TransAIR

DEMOCRATIZE AI WITH OPEN RESEARCH

Open Science in Artificial Intelligence and Robotics.

CONTENT

DEAR MEMBERS OF THE AI AND ROBOTICS COMMUNITIES

From September 30 to October 14, 2020, more than 120 AI researchers and practitioners from 18 countries met online to discuss the democratization of AI. The conference focused on the advances, challenges, and potentials of open science in artificial intelligence and robotics. I am convinced the topics we discussed will play an important role for society over the next decades – open science is essential if we want to harness these new technologies for the benefit of all and develop applications beyond those that promise the greatest commercial success. This brochure provides an overview of the discussions and can serve as a starting point to dig deeper into particular topics or to get in touch with the participating experts.

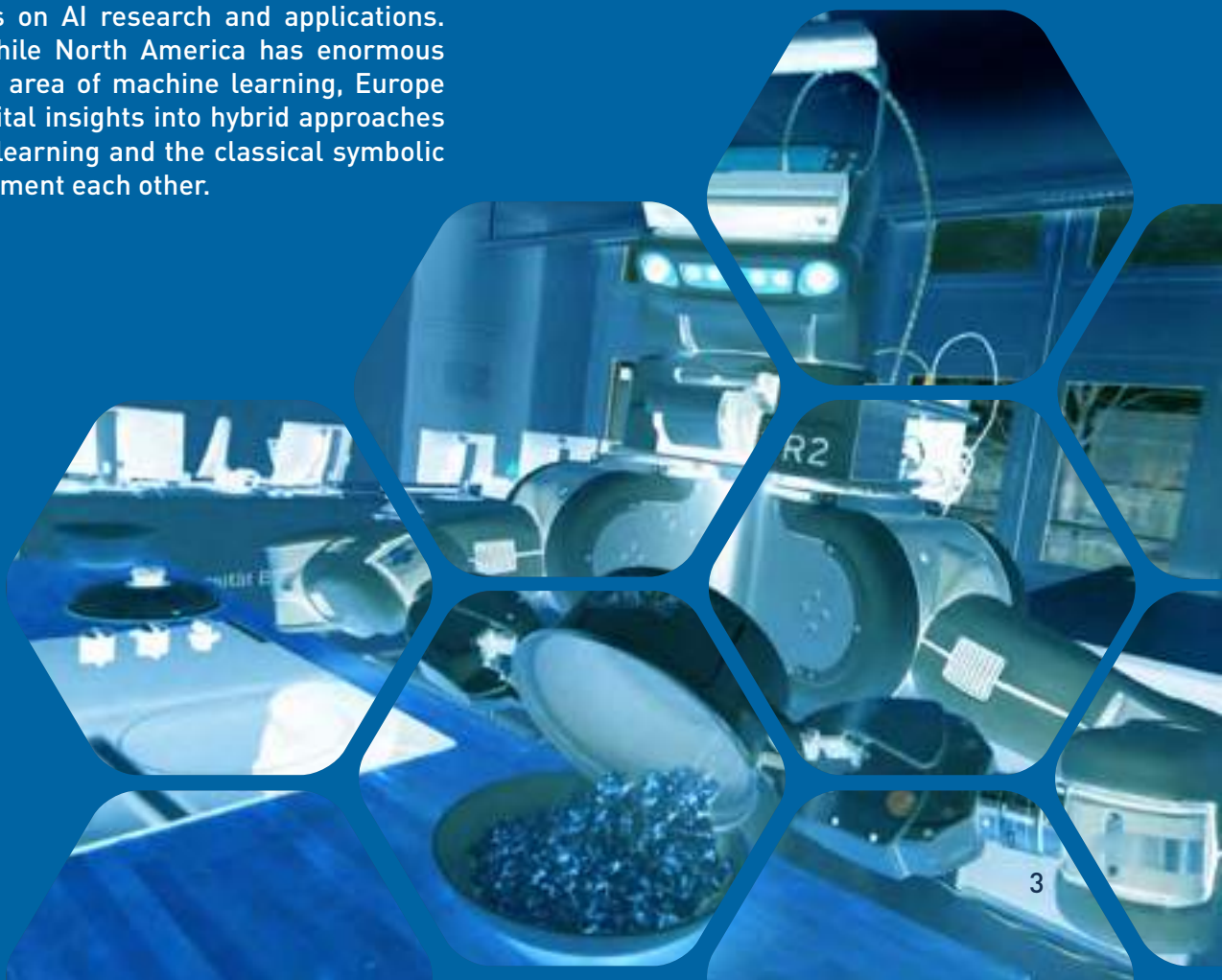
Building bridges and making new connections is the goal at the heart of the TransAIR project, which organized the event. Much of today's research in AI and robotics takes place within silos that prevent the open sharing of knowledge. This is unfortunate because the research challenges are enormous and could be solved quicker with concerted efforts rather than organizations racing against each other. Also, there is much to learn from one another regarding the perspectives on AI research and applications. For example, while North America has enormous strengths in the area of machine learning, Europe can contribute vital insights into hybrid approaches where machine learning and the classical symbolic methods complement each other.

Exchanging ideas in workshops is one way to learn from others. Open science is another. That is why we focused the first of two TransAIR conferences on open science and its potential to democratize AI. Collaboration is also the only way to keep state-of-the-art AI and robotics technology in the hands of the public, because individual research institutions cannot match the budgets of large corporations.

So please take a close look at the summaries of the talks and tutorials. And then tune in again in March 2021 when we will hold the second conference, this time focusing on cognitive architectures.

I hope this brochure serves as an inspiration for your own work.

