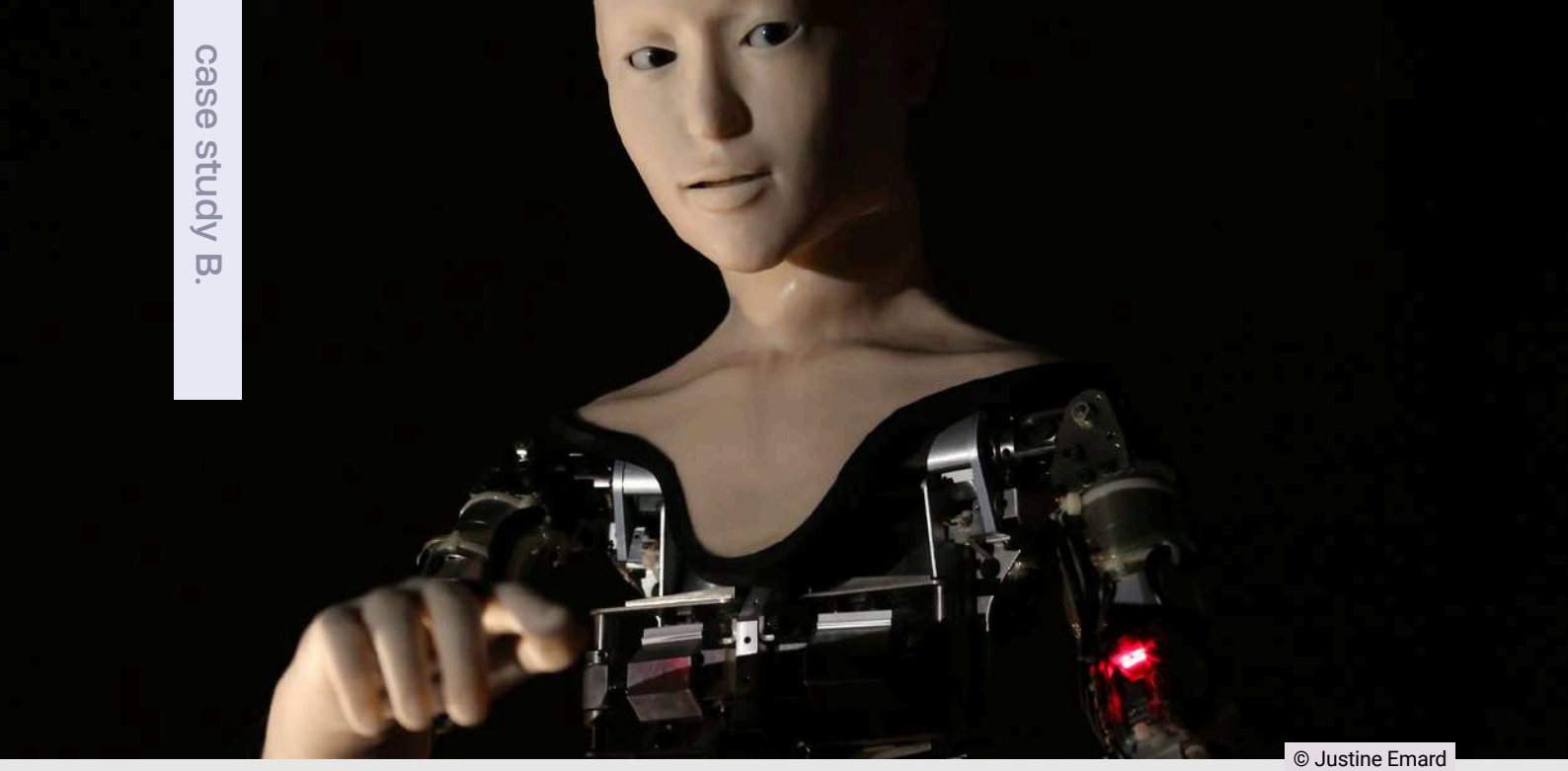
TECHNOLOGY APPLIED:

robotic fabrication, computer vision, 3D scanning, machine learning

INDUSTRY AREAS ADDRESSED:

industrial robotics, furniture and product design, woodworking, sustainable manufacturing

Credits:
VOJEXT S+T+ARTS Art Residency 2: Robotics in Arts and Crafts received funding from the European Union's Horizon 2020 research and innovation program under Grant Agreement 952197
Residency led by VOJEXT PARTNERS: Robotnik and WAAG
Collaborative partner: Vincent Huyghe



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ALTER

KOHEI OGAWA (JP)
ITSUKI DOI (JP)
TAKASHI IKEGAMI (JP)
HIROSHI ISHIGURO (JP)

Alter, an experimental humanoid robot developed by researchers Kohei Ogawa, Itsuki Doi, Takashi Ikegami, and Hiroshi Ishiguro, explores how robotic systems can develop lifelike behaviour beyond predefined movements and programmed responses. Bringing together robotics, artificial life research, and artistic experimentation, the project challenges conventional approaches to robotic control by investigating how autonomous behaviour can emerge from the interaction between a machine, its body, and its environment.

Unlike robots designed to perform specific tasks, *Alter* uses a neural-network-inspired control system that generates movements in response to sensory information.

STARTS PRIZE NOMINATION, 2018

Its exposed mechanical structure and human-like face create an unusual contrast between machine and living organism, inviting observers to question what makes movement appear natural, intentional, or alive. Rather than reproducing human gestures through fixed sequences, the robot exhibits unpredictable, evolving patterns of behaviour.

Through its experimental approach, *Alter* offers a testing ground for understanding how complex behaviours emerge from relatively simple interactions between sensors, control systems, and physical structures. The project demonstrates how artistic inquiry can introduce unconventional research questions into robotics, contributing to the exploration of embodied intelligence and new forms of interaction between humans and autonomous machines.



