German Research Center for Artificial Intelligence

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Fighting Plastic Waste, Smart Recycling, Crop Protection

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ARTIFICIAL INTELLIGENCE

IN THE INTERESTS OF ENVIRONMENT AND SUSTAINABILITY

Artificial Intelligence is providing solutions and tools to help achieve the environmental and sustainability goals of the EU and the UN and contribute to the implementation of the Paris Climate Agreement. The range of challenges for AI systems is diverse. DFKI is stepping up to meet these challenges.

The German Federal Ministry for the Environment is addressing AI with a new funding initiative, ***"AI pilot projects for environment, climate, nature conservation, and resources."*** *DFKI responded to this call for proposals with project applications in plastic waste management, recycling, and in ecological agriculture and they all have reached the second round. In all three application scenarios, AI will be implemented.*

In ***"PlasticObs,"*** *the subject is the long-range detection of plastic waste. The aim of the project is to create a database filled with detailed information about the degree of plastic pollution and to develop an appropriate evaluation methodology that accounts for flow velocities and tides. The focus of the* ***"Smart Recycling"*** *project is to develop methods for sorting and reuse of construction and demolition materials using AI, sensors, and robots.* ***"Cognitive Weeding"*** *is a planning concept for the more effective use of herbicides and for avoiding their use altogether in the right places and is based on analyzing crops and weeds (see pg. 6).*

In ***"Designetz,"*** *AI will be making a significant contribution to the energy transition (see pg.10). For example, methods designed to support grid stability include forecasting methods for photovoltaic energy generation and analyzing load curves in private households or at the local transformer level. In* ***"GridAnalysis,"*** *a project recently launched with funding from the German Federal Ministry for Economics and Energy, we are combining machine learning and deep learning methods to identify impending power overloads in the grid at an early stage. DFKI draws on many years of expertise in the intelligent management of power distribution grids (see pg.12).*

AI methods are also being applied to monitor forests in forest management and nature conservation. AI researchers in the ***"TreeSatAI"*** *project are studying deep learning methods for the analysis of aerial and satellite imagery in support of forestry experts as they assess the conditions of forest stands (see pg. 14).*

Germany will hold the EU Council Presidency until the end of 2020. Environmental and climate protection efforts do not stop at national borders. DFKI will remain active on a European level to promote AI for Europe with its participation in the ***CLAIRE*** *Initiative. The goal of the EU* ***VISION*** *project is to organize a targeted exchange between researchers and industry representatives (see pg. 18).* ***HumanE-AI-Net*** *develops human-centric AI systems with a focus on the ethical, legal, democratic, and cultural values of the European Community (see pg. 20). Trustworthiness, transparency, and explainability are key factors in the* ***XAINES*** *project (see pg. 37), which is sponsored by the Federal Ministry of Education and Research, and these also happen to be goals in our work on human-centric AI.*

Prof. Dr. **Antonio Krüger**

Prof. Dr. Prof. h.c. **Andreas Dengel**

Prof. Dr. Dr. h.c. **Frank Kirchner**

Prof. Dr. **Philipp Slusallek**

Editorial


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10 Pilot project for the electrical power grid of the future – **Designetz Saarland** shows positive returns

12 **GridAnalysis** – Artificial Intelligence for safer power grids

13 Test Center for **Maritime Technologies** operating off the Heligoland coast in the North Sea

06 **Fighting plastic waste, smart recycling, crop protection: How DFKI is using AI on behalf of the environment**

14 **TreeSatAI** – Artificial Intelligence observing earth using multi-source geodata to monitor the forests and preserve infrastructure and nature

16 **European Big Data Value Forum** (EBDVF 2020), November 3-5, 2020, Berlin + Virtual – Building a Strong European Data and AI Ecosystem

18 **Networking AI research in the European Union** – DFKI and CLAIRE participating in new projects

20 **HumanE-AI-Net** AI that understands humans

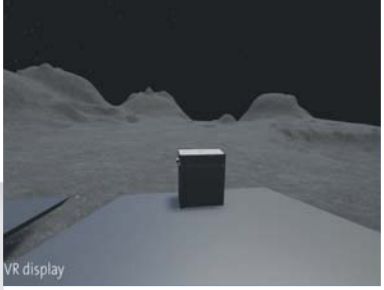
21 **The EU Council Presidency Translator** – Linking a multi-language Europe