Prof. Michael Beetz
Initiator and project director of TransAIR and head of the Institute for Artificial Intelligence (IAI) at the University of Bremen.



DISCUSSION

BENEFITTING FROM OPEN-SOURCE SOFTWARE IN RESEARCH AND BUSINESS

Scientists and industry representatives discussed the opportunities and limitations of open-source software in AI and robotics at the TransAIR conference. They agreed that the open-source approach is essential in the academic world, while businesses can benefit significantly if they have a good strategy and avoid the risks.

Open science and open-source software have become much more prevalent in robotics and AI over the last ten years. "In 2010, the Robot Operating System was still in its infancy, the PR2 robot had just been announced, and many research groups developed their own standards that were difficult to use under varying circumstances," said Moritz Tenorth, CTO of Magazino, at the TransAIR conference. "That has been simplified massively. There's now a common platform – a basis for using other people's software and integrating it into a system."

Also, he said, the "AI summer" of the last years had brought much progress in the area of deep learning, which had been a niche topic for a long time before that. On the flip side, this boom had drained the academic and open-source communities of valuable contributors who were "sucked up by large companies," Tenorth said. "There are many people who I heard a lot from while they were in academia, but in the past years I've had no idea what they were working on. That's a pity because they had great ideas in the past, and it would be cool to keep up that exchange of ideas now."

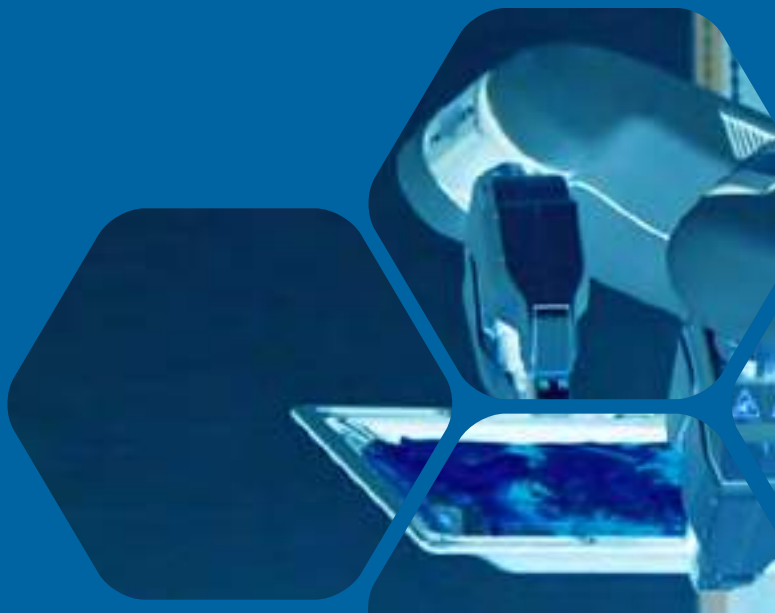
At the TransAIR conference, moderator Jennifer Sarah Boone discussed the consequences of these developments for businesses and research institutions with Tenorth, Alessandro Saffiotti (head of the Cognitive Robotic Systems Lab at Örebro University, Sweden), Dave Coleman (CEO of PickNik), and Michael Beetz (head of the Institute for Artificial Intelligence, University of Bremen). Their topic: "Open vs. closed research for AI-based robotics: challenges, opportunities, caveats."

WHAT ROLE DOES OPEN RESEARCH PLAY IN THE ACADEMIC WORLD AND IN BUSINESS?

Michael Beetz has long been a proponent of open research. "From my point of view, it's absolutely essential for academics," he said. According to Beetz, the main competitors for academic research groups are the researchers at big high-tech companies, who often have more resources at their disposal. "If academics want to play a major role in AI research in a sustainable way, I think the only way is to work together," Beetz emphasized.

Alessandro Saffiotti agreed. "Academic work must be open almost by definition and for the reasons Michael mentioned, but also for a more fundamental reason: the results must be open to the scrutiny of peers and as many other people as possible."

In the industrial world, open research is also taking root. "The Robot Operating System is getting more accepted," said Moritz Tenorth. "There were times when people were afraid of open-source, but nowadays even large companies accept it and build products out of it." His own company contributes back to the community, for example as maintainers of some software components. "But of course, we also keep lots of our software as proprietary code, because for a company it is also important to build a business model," he said.



WHAT ARE THE BIGGEST RISKS IN USING OPEN-SOURCE TECHNOLOGY?

Businesses also need to be aware of potential complications that come with using open-source software, but the risks to focus on are not always the most obvious ones. "Security is often touted as a risk, but when you have more eyes on the software, there are more people to review it," said Dave Coleman. "The argument goes back and forth, but I don't think the biggest risk is security. It's technical debt."

Therefore, he suggested, it is best to work with the original maintainers of the project to teach you how to use it. That way you can learn about the shortcuts that were taken during its development and might come back to haunt you now. "Just some grad students that didn't know how to write integration tests or things like that," Coleman said. "There are potentially lots of corner cases that you are bringing on that hadn't been thought about."

Moritz Tenorth backed up his assessment: "It's a big risk when you are using something that you don't understand." He also pointed out that it is not easy to find a business model in robotics that works well with open-source software, naming examples of promising young companies that had failed. "For us at Magazino, sharing is – on the one hand – being fair to the community, on the other hand being visible in the community. When you are known for maintaining and contributing good software, it's easier to attract people. Larger companies have better-known names and can pay higher salaries, and if you still want to attract good people, then you have to work on different levels and develop your brand in this way."