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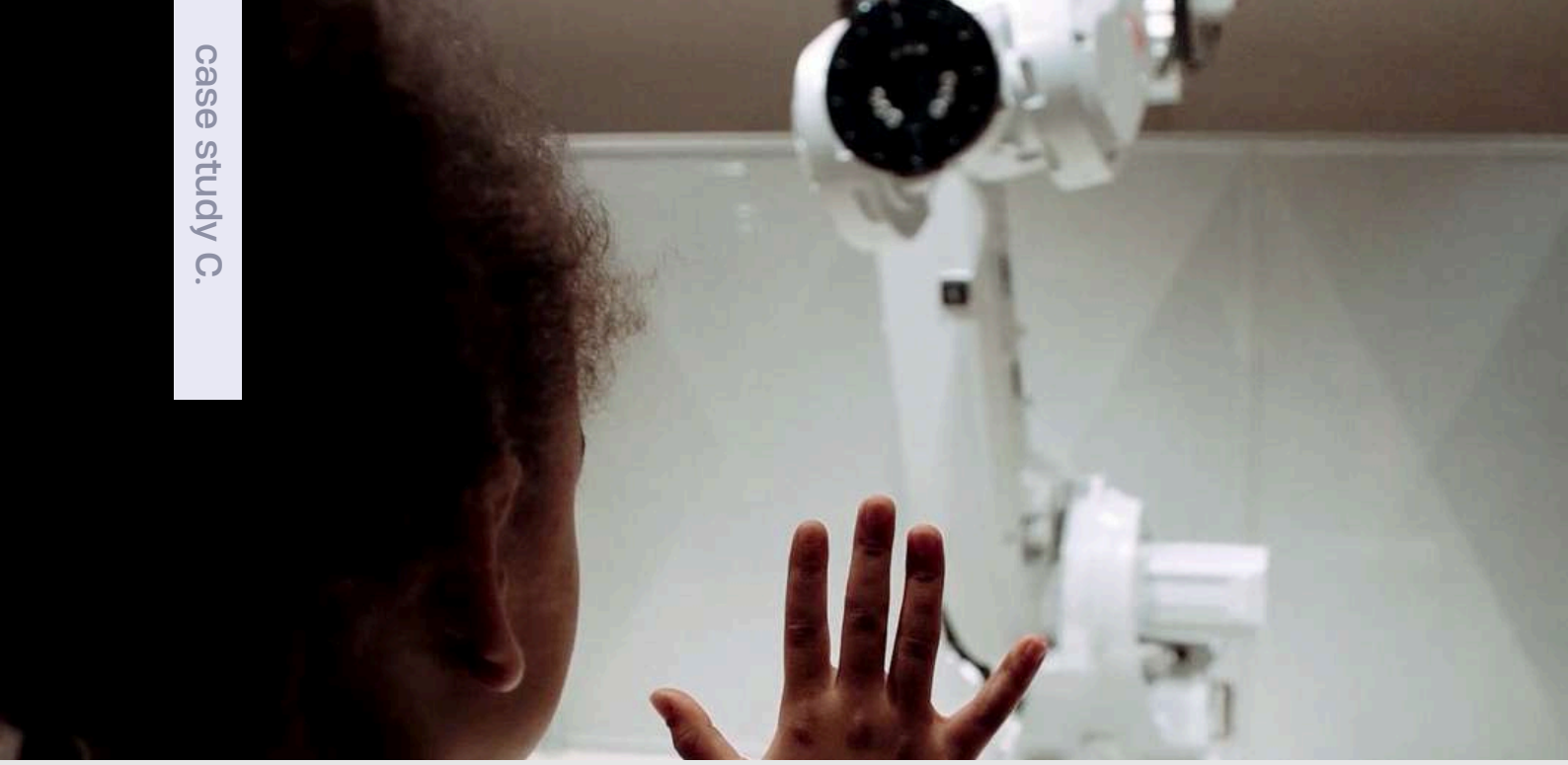
TECHNOLOGY APPLIED:

humanoid robotics, artificial neural networks, sensor-based control, autonomous behaviour systems

INDUSTRY AREAS ADDRESSED:

robotics, artificial intelligence, human-robot interaction, interactive technologies

Credits:
Supported by Osaka University and The University of Tokyo



MIMUS: COMING FACE-TO-FACE WITH OUR COMPANION SPECIES

MADELINE GANNON (US)

STARTS PRIZE
(HONORARY MENTION, 2017)

Mimus, created by artist and researcher Madeline Gannon, explores how artistic experimentation can transform the behaviour of industrial robots and reshape their relationship with humans. Developed in collaboration with Autodesk and ABB Robotics, the installation reimagines a powerful industrial robotic arm as a curious, responsive creature rather than a machine designed solely for repetitive tasks. By introducing principles of animal behaviour and nonverbal communication into robotic design, Gannon challenges conventional approaches to human-robot interaction.

Equipped with a sensing system and custom control software, *Mimus* detects visitors and responds to their presence through autonomous movements. Instead of following predefined sequences, the robot approaches, observes, and follows people, creating encounters that feel spontaneous and expressive. This required new approaches to real-time motion control, environmental sensing, and interaction design. The project demonstrates how artistic research can contribute to robotics innovation by exploring movement, curiosity, and social behaviour as design parameters, opening possibilities for more intuitive and adaptive interactions between humans and industrial machines.