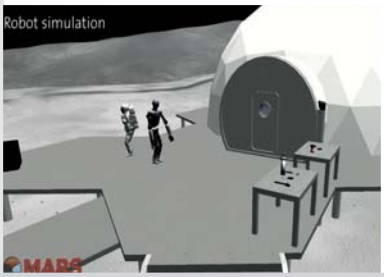
22 **Europe's opportunities in Business AI** – Interview with Dr. Feiyu Xu, Senior Vice President, Global Head of Artificial Intelligence, SAP

24 Rhineland-Palatinate announces AI strategy – Andreas Dengel named **AI Ambassador**

25 **AI Campus** Launch signal for digital learning platform

26 AI method to detect the quality of donor corneas – The **KItatta** Project





27 **Robotics in Healthcare** – DFKI Bremen developing the hospital bed of the future with the St. John Ambulance

28 Robots learn to understand humans – Research begins on project **EXPECT**

29 Can we predict the path of a pandemic? – DFKI and Fraunhofer ITWM are supporting **pandemic management** in the city of Kaiserslautern

30 The **EVAREST** research project – Added value from smart data

32 Design Thinking Workshop for resilient production – Project **SPAICER**

33 Always prepared to think anew – **SmartFactory** Kaiserslautern celebrates fifteen years

34 AI for Biopharmaceutical Production – **Sartorius** becomes the 33rd DFKI Shareholder

35 AI for **Digital Administration** – Three ongoing studies

36 DFKI gets new **NVIDIA DGX A100** system for Machine Learning research

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37 Launch of project **XAINES** about the explainability of AI

38 **SensAI** combines knowledge graphs with Deep Learning methods

39 DFKI Staff Interview with Dr. Heiko Maus

40 News in brief

42 Company Profile

Content

FIGHTING PLASTIC WASTE, SMART RECYCLING, CROP PROTECTION: HOW DFKI IS USING ARTIFICIAL INTELLIGENCE ON BEHALF OF THE ENVIRONMENT

One garbage truck every minute! That is how much plastic waste is dumped into the oceans worldwide, according to the United Nations Environment Program (UNEP). Eight million tons of plastic waste, year after year, more than half of all life on earth is threatened by pollution. The dramatic statistics make it absolutely clear: Something must be done quickly to combat plastic pollution in the world's oceans. Many issues arise when searching for an effective means to combat the situation. One important question is: Where does all this waste come from?

The research department of Marine Perception (MAP) is part of DFKI Laboratory Niedersachsen and is looking for the answer to this question. Under contract to the World Bank, Prof. Dr. Oliver Zielinski and his team are developing smart sensors and analytics to get a picture of the extent of plastic pollution, particularly in Southeast Asia. Drones equipped with multispectral cameras make flyovers of the rivers and record the plastic waste in them, providing essential data about the type and possible source. After all, rivers are the central route for plastic waste to find its way from land to the oceans. The goal of the project series is to identify the sources of the waste to assist local governments in their action plans against the polluters.

New DFKI Competence Center for Environmental Protection and Sustainability – The Search for AI solutions

The collaboration with the World Bank is one of several initiatives with which DFKI is advancing the use of artificial intelligence for environmental and re-

source protection. The Pacific Garbage Screening (PGS) association's waste collection boat, equipped with smart sensors from the MAP unit and built-in cooperation with Berky company, has already been used for river cleaning in Slovakia. DFKI established the "Artificial Intelligence for the Environment and Sustainability" Competence Center to consolidate its expertise from earlier projects, joint ventures, and contacts regarding this topic.

The Center, under the direction of Prof. Zielinski, has the short title "DFKI4Planet" and is an initial contact point for interested scientists, environmental organizations, and companies. The new Competence Center provides an address for interchange with government, civil authorities, and the public, and also serves as an internal interface for the 20 DFKI research departments. One thing is becoming increasingly evident: On the path to a more sustainable future, artificial intelligence is making a major contribution, and now is the time to develop the right concepts and ideas – an insight shared by the Federal Environment Ministry.