Coleman's company PickNik sells services for support, integration, and consulting. "All that is where we pay the bills. We provide the open-source software license-free."

WHAT DO YOU DO WHEN THE COMMUNITY SETS OTHER PRIORITIES THAN FIXING THE PROBLEMS YOU NEED TO HAVE FIXED?

When the software developers are not on your payroll, they get to set their own priorities, and those might diverge from yours. "That's definitely a pain point I have to deal with a lot," said Coleman. In his experience, one option is to reach out to that project and offer to become a maintainer or a contributor so that you can make the adjustments yourself. Another option is "choosing the project wisely." The third: Depending on how modular the project is, you can build your solutions on top of it.

According to Tenorth, this can even be an advantage. "Open-source gives you more ownership of these parts. It's different from a closed-source application that's taken off the market or a cloud application that is upgraded and moved in a direction you don't want to have." You could even fork from the project and maintain your own version.

HOW DOES THE ENVIRONMENT FOR OPEN-SOURCE DIFFER IN EUROPE AND THE U.S? SHOULD THERE BE MORE COOPERATION?

It often seems as if the open-source approach is more popular and widespread in the U.S. than in Europe, especially when it comes to cooperation between the academic and business worlds. Michael Beetz suggested one reason for this may be that German companies, in particular, are more conservative regarding new technologies. In his opinion, innovation hubs connecting research to businesses could be essential tools to get progress into the field. Moritz Tenorth pointed to a better funding environment and more advanced start-up culture in the U.S.

Meanwhile, the panel's American participant offered a counter perspective: "I'm on the other side of the pond, and I've been fairly impressed with the EU's involvement in open-source – at least in the bubble of robotics and ROS," Dave Coleman said. Even his company PickNik had received EU grant money recently to continue the development of the open-source project MoveIT in cooperation with developers in Europe. "In the ROS world there's a ton of collaboration between Europe and the U.S.," he said. "There's a consortium called ROS Industrial, a big part of it is in Germany, another in the U.S."

Alessandro Saffiotti also commended the EU Commission for pushing open-publication approaches in its framework program: "I think that's a very good move." However, "We have a PR problem in Europe," he said. "The way we popularize the research and even the funding efforts that we are doing is extremely modest."

WHAT ARE SOME OF THE MOST IMPORTANT NEXT STEPS TO BOOST OPEN-RESEARCH PROJECTS? WHAT NEEDS TO BE DONE TO DEMOCRATIZE AI?

To strengthen open research on the academic side, Michael Beetz suggested providing stronger incentives, especially for early-career researchers, "because it's an incredible effort to make things open and to push the software to a level that others can use. It has more impact that way, but if academia only counts publications, this type of contribution to the field remains underrated."

According to Alessandro Saffiotti, the greatest potential in open research is making AI more trustworthy: "The increasing use of AI systems that very few people understand – and even the designers don't understand – is dangerous for society, but also very dangerous for the AI field itself." He warned that the field may get a bad reputation when systems get misused or turn out to be unfair.

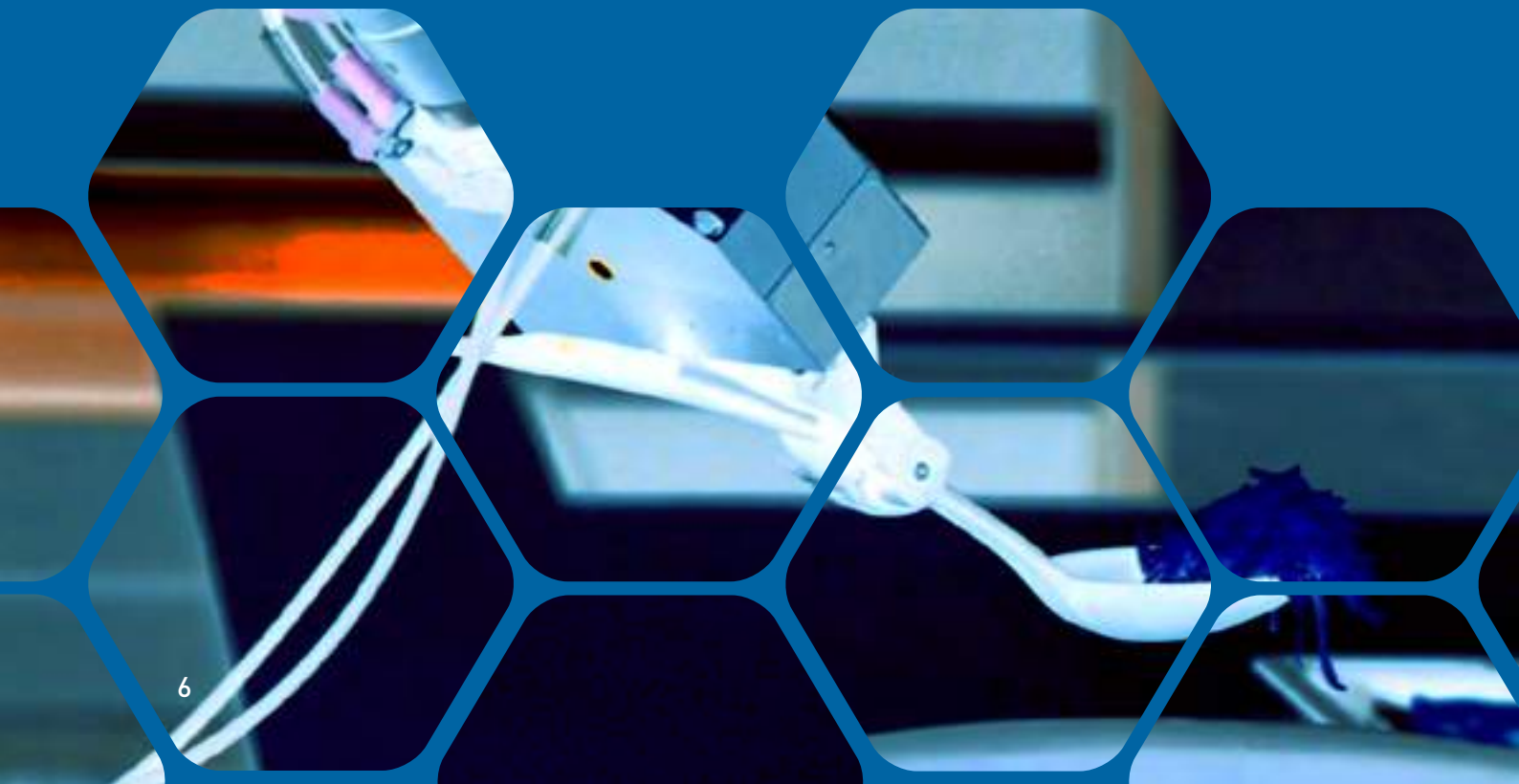
To democratize AI, transparency will have to be complemented by education, Saffiotti said not only academic and in schools, but in the entire population. "The goal is to avoid unfounded fears, but also – more importantly – to avoid unfounded trust in AI systems. We have to make sure that people know what they are doing when they are using these systems."