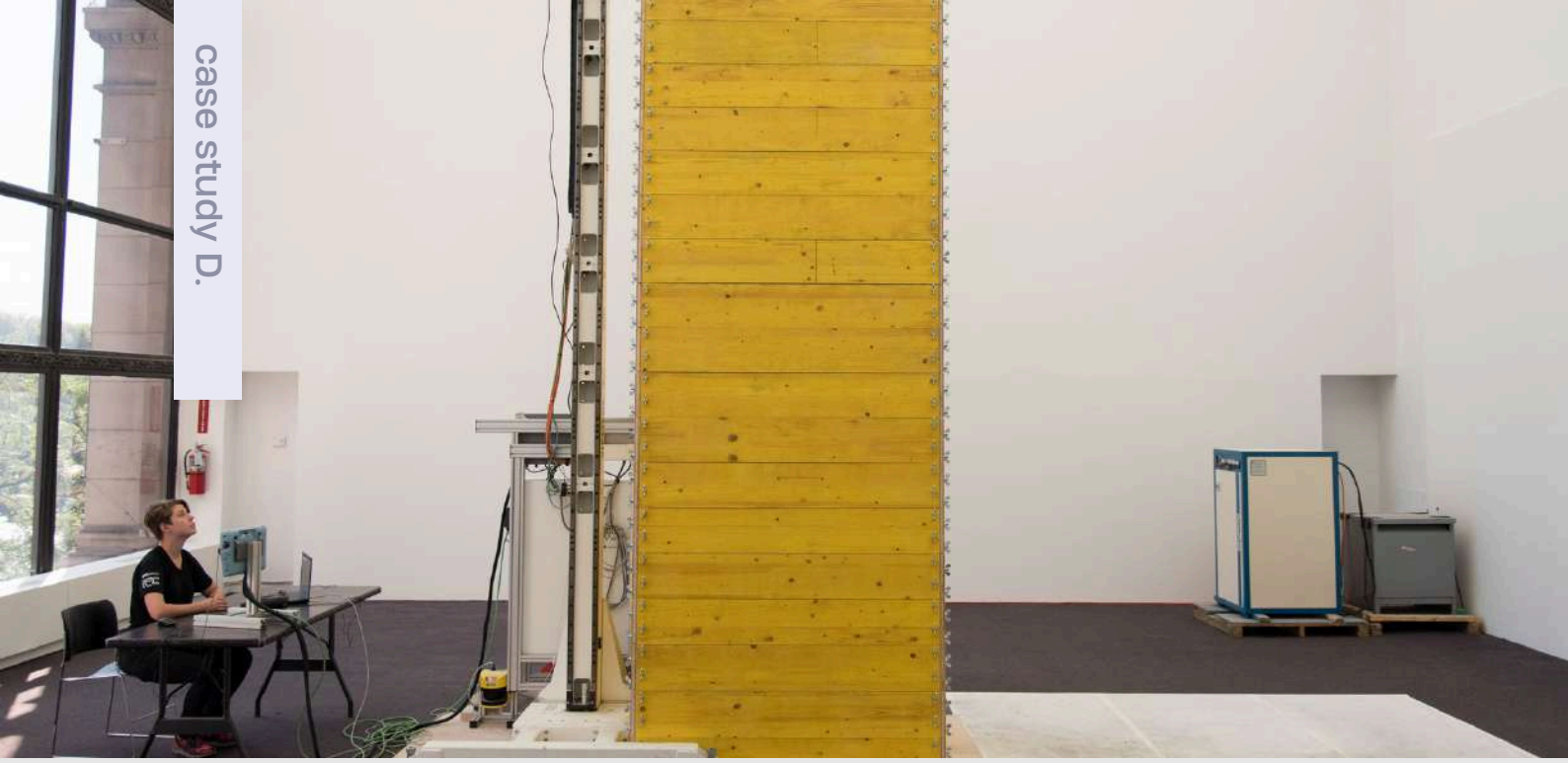
INDUSTRY AREAS ADDRESSED:

robotics, industrial automation, human-robot interaction, interactive design

TECHNOLOGY APPLIED:

industrial robot, motion tracking

Credits:
Madeline Gannon is the founder and principal researcher of ATONATON
Development Team: Madeline Gannon, Julian Sandoval, Kevyn McPhail, Ben Snell
Supported by: Autodesk, ABB Robotics, and The Studio for Creative Inquiry



ROCK PRINT

GRAMAZIO KOHLER RESEARCH, ETH ZURICH (CH), AND SELF-ASSEMBLY LAB, MIT (US)

Rock Print, an architectural research project by Gramazio Kohler Research and the Self-Assembly Lab at MIT, explores how robotic fabrication can introduce new construction methods by combining computational design with the physical behaviour of materials. The project investigates granular jamming, a phenomenon in which loose particles such as gravel can form stable, load-bearing structures when constrained.

Using a custom robotic 3D-printing process, a robotic arm lays a continuous network of tensile string between layers of poured gravel, creating precisely shaped structures without conventional binding agents. Once the string is removed, the structure disassembles, allowing the materials to be recovered and reused.

STARTS PRIZE (GRAND PRIZE, INNOVATIVE COLLABORATION, 2017)

Rather than simply automating existing construction techniques, *Rock Print* demonstrates how architectural experimentation can redefine what robots are capable of building. By combining robotic precision with the self-organizing properties of materials, the project introduces a new approach to fabrication that works with natural physical processes instead of relying on permanent connections. This interdisciplinary research expands the possibilities of robotics beyond conventional industrial assembly, proposing more adaptable, reversible, and resource-efficient methods for architecture and construction.

TECHNOLOGY APPLIED:

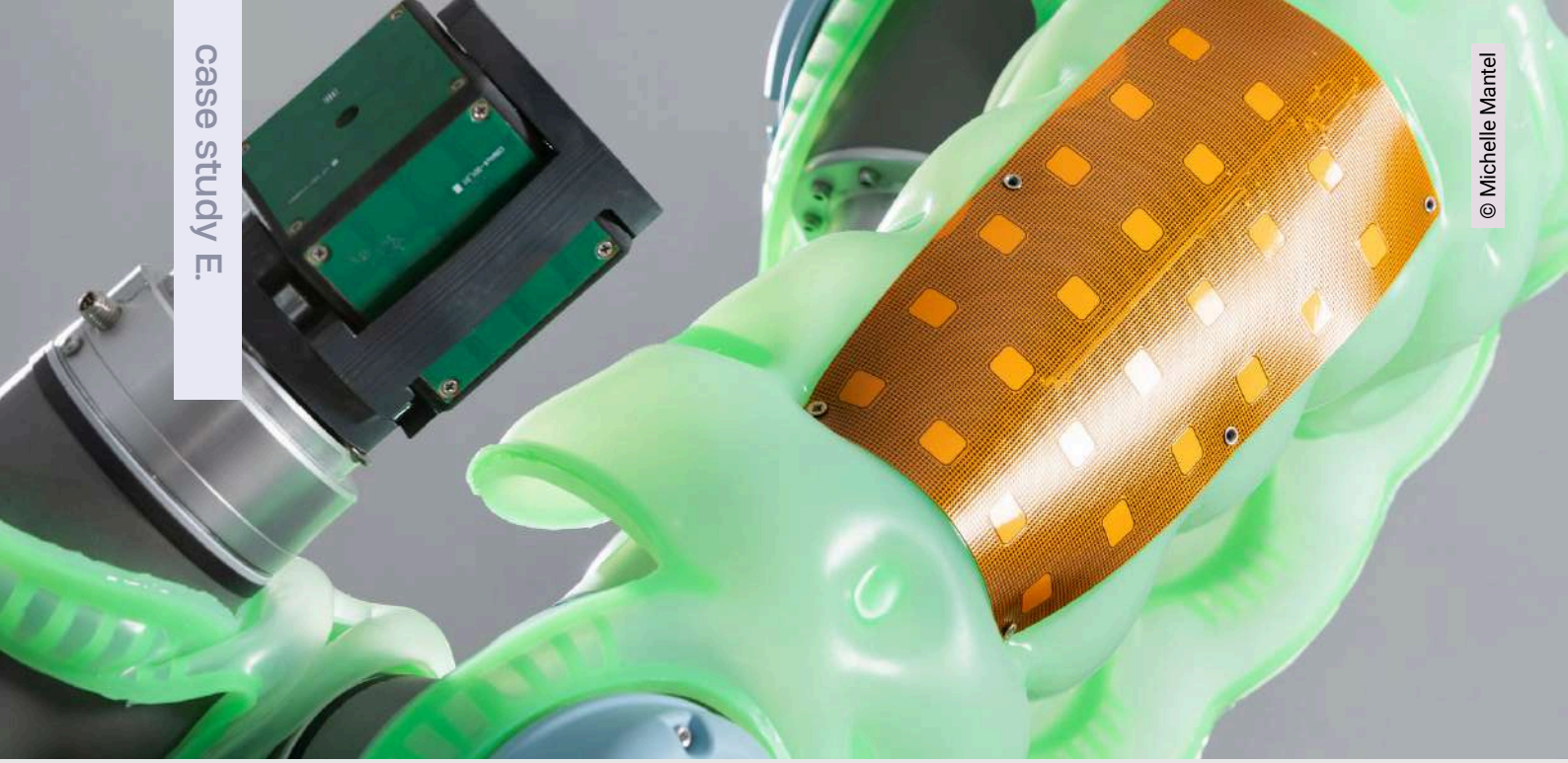
robotic fabrication, computational design, robotic 3D printing

