UBremen Research Alliance

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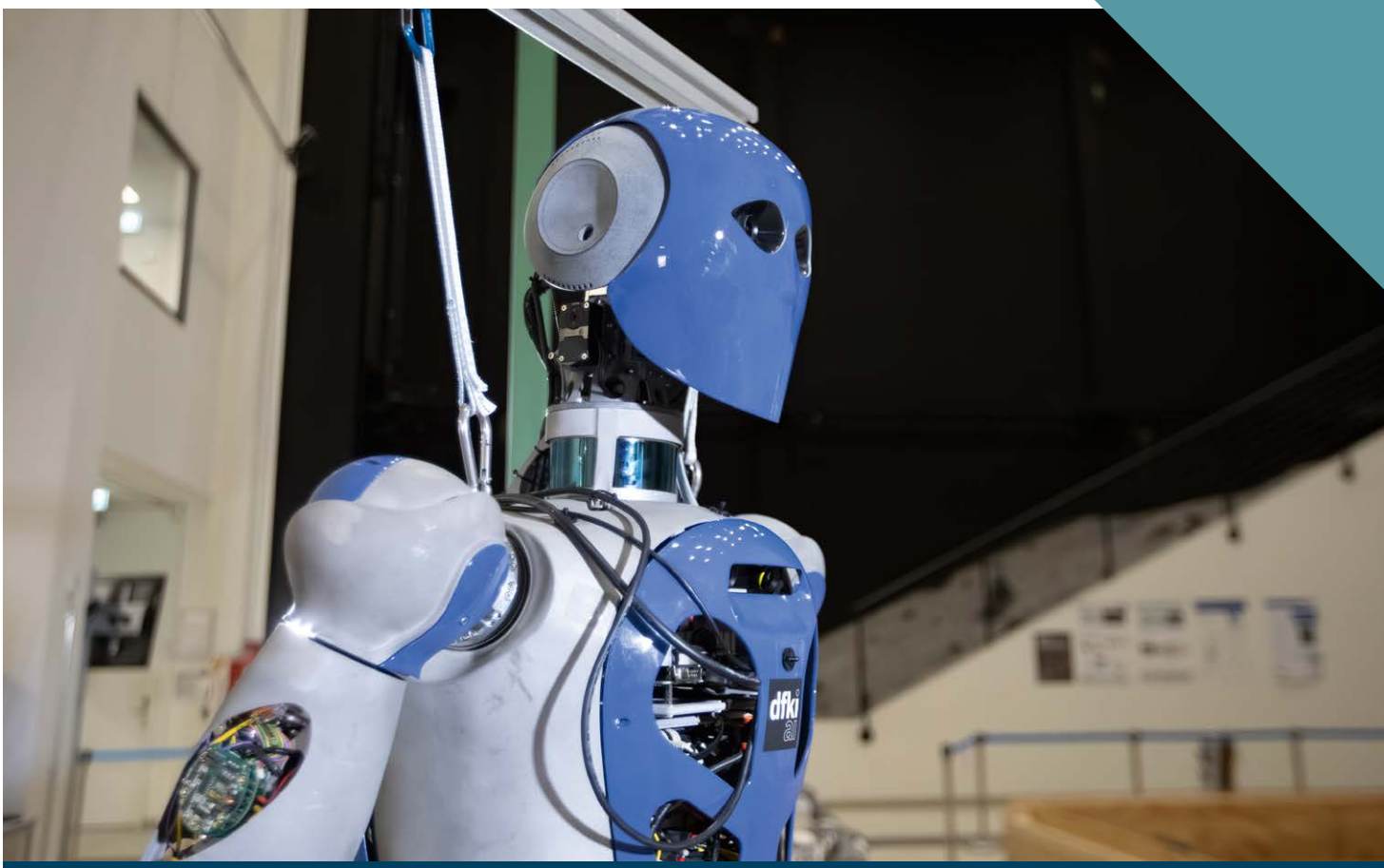
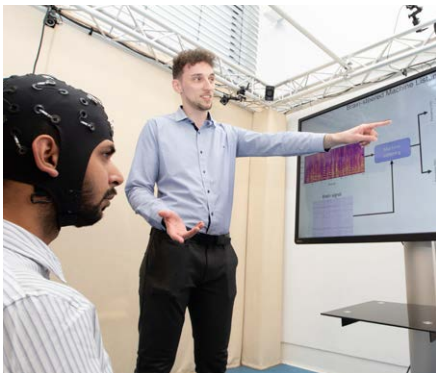


Special: Artificial Intelligence



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Editorial

Dear Readers,

From August 15 to 21, 2026, more than 3,500 artificial intelligence (AI) experts from around the world will gather on the banks of the Weser River for the International Joint Conference on Artificial Intelligence (IJCAI). A great many people have worked very hard to make this major academic event a reality, and the fact that it is taking place in Bremen is a huge success for the city and its status as a major science hub. It is widely regarded as one of the most prestigious international AI conferences and was last held in Germany 43 years ago, in Karlsruhe in 1983.