Michael Beetz is the initiator of TransAIR, the head of the Institute of Artificial Intelligence, and a professor at the University of Bremen.

Alessandro Saffiotti is the head of the AASS Cognitive Robotics Systems Laboratory and professor of computer science at the University or Örebro.

Dave Coleman is the co-founder and CEO of PickNik and an open-source robotics advocate.

Moritz Tenorth is the CTO at Magazino, a start-up developing robotics solutions for intralogistics.



PRESENTATION SUMMARIES

Yiannis Aloimonos, Eadom Dessalene

A SHORT SOCRATIC DIALOGUE ON ACTION AND INTELLIGENCE

The Syntax of action: Understanding human activity from video is a fundamental problem in today's computer vision and imitation learning. Yiannis Aloimonos and Eadom Dessalene discuss the issue of the syntax of human activity and advance the viewpoint that perceived human activity first needs to be parsed, just as in the case of language.

Using these ideas, they propose the Ego-OMG framework. Egocentric object manipulation graphs are extracted from a basic parsing of a video of human activity – they represent the contacts of the left and right hand with objects in the scene – and they can be used for action prediction. For this purpose, the Ego-OMG framework integrates three components: semantic temporal structure of activities, short-term dynamics, and representations for appearance.

Aloimonos and his research group evaluated Ego-OMG on the EPIC Kitchens Action Anticipation Challenge. They demonstrated state-of-the-art performance, outranking all other previous published methods by large margins. They ranked first on the unseen test set and second on the seen test set of the EPIC Kitchens Action Anticipation Challenge. More information is available in this paper: https://arxiv.org/abs/2006.03201

Yiannis Aloimonos is Professor of Computational Vision and Intelligence at the Department of Computer Science, University of Maryland, and the Director of the Computer Vision Laboratory at the Institute for Advanced Computer Studies (UMIACS). He is also affiliated with the Institute for Systems Research and the Neural and Cognitive Science Program. For the past five years he has been working on bridging signals and symbols, specifically on the relationship of vision to reasoning, action and language.

Eadom Dessalene is a PhD student at the University of Maryland's Department of Computer Science.

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https://www.youtube.com/watch?v=ZwAK0BqIBtc

John Laird

OPEN RESEARCH AND THE SOAR COGNITIVE ARCHITECTURE

John Laird's current research focuses on three related areas: cognitive architecture, integration of cognitive architecture with robotics, and interactive task learning. He is one of the original developers of the Soar cognitive architecture and leads its continued evolution. He was also a founder of Soar Technology, Inc.

At the TransAIR Conference, Laird reviewed the Soar. Fundamentally, Soar is a general cognitive architecture for developing systems that exhibit intelligent behavior. Researchers all over the world, both from the fields of artificial intelligence and cognitive science, are using Soar for a variety of tasks. It has been in use since 1983, evolving through many different versions to where Soar is now (Version 9).

The goal is to enable the Soar architecture to support all capabilities required of a general intelligent agent by approximating rational behavior. Ideally, Soar should work on the full range of tasks expected of an intelligent agent, from highly routine to extremely difficult, open-ended problems. It should represent and use appropriate forms of knowledge, such as procedural, semantic, episodic, and iconic, and employ the full range of problem-solving methods. It should interact with the outside world and learn about all aspects of the tasks and its performance on them.

John E. Laird is the John L. Tishman Professor of Engineering at the University of Michigan, where he has been since 1986. He received his Ph.D. in Computer Science from Carnegie Mellon University in 1983. With Paul Rosenbloom, he is the winner of the 2018 Herbert A. Simon Prize for Advances in Cognitive Systems. Laird is also a fellow of AAAI, AAAS, ACM, and the Cognitive Science Society.

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Video presentation:
https://www.youtube.com/watch?v=yM39XUHPgK8

More information about Soar:
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Jan Andersen

RESEARCH ADMINISTRATION IN OPEN SCIENCE

Research managers and administrators facilitate the process from the idea to the realization of a research project. They can be a sparring partner for young researchers' careers, help them identify funding opportunities, and explain – or sometimes even solve – the non-academic parts in research applications, e.g. their impact, gender issues, open science, and ethics.