300 chances to use AI for the climate and the environment

The shipping trade relies on beacons to aid in orientation for steamers and rowing boats and to show them the right route. The title of a new funding initiative of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) is not a coincidence: To set an example for nature-friendly digitalization, the Ministry is seeking projects to serve as "AI Beacons for the Environment, Climate, Nature Conservation, and Resources." Around 300 project proposals and ideas were submitted to the BMU last year. "That's 300 opportunities to use AI strategically for the climate and environment," said Federal Environment Minister Svenja Schulze (SPD) speaking at the "AI x Climate" Conference in November 2019.


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To take advantage of these opportunities, federally owned ZUG (Future – Environment – Society) company selected twelve ideas to receive start-up funding to develop specific project outlines. Partners have five months' time to define their concepts and show how they plan to use artificial intelligence to set examples for a greener future – e.g., through sustainable tourism, solar energy production, or species protection in wind power projects. Three areas of DFKI research are involved in various applications of AI: in plastic waste management, in the closed-loop economy, and in environmentally-friendly agriculture.

Old methods, new technologies

The team at the MAP unit in Oldenburg studies ways to expand known environmental protection methods through the use of new technologies and make them practical worldwide. Aircraft have been used to explore and investigate oil spills in the oceans since the 1980s. The idea behind the "PlasticObs" project, in which DFKI partners with OPTIMARE Systems, is to track and analyze plastic waste using the same method – by equipping airplanes with the right sensor technology. The advantage over the use of drones is that airplanes take off every day anyway and fly over relevant areas. With very little effort, a broad network for monitoring plastic pollution could be created.

If implemented, the core of the project is the evaluation method used and having sufficient data available for the detection and examination of plastic waste, even from a great distance. Data is required not only about the form and structure of the waste but also its behavior in the water and the influence of currents and tides. The aim of the project partners is to create a database of detailed information about plastic

Small aircraft like this propeller plane in Brazil are flying daily and could be equipped with sensors to collect data on plastic pollution without much additional effort.

The PlasticObs project aims to detect, characterize, and analyze clusters of plastic trash, also from great distances.

pollution and to implement special evaluation methods based on artificial intelligence. Both are to be provided as open-source software accessible worldwide to facilitate cost-efficient monitoring and tracking of plastic waste and to strengthen the public perception of the problem through the newly gained knowledge.

AI and Robotics for sustainable recycling

The Robotics Innovation Center (RIC) in Bremen is also concerned with the problem of waste but enters the challenge at an earlier point: While the "PlasticObs" project aims to rid habitats of pollution, the idea behind "Smart Recycling" is to prevent pollution in the first place. The reuse of waste materials in the sense of a closed-loop economy is already well-established, but it can only be applied to certain types of waste – those that can be easily shredded and then automatically separated. Yet, more than half of the waste produced in Germany does not belong to this category: 220 million tons of construction and demolition materials bypass the recycling system every year due to size and consistency.

The response by a team under the direction of Prof. Dr. Frank Kirchner is to use modern sensor technologies, artificial intelligence, and robotics for sorting and reusing waste in keeping with the funding concept. The focus here is on the waste that the existing recycling system has no use for at all or only at great expense. Together with the Institute for Energy and Recycling Management at the Bremen University of Applied Sciences, the Hamburg University of Applied Sciences, and Nehlsen Stoffstrom & Co., RIC is hoping that the project will help raise the recycling rate of municipal waste to over 65 percent – as the German Resource Efficiency Program recommends. To this end, concepts for using robot arms and automated excavators equipped with intelligent sensor technology and sorting algorithms are being developed. If the project is implemented, the planned methods can also be applied in other areas in the future, such as sustainable agriculture or disaster control.

Weed control based on nature-friendly AI

Sustainable agriculture is also at the heart of the concept approved for funding at the research department for Plan-Based Robot Control (PBR): With its expertise in the application of artificial intelligence and robotics in agriculture, Prof. Dr. Joachim Hertzberg's team is working on methods to promote biodiversity and support sustainable plant cultivation. In modern agriculture, the use of herbicides to increase yields can hardly be avoided, yet it is subject to justified criticism: Chemical agents cannot distinguish between bad weeds and good weeds. While the former impair crop growth, the latter provide a habitat and food source for bees and many other insects – and is worth protecting.