INDUSTRY AREAS ADDRESSED:

construction robotics, architecture and engineering, circular building systems







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SOFT COLLISION
ANNA SCHAEFFNER (DE)

VOJEXT S+T+ARTS RESIDENCY
+ STARTS PRIZE (NOMINATION, 2024)

Soft Collision, an artistic research project by Anna Schaeffner developed in collaboration with robotics engineers and technical researchers from Universidad Politécnica de Madrid (UPM), Nebrija University, and IIT, explores how physical contact can transform human-robot interaction. Challenging the conventional approach of preventing collisions, the project investigates how touch can become a means of communication, enabling more intuitive and responsive collaboration between humans and machines.

The research resulted in a soft, deformable pneumatic membrane that envelops a robotic arm. Equipped with flexible sensors and air channels, this skin-like interface detects the pressure, direction, and intensity of human touch, translating physical gestures into robotic movements.

Through subtle inflations and pulses of air, the robot provides tactile feedback, allowing users to guide and interact with it without relying solely on conventional programming.
Through close collaboration with technical and industrial partners, Schaeffner helped develop a new interaction protocol grounded in tactile feedback and direct physical communication. By challenging conventional approaches to robotic safety and control, the project introduces new possibilities for integrating touch-based interaction into industrial robotics. It demonstrates how artistic research can influence the design of robotic systems and their operating procedures, moving towards safer, more adaptive collaboration between humans and machines in manufacturing environments.

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TECHNOLOGY APPLIED:

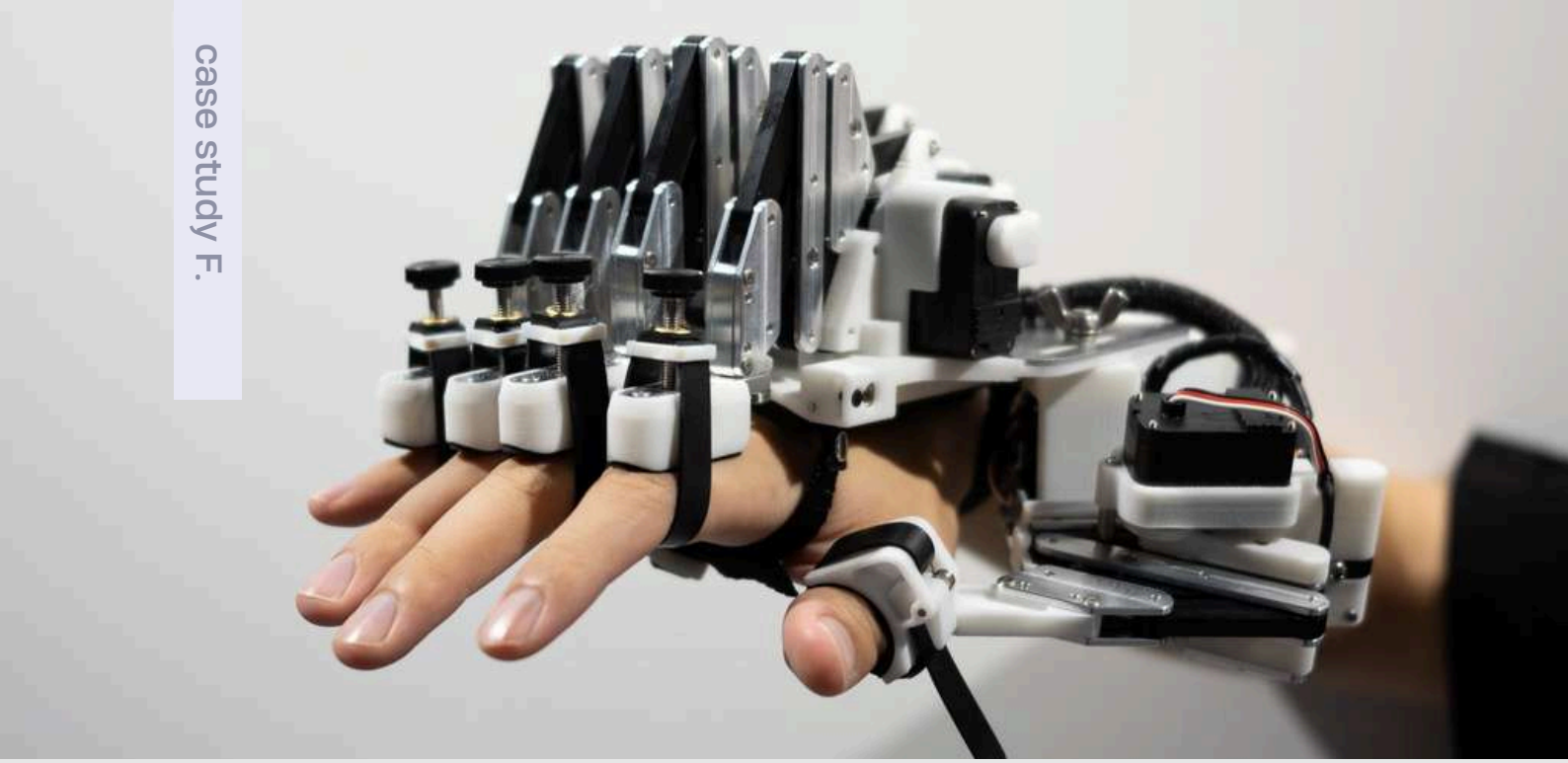
soft robotics, pneumatic systems, tactile sensors, human-robot interaction design