Jan Andersen has worked to create a nourishing environment for researchers at several universities for many years and supported networks of research managers to facilitate the exchange of ideas. At the TransAIR Conference, Andersen discussed the emergence of professional support staff and how researchers can benefit from involving their local research manager and administrator in their projects.

This can be especially helpful when researchers explore the field of Open Science, where the academic, legal, and economic aspects of scientific projects can vary considerably. Andersen says that researchers in AI and robotics have a unique advantage since it is a relatively new area of study: "You can set your own standards for what you want to achieve in research and I think that Open Science, Open Research is an extremely important part of that," he says. You can watch his presentation on YouTube (see link below).

Jan Andersen is Head of the Research Office at the University of Southern Denmark and the co-author of "Research Management – Europe and beyond". He was involved in establishing four very successful research support units and served as advisor for Rectors of the Danish Technical University, University of Copenhagen and the former Royal Veterinary and Agricultural University. From 2010 to 2013, Andersen was chairman of the European Association of Research Managers and Administrators (EARMA) and its board member until 2018.

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Radu Rusu

HOW DO WE BUILD THE NEXT INTERNET?

The tools at our disposal for solving some of the hard problems our society is facing are old and often inadequate. Radu Rusu, CEO of Fyusion, says we should move on and build new tools. “Everyone is looking to AI- based solutions like it is the next gold rush, without understanding how Machine Learning actually works,” he says. “We’re pumping massive amounts of data into these systems, without realizing that this data came before artificial intelligence was a thing, and even before the internet or computers existed. 2D images are actually just digital representations of something that was available before in analog form.”

He thinks it is time for a new approach. “Someone needs to pause, zoom out, and take a look first and foremost at the problems that we need to solve, identify and analyze them, and only then derive complete technical solutions that might or might not involve the current generation of Machine Learning.” And most importantly, these solutions might indicate that new types and formats of data, whether visual or otherwise, need to be created.

“The field that made significant progress there is robotics, where mapping and identifying the world with high accuracy was an absolute requirement for the stability and performance of a machine moving into our world,” Radu Rusu emphasizes. “However, these concepts – such as 3D visual representations – have not yet been translated fully to scale and made de facto standards for other, more common applications.”

In his talk, he took a trip down memory lane and revisited some of these concepts. He also discussed how open-source platforms such as the Point Cloud Library (PCL) have contributed to the proliferation of new visual understanding technologies. Radu Rusu explained how Fyusion attempts to redefine the meaning of “scalable 3D visual formats”, and how it created the first comprehensive and scalable technology stack for capturing photorealistic 3D spatial models of the real world using a single camera, built with visual understanding in mind.

Radu B. Rusu is the CEO and Co-Founder of Fyusion, President of Open Perception, and a world-renowned expert in 3D data processing with over 15 years of experience in the field. He was named one of “Top 100 Most Intriguing Entrepreneurs” in 2016 by Goldman Sachs and was awarded the IEEE RAS Early Career Award in 2013 for his contributions to the field of 3D Computer Vision and Robotics. Before Fyusion, Radu was a Visiting Lecturer at Stanford University for two years and a Research Scientist at Willow Garage, where he led the 3D Computer Vision efforts that created the Point Cloud Library (PCL) project.

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Lydia Kavraki

OMPL FOR MOTION PLANNING

Path planning is a core problem in robotics. Lydia Kavraki developed a method called the Probabilistic Roadmap Method (PRM), which caused a paradigm shift in the robotics community. The approach introduced randomization schemes that exploited local geometric properties and produced efficient solutions without fully exploring the underlying search space.

Kavraki's work has given rise to the development of sampling-based motion planners that are now ubiquitous in academia and industry. Work in her group has produced the Open Motion Planning Library (OMPL), an open-source library of motion planning algorithms. The library links directly with the Robot Operating System (ROS) and MoveIt, and it is heavily used in industry and academia. Departing from purely geometric problems, Kavraki has shown how the foundations of PRM can be exploited and adapted to problems that involve kinematic, dynamic, physics-based constraints and a very high-dimensional solution space.

In her talk, Kavraki gave an overview on the brief history, problems and complexity of motion planning, and she explained how her lab has benefited from its activities in the area of open-source software development. She firmly believes that open research has significant advantages for academia and industry.

Lydia E. Kavraki is the Noah Harding Professor of Computer Science, professor of Bioengineering, professor of Electrical and Computer Engineering, and professor of Mechanical Engineering at Rice University. She is also the Director of the Ken Kennedy Institute at Rice. In robotics and AI, she is interested in enabling robots to work with people and in support of people.

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Video presentation:
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Chad Jenkins

THAT AIN'T RIGHT – AI MISTAKES AND BLACK LIVES

There's a common misconception that decisions made by computers are automatically unbiased – as opposed to those made by humans. However, Chad Jenkins pointed out many ways in which AI can fail to deliver fair and reasonable results. He pointed out what needs to be done in AI to get the intellectual domain right and how the technology and understanding researchers generate can have a positive impact on the world.

"If we don't provide equal opportunity and fairness for everybody, we don't provide equal opportunity for anybody," Jenkins said. One example he gave of AI gone wrong was the case of a black man who was arrested due to false facial recognition results. There are multiple reasons for such problems, according to Jenkins. He distinguished between "back-end problems" – such as the lack of black researchers and the low number of black people with computer science degrees – and "front-end problems", e.g. the uneducated use of AI by law enforcement and other entities. The AI community will have to address these issues if it wants to make the technology primarily a force for good.