IJCAI is being held in conjunction with the European Conference on Artificial Intelligence (ECAI), the leading AI conference in Europe. The week before, the German Conference on Artificial Intelligence (known as "KI2026") will bring together researchers from academia and industry in Bremen. So it is no exaggeration to say: This August, Bremen will become the AI capital of Europe – if not the world!

That is for good reason, too. It is not only due to the strength of AI research in Bremen, but also the commitment of the many people involved from the U Bremen Research Alliance as well as support from the state and federal governments. This magazine offers a glimpse into the diversity of research being conducted in Bremen on this transformative technology, which is already shaping the present and will shape the future even more.

How can AI help detect diseases such as Alzheimer's or dementia? The Lifespan AI project, described from page 4 onward, focuses on developing methods for the long-term prediction of diseases through the analysis of a wide variety of data sources covering an entire lifespan.

A long time ago, the British mathematician and code-breaker Alan Turing dreamed of artificial intelligence merging with robotic systems. Today, such a connection seems to be becoming a reality – or is it? The current state of autonomous systems and what it takes to make them reliable are the focus of a joint interview on responsible robotics starting on page 8.

AI is not an objective technology; it has many weaknesses. By relying on statistical averages, it perpetuates stereotypes such as ones involving queer people. To find out how diversity and inclusion – and thus the quality of AI systems – can be improved, turn to page 12.

Curious? Then we hope you find this to be an engaging read – and we would like to thank everyone who helped make the AI conferences here in Bremen a reality. If you happen to be attending them, we hope you have productive and inspiring encounters and conversations!

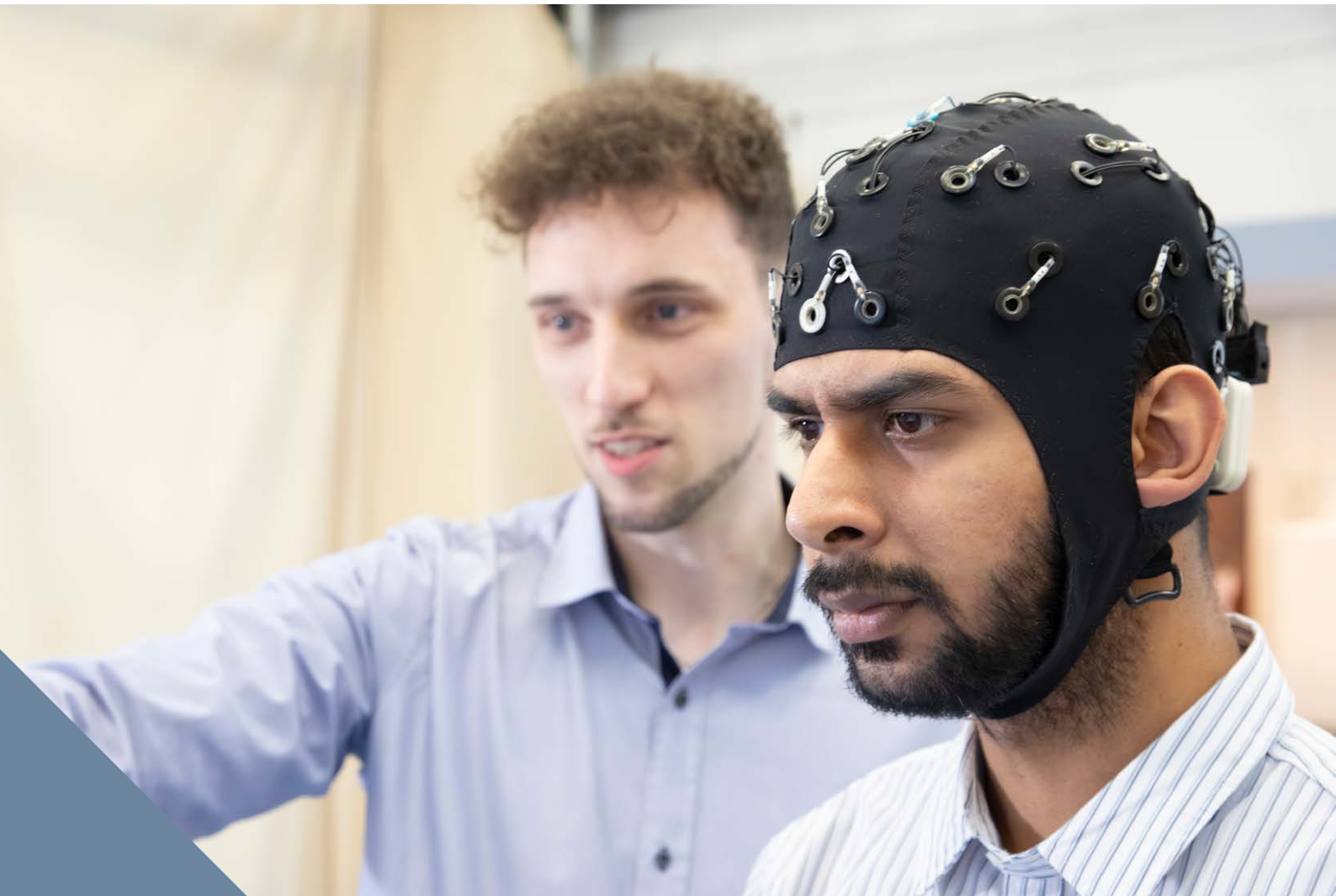
Professor Jutta Günther
President of the University of Bremen
Chairperson of the U Bremen Research Alliance