INDUSTRY AREAS ADDRESSED:

manufacturing, robotics, human-machine interfaces, safety design



VOJEXT S+T+ARTS Art Residency 3: Social Robots
Residency led by VOJEXT partners: Fondazione Istituto Italiano di Tecnologia (IIT), Universidad Politécnica de Madrid (UPM), Universidad Nebrija (UNNE) and Waag Futurelab
This project has received funding from the European Union's Horizon 2020 research and innovation program under the Grant Agreement no.952197
With support from: The Cluster of Excellence "Matters of Activity. Image Space Material" Berlin



SURPASSING LIMITS OF VIRTUOSITY OF PIANISTS BY EXOSKELETON

STARTS PRIZE NOMINATION, 2025

SHINICHI FURUYA (JP)

Surpassing Limits of Virtuosity of Pianists by Exoskeleton, developed by Shinichi Furuya and researchers at Sony Computer Science Laboratories, explores how robotics can expand human physical capabilities beyond the limits of conventional training. The project addresses the “ceiling effect”, a phenomenon in which highly trained individuals, such as musicians and athletes, reach a point where extensive practice no longer leads to significant improvements. By approaching human movement not only as a technical function but also as a form of embodied knowledge, the research introduces a perspective that connects artistic experimentation with robotics and human augmentation.

The team developed a wearable robotic exoskeleton that guides pianists' fingers through complex movements at speeds beyond their usual capabilities. By passively experiencing unfamiliar movement patterns, pianists improved their maximum finger movement speed even after removing the device, with improvements also observed in the untrained hand. Rather than using robots to replace or mechanically assist human performance, the project investigates how technology can expand the body's capacity to learn. It demonstrates how exploring the boundaries of bodily expression and experience can inspire new directions in robotics research, with potential applications in advanced skills training and motor rehabilitation.



TECHNOLOGY APPLIED:

wearable robotics, robotic exoskeletons, movement training

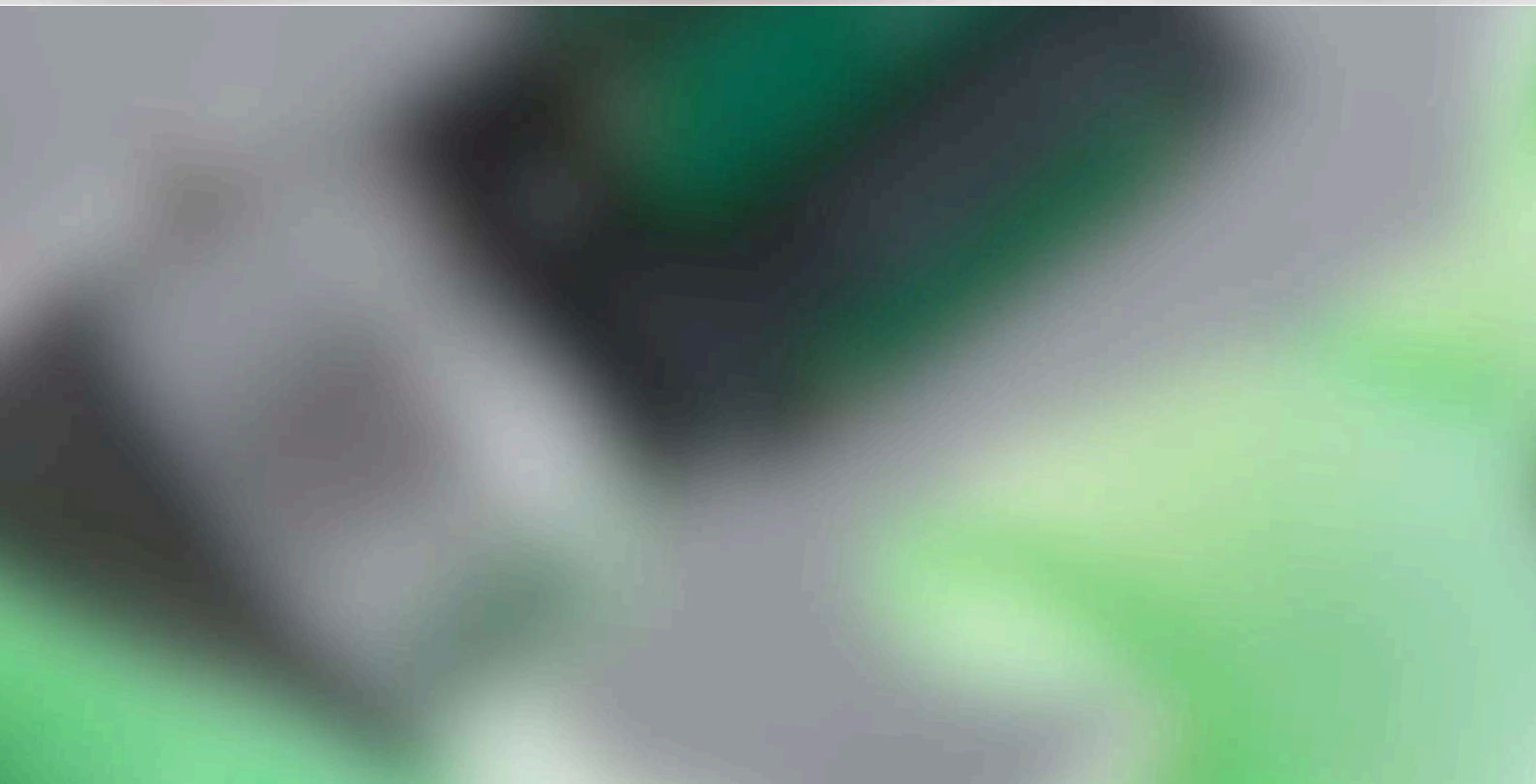
INDUSTRY AREAS ADDRESSED:

robotics, music education, human performance training, rehabilitation technology

All credits are given to Sony Computer Science Laboratories Inc.
This study was supported by JST CREST (JPMJCR17A3),
JST Moonshot (JPMJMS2012),
and JSPS Grant-in-Aid for Transformative Research Areas B (20H05713).