Chad Jenkins is a Professor of Computer Science and Engineering at the University of Michigan as well as the Associate Director of the Robotics Institute and the Editor-in-Chief of the journal "ACM Transactions on Human-Robot Interaction". His research interests include mobile manipulation, computer vision, interactive robot systems, and human-robot interaction.

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Gayane Kazhoyan

TUTORIAL ON CRAM (COGNITIVE ROBOT ABSTRACT MACHINE)

CRAM (Cognitive Robot Abstract Machine) is a software toolbox for the design, implementation, and deployment of cognition-enabled autonomous robots performing everyday manipulation activities. CRAM equips autonomous robots with lightweight reasoning mechanisms that can infer control decisions rather than requiring the decisions to be preprogrammed. This makes CRAM-programmed autonomous robots much more flexible and reliable than control programs that lack such cognitive capabilities.

Gayane Kazhoyan is actively involved in the development of CRAM. She has created a video tutorial showing the basics of the CRAM framework. The aim of the tutorial is to give an impression of the knowledge a robot needs to execute a simple fetch-and-place task. It also shows how many different details have to be kept in mind and teaches writing simple failure handling strategies. In addition, the tutorial familiarizes the user with the API of actions already implemented in the CRAM framework.

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Video presentation:
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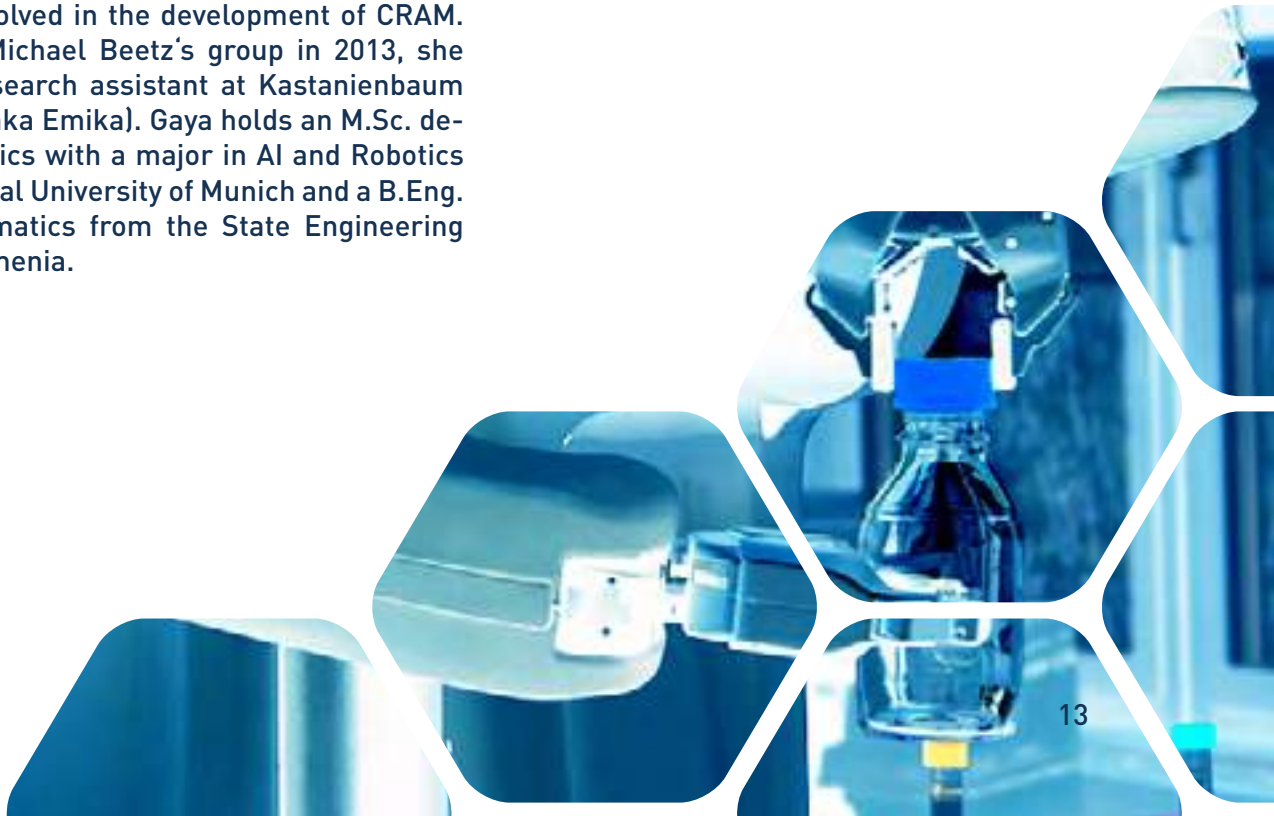
Gayane Kazhoyan (a.k.a. Gaya) is a PhD student at the University of Bremen's Institute for Artificial Intelligence. Her main research interests are cognition-enabled robot executives. She is currently passionately involved in the development of CRAM. Before joining Michael Beetz's group in 2013, she worked as a research assistant at Kastanienbaum GmbH (now Franka Emika). Gaya holds an M.Sc. degree in Informatics with a major in AI and Robotics from the Technical University of Munich and a B.Eng. degree in Informatics from the State Engineering University of Armenia.



Toni Tan

SEMANTIC COLLISION DETECTION AND PROXIMITY QUERY

In motion planning algorithms, the computation of collision detection and proximity queries (CD & PQ) is very time-consuming. At the TransAIR conference, Toni Tan presented an idea to simplify the complex process of benchmarking collision detection algorithms. He specifically focused on CD & PQ methods for the narrow phase of rigid polygonal polygon soups.