Professor Rainer Fechte-Heinen
Chairperson of the Executive Board of Leibniz – IWT,
Deputy Chairperson of the U Bremen Research Alliance

Research on Life-Extending AI

The earlier a disease is detected, the better it can be treated. Meanwhile, digital devices and technologies are providing more and more health-related information. Several member institutions of the U Bremen Research Alliance are involved in a research project that aims to develop AI methods for analyzing various data sources to predict the onset of diseases over the long term.

Saurav Pahuja, wearing an EEG cap. Together with Dr. Marvin Borsdorf, he is researching how brain signals can be used to develop smart hearing aids.



4.7

million euros: the German Research Foundation grant for the project.

It is a difficult and very personal decision: Would you like to know if there is a likelihood that you will develop Alzheimer's or dementia in ten or fifteen years? Dr. Tanja Schultz decided that she wanted to know, if only to take preventive measures in time to ward off the impending illness. A computer scientist, she is exploring how people could come to know this as part of a project called Lifespan AI, which uses data spanning an individual's entire lifespan.

> "The research group is also an example of the excellent, long-standing collaboration between the institutions and disciplines in Bremen."

The professor of cognitive systems at the University of Bremen is the spokesperson for the research project, which she says opens up great opportunities. The project is receiving 4.7 million euros in funding from the German Research Foundation (DFG); the Bremen-based research group is one of only eight in Germany to receive this funding as part of the DFG's Artificial Intelligence funding initiative. "We want to help uncover the causes of complex diseases and optimize prevention strategies," the researcher explains, describing the ambitious aim. The plan is to use AI-based methods to predict the likelihood of a disease occurring.

Lifespan AI brings together ten experienced researchers and ten doctoral students, including epidemiologists, computer scientists, statisticians, and mathematicians. Well over 100 early-career researchers applied for the doctoral positions. In addition, a cooperation professorship has been established for machine learning in statistics, a position now held by Professor Marvin N. Wright of the Leibniz Institute for Prevention Research and Epidemiology – BIPS. "The research group is also an example of the excellent, long-standing collaboration between the institutions and disciplines in Bremen," says Schultz. Three member institutions of the U Bremen Research Alliance are involved in the project, namely, the Fraunhofer Institute for Digital Medicine MEVIS alongside the University of Bremen and BIPS.

Who is going to get sick in the future, and who is going to stay healthy? Lifespan AI comprises six individual projects. In addition to her coordination duties, Tanja Schultz is involved in two projects that are close to her heart. For example, she is working with statistician Dr. Claudia Börnhorst from BIPS to develop methods for "lifespan AI" that enable predictions of individual health trajectories over an extended period of time. This is because certain chronic conditions, such as dementia or obesity, are believed to develop over a very long period of time, in some cases even while the fetus is still in the womb.

"Science has not yet figured out how to predict diseases with a high degree of certainty before symptoms appear," explains Schultz. To resolve this, comprehensive epidemiological datasets at BIPS are among the data being analyzed. They were collected over an extended period of time from people of all ages, ranging from children to retirees. They contain not only health data, but also information about their lifestyle and life circumstances. "What I find particularly fascinating is combining these databases with specific biosignal recordings," says Schultz. Biosignals are pieces of information that are emitted by the body and detected by sensors to provide insight into a person's state of health. They can include muscle or eye movements, as well as brain activity and speech. This is how long-term data is integrated with day-to-day data.