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INTERVIEW WITH



INTERVIEW WITH REINHARD NAGLER



REINHARD NAGLER (AT)

CEO OF KUKA AUSTRIA, SLOVENIA AND SWITZERLAND

Reinhard Nagler is CEO of KUKA Austria, Slovenia and Switzerland. He has been with KUKA for more than ten years, holding various leadership positions in sales and general management. In his current role, he oversees the company's activities across these markets, where KUKA has long supported creative applications of robotics, including its cooperation with the University of Arts Linz and partners such as Ars Electronica, bringing industrial robots to artists, designers and architects.

KUKA is one of the world's leading suppliers of intelligent, robot-based automation solutions. Founded in 1898 and headquartered in Augsburg, Germany, the company develops industrial robots, autonomous mobile robots, production systems and automation software. Its technologies are used across sectors ranging from automotive, electronics and metalworking to healthcare, logistics, battery production and construction, helping companies of all sizes make their production more flexible, efficient and accessible.

INTERVIEW WITH REINHARD NAGLER

S+T+ARTS: From your perspective, what can the robotics industry learn from artists and their ways of working?

Reinhard Nagler: In industrial robotics, we traditionally focus on efficiency, precision, reliability and productivity. Artists often approach technology from a completely different perspective. They start with an idea or a vision rather than a technical specification and are willing to experiment without knowing the final outcome.
I believe this mindset is extremely valuable for our industry. Artists challenge established boundaries, question conventional thinking and explore possibilities that engineers might otherwise overlook.

For me, the most important lesson is that innovation does not always begin with a clearly defined business case. Sometimes it starts with curiosity, creativity and the courage to try something completely new.

„INNOVATION DOES NOT ALWAYS BEGIN WITH A CLEARLY DEFINED BUSINESS CASE. SOMETIMES IT STARTS WITH CURIOSITY, CREATIVITY AND THE COURAGE TO TRY SOMETHING COMPLETELY NEW.“

S+T+ARTS: KUKA has collaborated with artists and cultural institutions for many years. What has motivated these partnerships, and what have been the most valuable lessons?

Reinhard Nagler: For KUKA supporting creative applications of robotics has been an important part of our activities for many years. A particularly valuable example is our long-standing cooperation with the University of Arts Linz and Professor Johannes Braumann, whose work with Creative Robotics and Robots in Architecture has helped make industrial robots accessible to artists, designers and architects. Together with partners such as Ars Electronica, we have supported an environment where creative experimentation meets industrial technology.
Our motivation goes beyond demonstrating robots in unusual settings. We want to inspire new ideas, explore emerging applications and connect with people who approach technology differently.
The most valuable lesson is that innovation often happens at the intersection of disciplines. When artists and engineers work together as equal partners, both sides benefit from perspectives they would not develop on their own.

INTERVIEW WITH REINHARD NAGLER

S+T+ARTS: Can you share an example where an artistic project has led to unexpected insights or new possibilities, if any?

Reinhard Nagler: The Fashion and Robotics project, developed by the Creative Robotics team at the University of Arts Linz, shows how this work can connect with broader manufacturing challenges. It uses collaborative KUKA robots to investigate methods of repairing textiles with recycled materials, pointing towards potential uses in sustainable production and the circular economy.
MycoGravity takes robotics into a very different field. Developed by Amir Bastan, Noor Stenfert Kroese and Johannes Braumann, it uses a KUKA robot to move a bioreactor containing mushrooms and investigate how changing gravitational conditions influence biological growth.
In performance, Austrian choreographer Silke Grabinger's *underbody*, developed with the Creative Robotics team, features five KUKA robots animating a figure that interacts with a human dancer. Here, robotic movement becomes a choreographic language, inviting audiences to reconsider the relationship between humans and machines.
What interests me about these projects is the range of roles the same technology can take on: a tool for textile repair, an instrument for biological research or a partner on stage. Their value lies in revealing possibilities that might never emerge from a conventional industrial brief, even when a commercial application is still some way off.

* * *

S+T+ARTS: As robots become increasingly visible outside industrial settings, how can encounters with art influence people's attitudes towards these technologies?

Reinhard Nagler: For decades, industrial robots have primarily been associated with factories and automated production. Outside our industry, they are sometimes perceived as complex, intimidating or even as a threat to employment.
Art creates a completely different experience. When people see robots painting, performing or interacting with humans, they discover technology as a tool for creativity rather than simply a machine replacing manual work.

I believe this emotional connection is important. People are more likely to accept technologies they can understand and relate to. At the same time, art can encourage critical reflection about automation, autonomy and the relationship between humans and machines. Ultimately, the future of robotics depends not only on technological progress but also on public trust and acceptance.

* * *

S+T+ARTS: Where can collaboration with artists open up new applications or business models in robotics, and what would make these partnerships more effective?

Reinhard Nagler: I see significant opportunities wherever robotics moves beyond traditional mass production and becomes more closely connected to people. Human-robot interaction is a good example: artists and designers bring an understanding of human perception, movement and communication that can help make working with robots more intuitive.

The same applies to flexible manufacturing. In architecture, furniture production, design and craftsmanship, there is a growing need for individualized products rather than large production volumes.

Creative professionals can help us explore new applications and business models, particularly in areas where automation has not previously been considered economically viable. For KUKA, this opens opportunities to make robotics accessible to new markets, smaller companies and entirely different user groups.

Making these partnerships work, however, means bringing together different ways of working. In industry, we focus on clearly defined objectives, budgets, timelines, safety and economic results. Artists often need more room to experiment and allow the outcome to emerge through the creative process.