The main idea is to provide the benchmarking of CD & PQ as an online service. This approach has the advantage that a large amount of CD & PQ algorithms are already available as pre-compiled libraries on a common, unified hardware platform via an easy-to-use – but nevertheless highly adjustable – web interface. This web-based service facilitates the comparison of CD & PQ algorithms dramatically. It is convenient for users of CD & PQ algorithms who simply want to find the best choice for their particular scenario and for researchers who want to compare their new algorithms to competitors.

Additionally, Toni Tan presented the idea of semantic CD & PQ based on a benchmark's results. This facilitates the identification of interesting object regions, e.g. regions that are hardly checked for collisions or regions where particular algorithms perform better or worse. This new method to visualize information from the CD& PQ benchmark could influence further research, for instance, by optimizing BVH construction algorithms or by optimizing the geometry for particular CD & PQ algorithms.

Toni Tan is a doctoral student in the Institute for Computer Graphics and Virtual Reality (CGVR) at the University of Bremen, under supervision of Professor Gabriel Zachmann. His doctoral work explores geometric computing for simulation-based robot planning.

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Johannes Pfau

MINING AND EXPLICATING INSTRUCTIONS FOR EVERYDAY ACTIVITIES

In his talk, Johannes Pfau discussed the framework, design and evaluation of the pipeline for mining and explicating everyday activity instructions within the EASE project (Everyday Activity Science and Engineering) at the University of Bremen. The EASE researchers utilize natural language processing and human computation games for this task.

Pfau outlines several methods to accumulate human-level world knowledge and ensure usefulness and quality of the aggregated data. For example, he presents virtual reality games where humans compete by performing specific tasks while their choices and actions are recorded in a database that can be queried by robots. Since not all human attempts at performing an action are worthy of imitation, the researchers have designed various ways to distinguish useful datasets from unhelpful ones.

Johannes Pfau is a PhD candidate of the University of Bremen's Digital Media Lab. His scientific work focusses on generative player modeling, human computation, serious games, and AI in video games.

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Janis Roßkamp

HIGH PRECISION HAND TRACKING USING A MARKER-BASED APPROACH

Hand tracking is essential in a wide range of applications – from the creation of CGI movies to medical applications and even real-time, natural, physically-based grasping in VR. Optical marker-based tracking is often the method of choice because of its high accuracy, the support for large workspaces, good performance, and the fact that no wiring of the user is required. However, the tracking algorithms may fail in case of hand poses where some of the markers are occluded. These cases require a subsequent re-assignment of labels to reappearing markers. Currently, convolutional neural networks (CNN) show promising results for this re-labeling because they are relatively stable and real-time capable.

In his workshop, Janis Roßkamp presented several methods to improve the accuracy of label predictions using CNNs. Additionally, he gave a brief demonstration on how to use specific software to label markers.

Janis Roßkamp is a Ph.D. student at the University of Bremen's Computer Graphics and Virtual Reality Group. His main research interest is natural interaction in virtual reality, which includes body and hand tracking techniques as well as physically-based algorithms, i.e., for realistic grasping.

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Mihai Pomarlan

EMBODIED SEMANTICS FOR THE LANGUAGE OF ACTION AND CHANGE

If they are ever to operate outside of controlled and simple environments, robots need an understanding of the physical world. This is a challenging problem because it requires a difficult mix of computational techniques: logical inference for abstraction and generality, and physical simulation to discover what details of a situation are relevant for a result.

Mihai Pomarlan presented a hybrid inference system combining these techniques to produce a deeper, embodied understanding of „functional relations", i.e., the relations between objects that constrain their behavior, such as support or containment. This understanding also captures some aspects of causality: by using physics simulations, the system is able to identify which objects are necessary for a functional relation to hold and, conversely, which objects prevent a relation from holding.

Mihai Pomarlan is a postdoc working at the University of Bremen at the interface between computational linguistics and cognitive robotics. Like most AI researchers, he believes AI has the potential to change the world, but – perhaps unlike researchers caught in the ongoing machine learning hype – he also believes there is inherent value in understanding how a system achieves some competence or skill, whereas competence without understanding can be downright dangerous.

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Video presentation:
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Jesse Richter-Klug

DATASET OF BINOCULAR AND RGB-D IMAGES ANNOTATED WITH 6D POSES

Robots have a hard time finding and identifying objects that are hidden – partly or entirely – behind other objects. They also tend to fail completing their task when objects are stacked, tightly packed, or have transparent or reflective surfaces. Jesse Richter-Klug presented promising solutions to these problems in his talk.

He specifically focused on fetching stored kitchen objects such as dishes and pots from drawers or dishwashers. His approach is to create a tracking system to locate objects, record video sequences, and use scenes in multiple "set-up stages." Each scene is captured with two cameras: Kinect (RGB-D image) and rc_visard (binocular RGB image). The goal is to provide a dataset of realistically packed crockery items in kitchen cupboards, drawers and dishwashers annotated with 6D object poses.

Jesse Richter-Klug is a computer scientist at the University of Bremen.

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Video presentation:
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Vladimir Herdt

VIRTUAL-PROTOTYPE-BASED VERIFICATION

The research department for Cyber-Physical Systems of the German Research Center for Artificial Intelligence (DFKI) is working on the technical development of intelligent, networked systems. Vladimir Herdt currently specializes in the verification of such systems. In his talk, he provided an overview of virtual-prototype-based verification techniques. DFKI scientists plan to transfer these techniques to the robot domain and apply them to the verification of robotic control plans.