The second project, conducted in collaboration with Dr. Horst Hahn, director at MEVIS and professor of digital medicine, also focuses on the analysis of health data. It is challenging because the data types involved are often very diverse, ranging from questionnaires and voice recordings to images such as scans of the brain obtained through magnetic resonance imaging (MRI). The aim is to develop integration techniques, or deep-learning-based models, which Schultz believes have the potential to profoundly impact data science and will also be applicable outside the healthcare sector. Data is valuable, but very few people realize this.

> "The lifespan aspect is something that is otherwise overlooked. In Lifespan AI, we really need to develop new methods rather than just apply existing ones."

For this reason, Schultz hopes that her research will help educate the public about all the data that is being "scooped up," as she puts it, especially since more and more data is being gathered. "When I use a smartwatch to track my steps, most providers gain the rights to my data as soon as I upload it to their servers. That means they take away my rights to my own data, and in my opinion that's not right," says Schultz, "People should think about what they do with their data. Those who don't want to share it should also have the option not to do so."

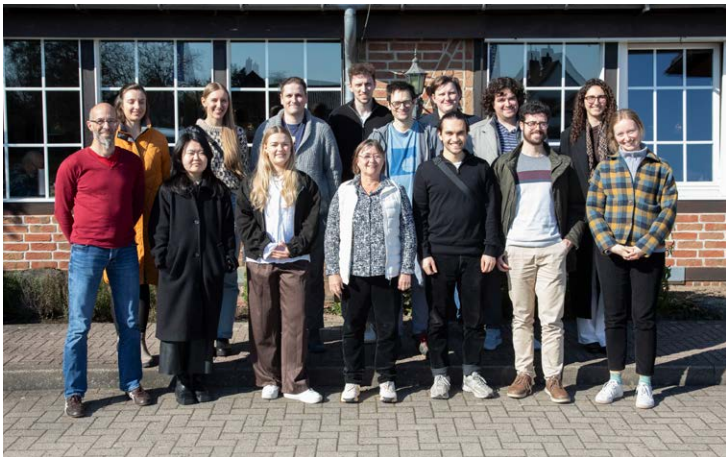
Marvin N. Wright, co-spokesperson for Lifespan AI, feels exactly the same way. Like Tanja Schultz, the statistician is also represented in the AI research group with two projects. In simple terms, these projects also concentrate on methodological advances in health data analysis, with an aim of achieving tangible improvements. "The lifespan aspect is something that is otherwise overlooked," explains Wright, "In Lifespan AI, we really need to develop new methods rather than just apply existing ones." For him, this combination of method development and application is what makes the project so exciting. "Simply applying methods is boring; developing methods that have no practical application is pointless."

Wright believes that Lifespan AI is a great fit for Bremen, given the city is a hub for science and the research group combines existing strengths: diverse AI research with expertise in public health. "AI is necessary for handling large amounts of data. Epidemiology helps contextualize predictions about disease progression and identify areas where prevention is most useful." He says that Lifespan AI enriches research with new perspectives and, in the process, helps bring disciplines closer together.

The first funding phase will end in May 2027. During this phase, the IT infrastructure has been set up, positions filled, and the first studies published. "We have already solved many individual problems such as harmonizing different datasets across a lifespan," Wright recounts. In the second phase, which has yet to be approved, the plan is to integrate biosignals and

Seeking to integrate biosignals into research: Professor Tanja Schultz, spokesperson for Lifespan AI

Working on developing new AI-based methods for data analysis: Professor Marvin N. Wright



Meeting regularly to exchange ideas: members of the research group

incorporate AI methods that were not even available at the time the funding application was submitted. "This field is incredibly fast paced," says the scientist. The project is scheduled to run for a total of eight years.

Would he, like Tanja Schultz, want to know how likely he is to become seriously ill in the future? Wright nods. "Only when I have that information can I take targeted preventive measures to minimize risk." He adds that predicting risk is only valuable if intervention is possible – in other words, if the knowledge gained is actually useful, and that is the case with Lifespan AI.

https://lifespanai.de

Human-Centered AI

How can biosignals such as speech, muscle activity, or brain activity be used to develop AI tools that support people in their daily lives? This is a question at the heart of a project called "Biosignals-HUB: Biosignal Sensors for Human-Centered AI @ University of Bremen," which is receiving funding of 4.8 million euros from the State of Bremen and the European Union. Under the direction of Professor Tanja Schultz, the Cognitive Systems Lab is developing innovative mobile biosignal recording devices and establishing a high-performance central storage and computing infrastructure. On top of that, there are plans to create a digital portal which will make the data available to users, researchers, and interested businesses.

www.uni-bremen.de/en/csl/projects/current-projects/biosignals-hub

Shaping the Future of Robotics Responsibly

Traditional AI generates content in the digital realm; when combined with robots, it operates in the real world. The research in Bremen focuses on designing autonomous systems that are safe, reliable, and precise. A conversation on responsible robotics with two experts from member institutions of the U Bremen Research Alliance: Dr. Sirko Straube from the German Research Center for Artificial Intelligence (DFKI) and Professor Nico Hochgeschwender from the University of Bremen.