The concept of the Cognitive Weeding project is to analyze crops and their weeds in order to plan the use of herbicides more effectively and avoid their use in the right places. The AI system in planning uses sensor data acquisition, automated plant identification, and tracking of weather and soil conditions

Robot arms can be equipped with AI technologies to sort large quantities of waste and increase the recycling rate.

to enable recommendations for action that could lead to sustainable and environmentally-friendly weed management. Biodiversity would be preserved, resources would be conserved, and efficiency would be increased with no loss in yields. In addition to the PBR research unit, the University of Applied Sciences Osnabrück is also involved in developing the already completed project outline.

Putting AI to work to protect the environment

The twelve project outlines selected by ZUG are to be evaluated by the Federal Environment Ministry in December 2020. The criteria include not only feasibility but also the potential for contributing to overcoming long-term ecological challenges. As part of the federal government's "Artificial Intelligence Strategy," projects that contribute to achieving climate protection goals, preserving biodiversity, support recycling and closed-loop economies, and improve the transparency and usability of environmental data are eligible for funding. These "beacon" projects must also be able to distribute knowledge and advance the social discourse on complex, data-driven systems.

The DFKI Competence Center for Artificial Intelligence for the Environment and Sustainability is committed to achieving these goals. Even though it is already a great success that three DFKI project concepts have reached the second round of funding from the Federal Environment Ministry – the efforts go well beyond that. More and more DFKI research departments have projects or are planning projects based on the vision of Federal Environment Minister Schulze to "make digital technologies or, more specifically, artificial intelligence work on behalf of environmental protection."

More information

www.dfki.de/en/web/research/competence-centers/ai-for-environment-and-sustainability

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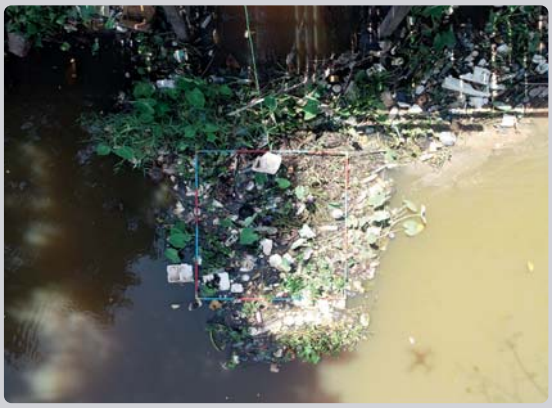

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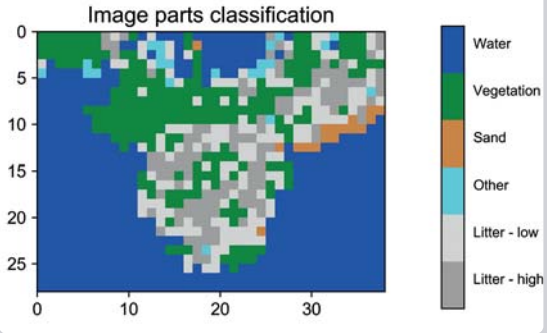

The MAP research analysis method can also be used to display the amount of pollution.

Result of classifications

Litter - high	122
Litter - low	142
Other	22
Sand	17
Vegetation	225
Water	536
Est. no of items	1024

DESIGNETZ SAARLAND SHOWS POSITIVE RETURNS

PILOT PROJECT FOR THE ELECTRICAL POWER GRID OF THE FUTURE

One of Germany's most important research initiatives for the energy revolution is coming to an end after four years. As one of the five "windows on intelligent energy" (Sinteg), Designetz developed strategies and solutions for the integration of alternative energies in the supply grids of the future. They serve as a blueprint throughout Germany and beyond and can help to achieve the targets for reducing CO2 emissions as agreed in the Paris Agreement of 2015. Designetz Saarland proved that the energy revolution is technically feasible and presented how it can actually succeed at its virtual close-out event on November 9, 2020.

Decarbonization, decentralization, and digitalization are forcing drastic changes for the energy sector in this country. The last nuclear power plant will go off the grid in the year 2022; the last German coal-fired plant in 2038. Experts tell us to expect an increase in gross electricity consumption – caused, for example, by e-mobility and digitization – of more than 25 percent by 2030. The coming supply gap must be compensated for with the help of renewable energy sources.