According to Herdt, virtual prototypes provide accurate simulation environments for complex embedded software. As an example, he presented the Concolic Testing Technique for software verification. Herdt and his colleagues also work on other VP-based verification techniques such as Coverage-guided Fuzzing and Cross-level Processor Verification.

Vladimir Herdt is a scientist at the German Research Center for Artificial Intelligence and at the University of Bremen. His main research interest lies in the verification of systems at a high level of abstraction. Currently, he is particularly concerned with fully automated formal methods for the determination of properties as well as debugging in SystemC (TLM) models.

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Video presentation:
https://www.youtube.com/watch?v=aAi_9znFXlI

AI AND ROBOTICS IN BREMEN

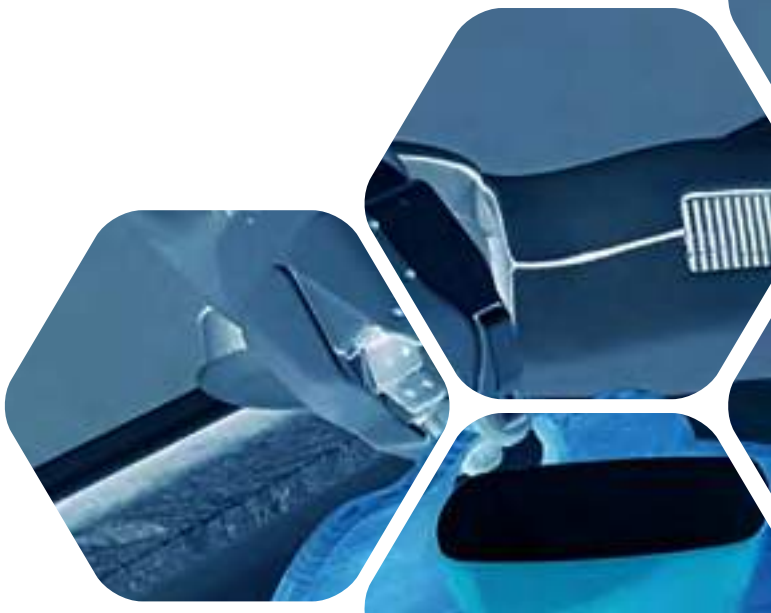
Bremen's appeal as an AI hub is based on its extensive research network, which is embedded in an area with a strong manufacturing and trade tradition.

The state of Bremen, located on the river Weser near the North Sea, has long been the main industrial and trade center of northwestern Germany. Among the largest employers are Daimler (Mercedes), which builds electric cars in its local plant, and Airbus. Beginning with the late 20th century, Bremen also developed excellent strengths as a city of science and research. More than 50 technology research institutions are based here – they represent all major German research powerhouses. About 37,000 students are enrolled in eight universities and colleges.

At the University of Bremen, the Institute of Artificial Intelligence, the Robotics Group and the Collaborative Research Center EASE lead the way in AI and robotics. Bremen's other large players include DFKI's Robotics Innovation Center, the logistics institute BIBA, Fraunhofer Mevis, Jacobs University, and major IT companies such as Neusta and HMMH. They are joined by a growing list of promising start-ups. Researchers and private companies have started Bremen.AI, a community focusing on strengthening the region's AI ecosystem.

Current research topics these institutions and companies are working on include:

- Autonomous driving on earth and the moon (AO-Car, CC AD)
- Learning household robots (EASE)
- Smart technology in logistics (BIBA)
- Smart technology in retail (Knowledge4Retail)
- Humanoid robot design (Robot AILA)
- Robots that play soccer (six-time RoboCup world champions in Standard Platform League)
- Study of human emotions (Emote, CyberEmotions)
- Smart government (chatbots in the Bremen Citizen Service)

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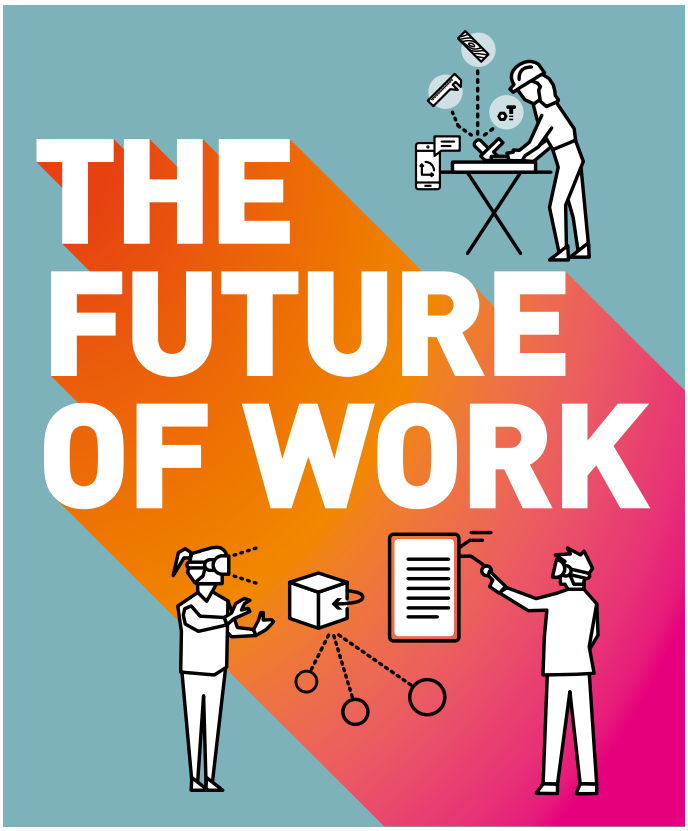

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