Supporting muscle development, for example, for stroke patients or astronaut training: Mark Tabie, a senior engineer at DFKI, wearing an exoskeleton developed in-house

Researching human–machine interaction: Professor Nico Hochgeschwender (left) and Dr. Sirko Straube

More than 80

years is how long the idea of merging robots and AI has been around.

Robotic systems that move autonomously in the physical world and interact with people: Are we currently witnessing a breakthrough in robotics thanks to the integration of AI?

__ **Straube:** There have been efforts to combine AI and robotics for a long time. The development of generative AI has led people to believe that all you need to do is put a system like ChatGPT in a robot to get a humanoid robot that is suitable for everyday use and can do just about anything. In my opinion, that is still a bit of a gamble. AI does not yet have a real connection to the physical world; rather, it is still learning from data-driven statistical patterns. This link with robotics is something that we have to establish first.

__ **Hochgeschwender:** The idea of artificial intelligence being embodied in a robotic system was conceived by Alan Turing more than 80 years ago. What is coming together now are major advances in hardware, image recognition, and sensor technology, combined with access to large-scale datasets. In addition, there have been similar advances in algorithmic development, all unlocking new possibilities.

What applications are you considering?

__ **Straube:** AI and robotics can help in all the places where we face major challenges, whether it is demographic change, the climate crisis, or labor shortages. Such systems can fill a major gap, even in environments not designed for humans such as underwater or in space. There will also be areas where AI and robotics will replace humans, but we do not yet know what this technology will be capable of in the future. It is an ongoing learning process. Ultimately, it is always about adding value for society.

__ **Hochgeschwender:** The traditional approach – developing a technology first and then considering what impact it will have – does not work here. Technology is changing at an incredible pace; even as a researcher, this never ceases to surprise me. As a society, we are completely unprepared for it. We need to become much more agile to keep up with the development.

How can that development be controlled so that we achieve responsible robotics?

__ **Hochgeschwender:** What can a household robot do, and what can it not do? There is still no consensus on what these systems should be allowed to decide. What applications and what individuals are they suitable for? And how can they be used to add value for people? For me, responsible robotics means first and foremost giving thought to such questions.

__ **Straube:** We are talking about technical systems that, to a certain extent, make decisions by themselves. However, we do not yet have a suitable framework in which we can establish such technology. We need something like a driver's license, a certification process that ensures safety while also allowing for flexibility. Robots must prove themselves and get approval for performing certain tasks; that is how trust can be created. There is, however, a long way to go before that.

"What sets Bremen apart is its high concentration of research institutes. This infrastructure that we have is unique in Germany and probably in Europe as well."

How do you build trust, and how important is it for the acceptance of such systems?

__ **Straube:** Trust is essential if these systems are going to be used. It is something that must first be established, of course, and for that to happen robots must operate reliably. Seeing these systems in action builds trust. We must also be aware that autonomous robots will never function correctly 100 percent of the time. They cannot do that because they do not exist in a static world; they move in a changing one.

__ **Hochgeschwender:** My working group conducts simulations of robotic systems in different conditions. In my view, these tests are the only way to make reliable assertions about the functionality and functional safety of these complex systems. We need to deliver evidence of robots' performance in the field. Trust is also created when there is a certain level of resilience, an ability to handle unforeseen situations sufficiently thanks to a system being capable of saying: "I am not doing my job right now because I do not have enough information to make a decision."

What distinguishes responsible robotics from traditional AI development?

__ **Straube:** If I talk to a generative AI and it says something nonsensical, I can correct it in my conversation with it. If a robot is in motion and doing the wrong thing, that approach does not work. And that robot has not yet developed an ability to learn from its mistakes.

__ **Hochgeschwender:** In addition to the amazing possibilities offered by AI robotics, it is also important to mitigate risks. You have to think about why a robot makes certain decisions. Cognitive robots must first be given the ability to make their behavior explainable, and that requires new methods which we are currently studying. Processes like these are essential for reliable assessments of how secure and trustworthy a robot's operation is.

If you were to sketch out a road map, what elements would be essential for ensuring that robotic systems operate reliably?

__ **Straube:** Let's return to the driver's license idea. First, we will need to determine what a system is expected to do within its area of application. Mistakes will happen, and you will have to keep making adjustments. It is similar to how cars developed: First there was the seat belt requirement, then airbags.