There are practical barriers, too. Industrial robots require infrastructure, technical expertise and appropriate safety measures, which can be difficult for individual artists to access. Providing an environment where artists and engineers can experiment together, with the right resources and support, is therefore essential.
Ultimately, successful collaboration depends on mutual understanding. Companies need to give artistic exploration space, even when there is no immediate return on investment, while artists need to understand the technology's technical and practical limitations.

INTERVIEW WITH REINHARD NAGLER

S+T+ARTS: Looking ahead, what do you expect to be the biggest changes in robotics over the next three to five years?

Reinhard Nagler: I believe the biggest transformation will be driven by artificial intelligence, simpler programming and greater flexibility. Robots will increasingly be able to understand their environment, adapt to changing conditions and perform tasks without requiring every movement to be programmed in advance. This will make automation much more accessible, particularly for smaller companies and industries where traditional robotics have been too complex or expensive. We will also see robotics expanding beyond traditional manufacturing into areas such as logistics, healthcare, construction and skilled crafts.

For me, the most important change is not simply that robots will become smarter or more autonomous. It is that robotics will become easier to use, more versatile and accessible to a much broader range of people and businesses."

"ROBOTICS WILL BECOME EASIER TO USE, MORE VERSATILE AND ACCESSIBLE TO A MUCH BROADER RANGE OF PEOPLE AND BUSINESSES.„

S+T+ARTS: Within these developments, where do you see the greatest opportunities for artists to contribute?

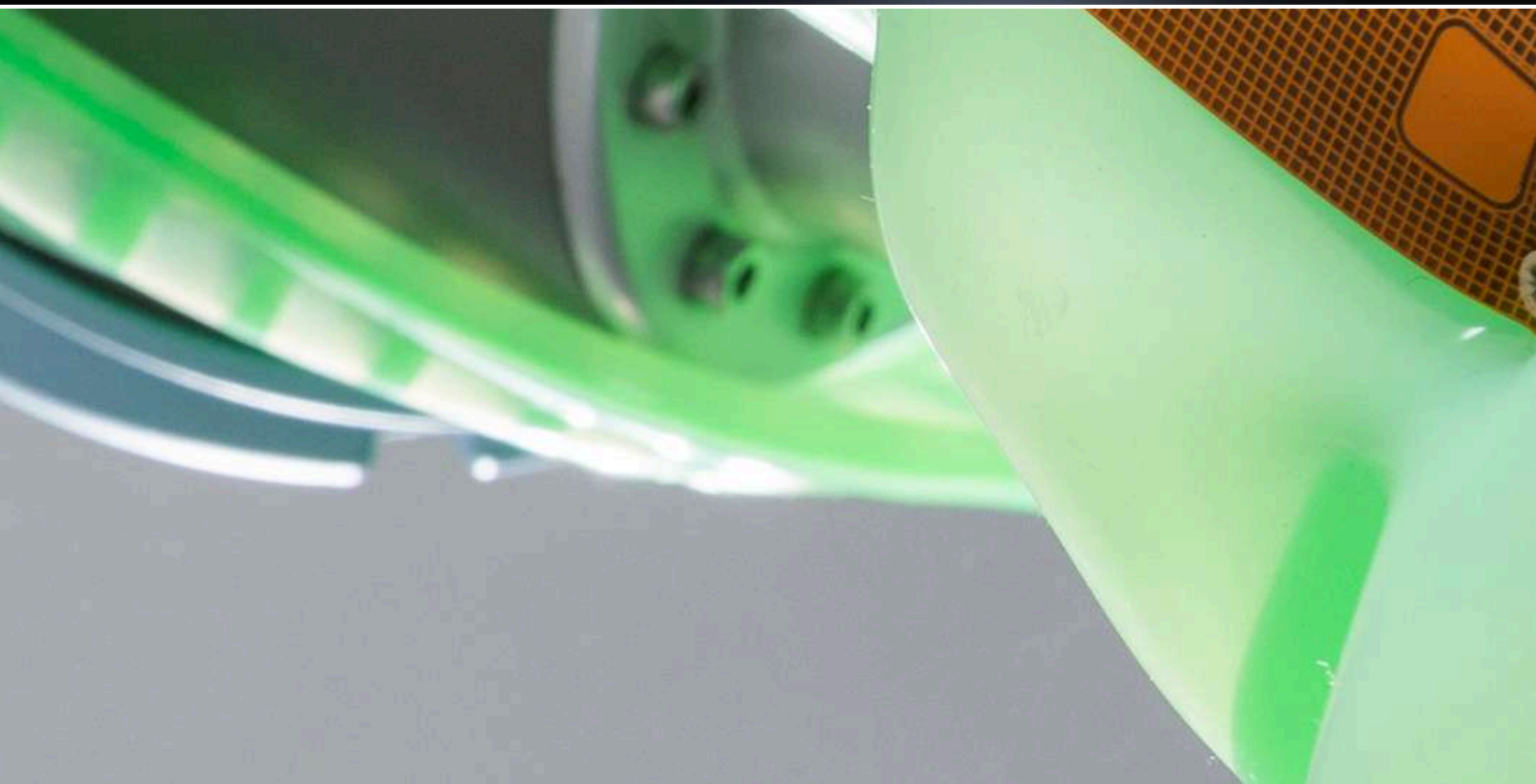
Reinhard Nagler: I believe artistic involvement will become increasingly important as robotics moves towards greater autonomy, artificial intelligence and closer interaction with humans. As robots become more adaptive and easier to operate, the way people communicate and collaborate with them will become just as important as their technical capabilities.
Artists and designers can contribute valuable perspectives on interaction, behavior, movement and the overall human experience. I also see considerable potential in making robotics more accessible to smaller businesses, craftspeople and creative industries through intuitive programming and flexible automation.

For decades, we have focused on teaching robots how to work for people. I believe the next major step is learning how robots can work with people. And this is where artists can make a particularly valuable contribution.

INTERVIEW CONDUCTED BY MASHA ZOLOTOVA (ARS ELECTRONICA) FOR S+T+ARTS INSIDER 4/6, 2026*

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GO FURTHER



GO FURTHER

Research paper · Surmounting the ceiling effect of motor expertise by novel sensory experience with a hand exoskeleton (Science Robotics, 2025)

Read

The study behind *Surpassing Limits of Virtuosity of Pianists by Exoskeleton* (STARTS Prize, Nomination, 2025), featured in this edition. Shinichi Furuya and his team at Sony Computer Science Laboratories show that a hand exoskeleton moving pianists' fingers through fast, complex patterns helped them break through a speed plateau that practice alone could no longer overcome, with gains carried over to the untrained hand.