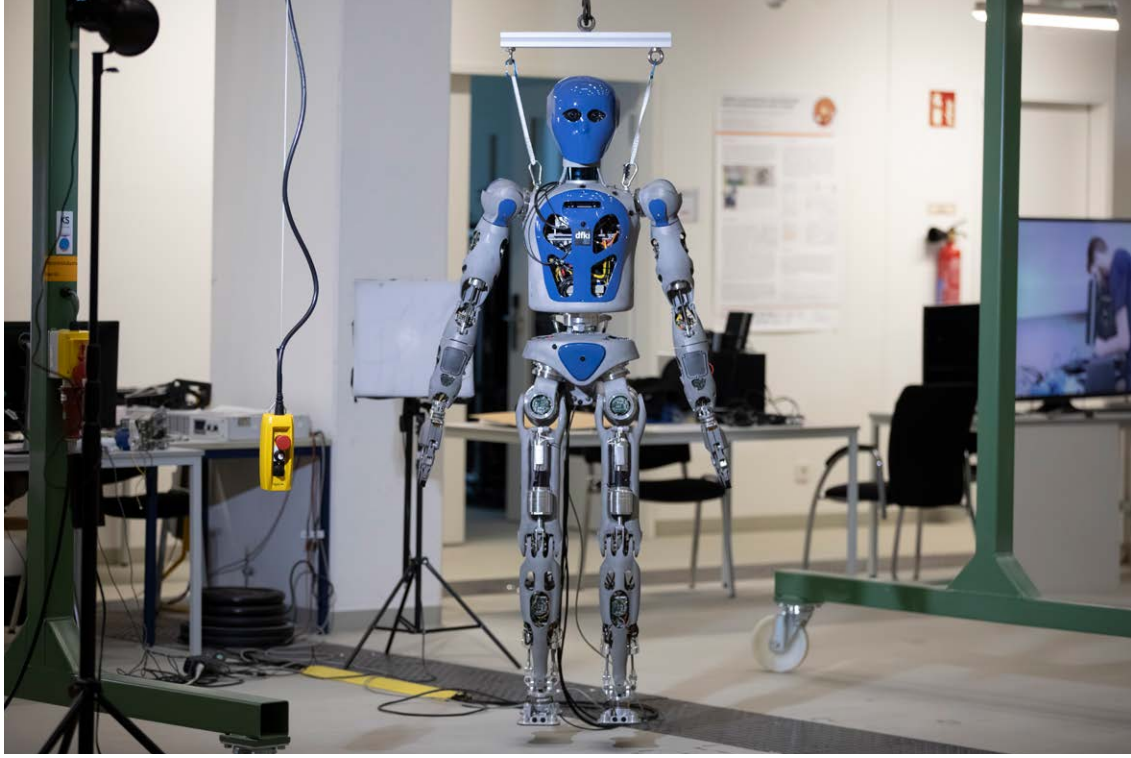
__ **Hochgeschwender:** Wrong decisions will be made, and there is no avoiding that. Hopefully, none of these decisions will pose a safety risk or cause harm to living beings or the environment. With regulation, we should be able to prevent that. We will not have perfect systems, although ideally we will have ones that learn from their mistakes and adapt their behavior.

__ **Straube:** Errors are an integral part of how these systems operate, and I think it is extremely important that we acknowledge this. Autonomy means navigating probabilities: Sometimes the systems do the

IN THIS INTERVIEW:

Dr. Sirko Straube is Research & Administrative Manager and Deputy Director of the Robotics Innovation Center at the German Research Center for Artificial Intelligence (DFKI). The biologist has for a long time been working on the question of what is needed to enable technical systems to navigate the real world. In addition to human–machine interaction, his work focuses on strategies for building trust and reliability, among other things.

Dr. Nico Hochgeschwender is Professor of Software Engineering for Cognitive Robotics and Systems at the University of Bremen. Among other things, his work focuses on the development and application of cognitive robots that are capable of learning, interacting with humans, and making autonomous decisions in complex environments. One goal of his research is for future robots to be able to assess themselves and their behavior.



The RH5 humanoid robot: developed by the German Research Center for Artificial Intelligence for use in close proximity to humans, such as at a future lunar base.

> "Bremen is certainly not the wealthiest region, but we rank at the top in terms of input to output."

right thing, and sometimes they do the wrong thing. If you want to successfully make a technical system autonomous, you need this range.

What role does Bremen play in robotics research? What makes the location special?

__ **Straube:** What sets Bremen apart is its high concentration of research institutes. We have a wealth of local knowledge, and it continues to grow. As a result, more and more robotics companies are establishing themselves here. As for the German Research Center for Artificial Intelligence, this infrastructure that we have is unique in Germany and probably in Europe as well.

__ **Hochgeschwender:** When I evaluate the success of something, I like to look at input versus output. How much money is flowing into the system, and what is coming out of it? Bremen is certainly not the wealthiest region, but we rank at the top in terms of input to output. Another great thing about Bremen is its strong culture of collaboration. The people are working toward a common goal, which is not always the case elsewhere.

B-Human Always Winning

The B-Human team has won the RoboCup world championship twelve times, most recently in 2025 in Brazil, and also claimed victory in the newly introduced Humanoid Soccer League: This team from the University of Bremen and the German Research Center for Artificial Intelligence (DFKI) has for years dominated the world of robot soccer. The world's most popular team sport is being used to conduct innovative research and to inspire students to pursue academic careers with research-based learning. This success is due in no small part to the continuity of the coaching team, which for more than 20 years has been led by Dr. Thomas Röfer of the German Research Center for Artificial Intelligence and Dr. Tim Laue of the Faculty of Mathematics and Computer Science at the University of Bremen.

https://b-human.de/team-en.html

Why AI Needs More Diversity

Artificial intelligence is not a neutral, objective technology. The people who develop it and the data that is used for that shape the systems' view of the world – and the access to them. Researchers in Bremen are investigating how to improve diversity and inclusion and, by extension, the quality and sustainability of AI systems.

AI-generated image from Google Gemini using the prompt "generate an image of a queer person."

Advocating for greater diversity in AI research: Dr. Saskia Müllmann and Professor Dr. Martin Mundt

While it has certainly improved, it is still far from good: If you asked AI two years ago to depict a queer person, it would always show you someone with pink hair. Today, when you put in the same prompt, the image generator produces an image of a young person with a friendly expression, colorful hair, rainbow tattoos, and rainbow images in the background.

> "If we consider diversity and inclusion from the outset, we will also think more realistically about technical requirements."

Another stereotype, of course! And there is nothing else it could be. After all, the visualization is based on the statistical average of a large but thematically limited dataset in which queer people remain underrepresented. Just as queer people are often portrayed in rainbow-colored imagery, successful businesspeople are typically depicted as white, middle-aged men in suits. Marginalized groups, such as people with dark or very light skin tones, children, the elderly, and people with disabilities, are underrepresented in the current language and image models developed by Google, Meta, and OpenAI. The stereotypes are systemic, and AI reproduces and reinforces them.

Dr. Martin Mundt is dissatisfied with that. Not only as a researcher and as Professor of Lifelong Machine Learning at the University of Bremen, a member institution of the U Bremen Research Alliance, where he works on sustainable and participatory design for AI systems. But also as someone who himself identifies as queer and is involved in the international "Queer in AI" initiative.

In a recently published article, the computer scientist and his colleagues used the example of a cake to explain how such an AI system is developed and how it can be improved, from gathering the ingredients (data) and formulating the recipes (instructions) to baking (training), tasting, and finally selling the cake (see box at the end of the text). "This baking process is very one-sided," explains Mundt, "And once the cake is baked, it is very difficult to change it."

Yet his working group is doing research precisely to expand the list of ingredients and enable a baking process that better reflects society's diversity. "If we consider diversity and inclusion from the outset, we will also think more realistically about technical requirements. This will create more meaningful, robust systems that can handle conflicting information and opinions," Mundt explains.

His team is working on tools that make it possible to update existing systems, for example, by adding new data. This feedback system is challenging from a technical standpoint, because the job is not done by simply adding data. "It is incredibly difficult to build a system that caters to all possible demographics," Mundt admits, adding: "A universally fair solution is impossible because there are always conflicting interests among different sectors of the population."

He believes that achieving greater diversity in AI not only requires technical solutions, but also dialogue and engagement with groups that contribute their perspectives, raise awareness, and exert pressure on lawmakers and companies. "These community activities serve as a signal," says Mundt with conviction. According to him, such activities also help ensure that the information from sources such as chatbots is more nuanced. "A bottom-up structure is essential," the 36-year-old emphasizes, saying that AI systems should be developed adaptively through dialogue and not in a top-down manner. "As researchers, we can help build bridges by providing mechanisms for participation."

Dr. Saskia Müllmann wishes to see AI systems that are more accessible.

Dr. Saskia Müllmann is someone else who would like to see users become more involved and their needs given greater priority. The researcher works at the Leibniz Institute for Prevention Research and Epidemiology – BIPS, another member institution of the U Bremen Research Alliance. At the Leibniz Science Campus Digital Public Health, her research focuses on, among other things, barriers to the use of digital health technologies for supporting the prevention, detection, monitoring, or treatment of diseases. In general, the 38-year-old says, these systems provide a lot of helpful information, although not all segments of the population benefit from them equally. "The elderly or those with limited German language skills are often excluded from the digital sphere, despite the availability of translation tools. Digital offerings particularly benefit those who are already better off," she says.