Article · Collaborations in Artistic Experiments with Robotics (Waag Futurelab)

Read

This article looks back at the VOJEXT S+T+ARTS Residencies, which paired artists with robotics researchers and SMEs to explore human-robot interaction, sustainable materials and traditional craft. It presents three residency projects, including Anna Schaeffner's *Soft Collision* and Marielena Papandreou's *GR-AI-N*, both featured in this edition, alongside Calin Segal's *Ornate Equations*, which turns ceramic debris into robotic mosaics. Short films document each residency.

Article · Fashion and Robotics: An organic shoe grown from bacteria (Scilog, FWF, 2024)

Read

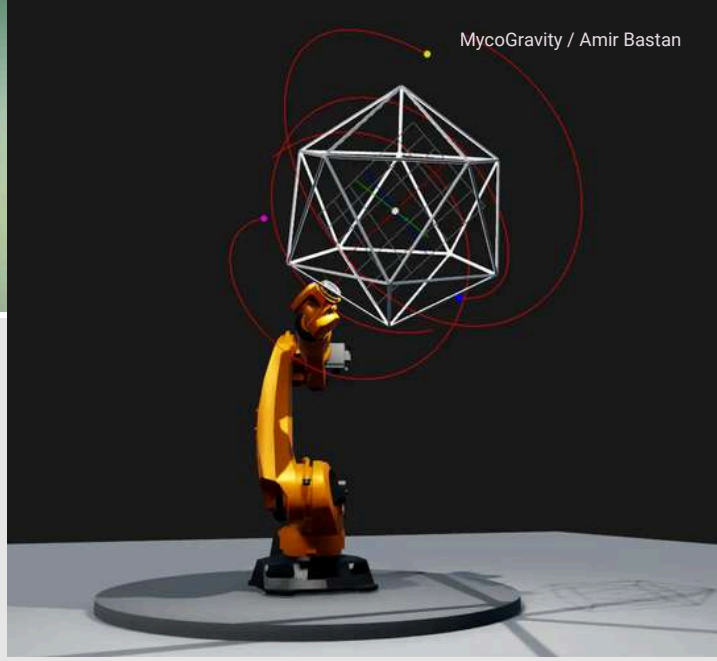
Mentioned by Reinhard Nagler in this edition's interview, the Fashion and Robotics project at the University of Arts Linz brought together fashion design, creative robotics and biomechatronics. Robots repair torn textiles, help redesign older garments and nurture materials grown from bacteria, pointing towards a more sustainable, repair-based fashion industry where humans and machines work together.

Podcast · Madeline Gannon, Design researcher and robot tamer (Design Notes, Google Design)

Listen

In this episode, artist and researcher Madeline Gannon, creator of Mimus (STARTS Prize, Honorary Mention, 2017), discusses how she gave an industrial robot a curious personality, and why rethinking robot behaviour can make machines more approachable. A conversation on human-robot interaction, movement and the design of machines meant to work alongside people.

GO FURTHER


MycoGravity / Amir Bastan

Project · *MycoGravity*
Amir Bastan, Noor Stenfert Kroese and Johannes Braumann

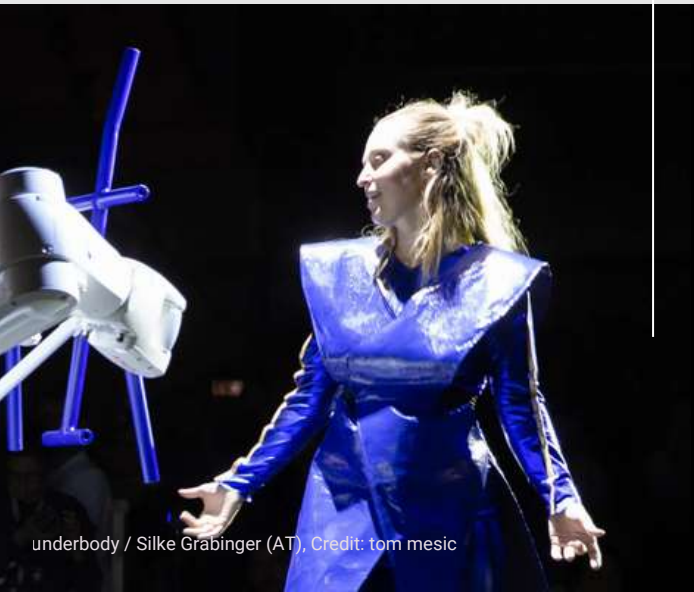
Developed by Amir Bastan, Noor Stenfert Kroese and Johannes Braumann, *MycoGravity* uses a KUKA robotic arm to move a bioreactor containing oyster mushrooms, simulating altered gravity conditions inspired by NASA research. Sensors and cameras track the fungi's growth in real time. A co-production of Creative Robotics at the University of Arts Linz, KUKA CEE and the Mushroom Research Center Austria.

Discover

Performance · *underbody*
Silke Grabinger

In *underbody*, Austrian choreographer and dancer Silke Grabinger performs with a robotic marionette moved by a KUKA industrial robot. Inspired by Gertrud Bodenwieser's 1923 piece *Dämon Maschine*, in which five dancers became one machine, the performance reverses the roles: here, machines control a single dancer. It questions who leads, who follows and who reacts, turning robotic movement into a choreographic language.

Discover


underbody / Silke Grabinger (AT), Credit: tom mesic

Network ·
Association for Robots in Architecture

The Association for Robots in Architecture develops tools such as KUKA|prc to make industrial robots accessible to architects, designers and artists. It also organises ROB|ARCH, an international conference on robotic fabrication in architecture, art and design, and hosts an online map of robots in the creative industries.

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Funded by the European Union



Publication powered by the Consortium of
S+T+ARTS Ec(h)o
in 2026

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Masha Zolotova, ARS ELECTRONICA
Design
Céline Delatte

STARTS Ec(h)o is funded by the European Union under the Grant Agreement No 101135691. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union. The European Union cannot be held responsible for them.