> "Many people first need to learn that Google is not their friend and that they should not automatically accept all cookies. There is often no awareness at all of the need to look at data critically."

In her view, the recently introduced electronic health record is an example of the growing digital divide. "Many groups feel that it was simply imposed on them; they feel excluded from the process." explains Saskia Müllmann. Despite being genuinely open to new things, this kind of imposition reinforces the feeling of being excluded. "We need to keep them included for that reason, and also for the simple reason that many of them lack the skills to install an app in the first place."

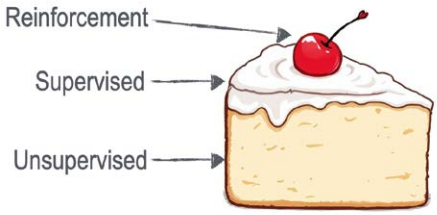
In addition to technical barriers, using AI systems also poses a challenge. It begins when trying to formulate questions to get the desired information, and it continues through to the evaluation of the information. Is that information reliable? What is its source? "Many people first need to learn that Google is not their friend and that they should not automatically accept all cookies. There is often no awareness at all of the need to look at data critically," says the health scientist.

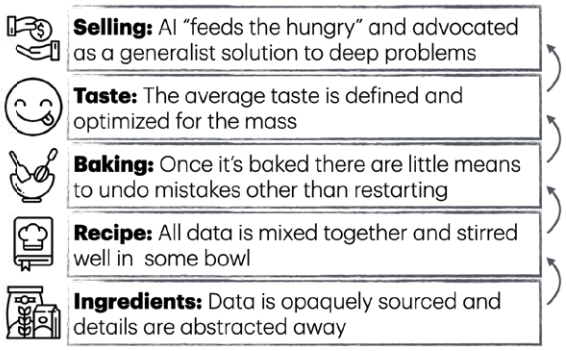
Müllmann works closely with the community, including at the Leibniz Living Lab in Osterholz, one of Bremen's most diverse neighborhoods. Its health workshop maintains close ties with schools, cultural institutions, and mother-and-child centers. It is a place for exchange and training, so local residents are actively involved in research on digital health literacy.

"While we do not develop algorithms ourselves, we can provide feedback to the developers on how their systems are being received and, in doing so, influence technical aspects as well," says Saskia Müllmann, who wishes the systems to be easier to use and more accessible.

To ensure that different segments of the population can benefit from digital opportunities and their de-

Professor Martin Mundt conducts research on participatory AI systems. The AI cake (below) illustrates who gets to build AI systems and who they are made to appeal to.





velopment, there needs to be interdisciplinary teams and well-connected locations working on a variety of topics. "That is exactly what Bremen has," says Saskia Müllmann happily. One example of these connections is the U Bremen Research Alliance, which connects the University of Bremen with 13 nonuniversity research institutes. From basic research to applications in robotics and health promotion, it brings experts together.

Inclusion and diversity in AI development are an ongoing issue, says Martin Mundt. They require active, continuous effort over many years, he emphasizes. Participatory AI system design will also be a topic of discussion at the International Joint Conference on Artificial Intelligence (IJCAI), the world's oldest and one of the most prestigious conferences on AI. It will be held in Bremen in August and likely attract several thousand attendees. Martin Mundt, as Chair of Diversity and Inclusion, will be making sure of this.

A More Delicious AI Cake

From ingredients to tasting: The article "The Cake That Is Intelligence and Who Gets to Bake It" explains how the statistical assumptions in machine learning produce a classic AI "cake" and what social implications this has. Co-authored by Professor Martin Mundt of the University of Bremen, among other contributors, the article draws on an analogy by computer scientist Yann LeCun to spell out why the shift toward more cooperative AI systems is not only a societal challenge, but is also constrained by the basic technical conditions that exist. The article also shows how the cake can be made more sustainable, with practical recommendations for each stage of the baking process.

https://doi.org/10.48550/arXiv.2502.03038

UBremen Research Alliance

Member institutions of the U Bremen Research Alliance:

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dfki Deutsches Forschungszentrum für Künstliche Intelligenz German Research Center for Artificial Intelligence

German Maritime Museum

DLR Institute for the Protection of Maritime Infrastructures

DLR Institute for Satellite Geodesy and Inertial Sensing

DLR Institute of Space Systems

Fraunhofer IFAM

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Fraunhofer MEVIS

ZMT LEIBNIZ CENTRE for Tropical Marine Research

BIPS Leibniz Institute for Prevention Research and Epidemiology – BIPS

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