"Power distribution grids are increasingly important in light of our digitalized, technological world and the need to continuously supply it with electricity."
Tobias Hans, Minister President of the state of Saarland

The situation in the power grids

Volatile green electricity generated by distributed photovoltaic and wind power plants currently accounts for a share of more than 42 percent. By 2030, this share is expected to increase to 65 percent. However, our distribution networks are not designed for this expansion. The future will demand more flexible, intelligent power grids that are able to accept and transport as much green electricity as possible. If possible, the electricity should be consumed where it is generated to avoid transport loss. A secure supply must still be guaranteed, and the "classic grid expansion in aluminum and copper" must be reduced to a minimum. In the future, this will only work with smarter grids; in other words, with smart metering systems, modern communications for a faster rate of transfer for large volumes of data, and higher levels of automation and intelligent controls. Significantly more transparency is needed in the distribution grids, especially in the low and medium voltage range, with regard to grid states and operations.

Panel discussion at the Designetz final event with Dr. Susanne Reichrath, Representative of Saarland's Minister President for Higher Education, Science and Technology, Prof. Dr. Antonio Krüger, DFKI, Prof. Dr. August-Wilhelm Scheer, AWSi gGmbH, Prof. Dr. Christoph Sorge, Saarland University, and Prof. Dr. Dieter Leonhard, htw saar.

The Research Project

Designetz has developed a functional operating manual for the "energy systems of tomorrow" under the lead management of innogy/E.ON with funding support from the German Federal Ministry for Economic Affairs and Energy (BMWi). As part of this effort, Designetz opened the energy industry to external partners and, in return, received support from companies, institutes, and organizations. For example, intelligent metering systems promise significantly more transparency in connection with modern ICT, particularly to the low-voltage networks that have long been a black box.

A total of 46 partners from the fields of science and research as well as energy, industry, and ICT contributed numerous individual solutions to form a new and practical integrated system. The "showcase" extends across an ideal pilot region that includes the federal states of North Rhine-Westphalia, Rhineland-Palatinate, and Saarland. The region has a unique mix of sparsely populated rural areas, metropolises, and industrial centers, which is representative of the whole of Germany.

Designetz Saarland

Designetz Saarland is managed by VSE Company, which is representing the consortium leader innogy / E.ON on the Saar River. In the big picture, Designetz in Saarland occupies a middle position as the state has wind energy but not as much as in Schleswig-Holstein; and, there is a photovoltaic sector although not as strong as in Bavaria. Saarland offers more rural regions and, at the same time, the steel and automotive industries as representative load centers. Saarland participates in four sub-projects as part of the demonstration:

- The grid project **"EMIL"** allows VSE, Energis, and Saarlouis Public Utilities, in addition to Voltaris, Hager Group, DFKI, and the University of Applied Sciences "htw saar", to persue the joint development and testing of innovative technologies for grid management with trans-regional partners.

- In Fenne in the Saarland, the Steag Company installed the **"electrode-boiler"** that converts electricity into heat that is easily stored. By linking the electrical, heat, and mine gas sectors, the e-boiler brings significantly more flexibility to the grid.

- At the **"Dillingen district heating storage facility"** Steag has studied how to operate in a stable and profitable way by linking the grids of different sectors while the share of alternative energies is increasing.

- In the sub-project **"Monitoring for Flexibilities"**, August-Wilhelm Scheer Institute (AWSi), DFKI, IS Predict, htw saar, and Saarland University have developed, in collaboration with trans-regional partners, a uniform, open, and secure data and services platform that facilitates efficient data management in compliance with data protection regulations.

Dr. Susanne Reichrath, Representative of Saarland's Minister President for Higher Education, Science and Technology, and Dr. Gabriël Clemens, Technical Director at VSE and Chairman of the DFKI Supervisory Board, at the opening of the bus stop on October 20, 2020.

"DFKI acquired much practical experience early on in the field of energy informatics. This included, for example, developing AI in forecasting methods for photovoltaic generation and in predicting the load curves for private households or at the local transformer level. In this project, together with our partners, Designetz is providing a secure data and service platform along with essential building blocks for an operating system to integrate renewable energy sources. AI contributes to grid stability by helping to harmonize consumption and generation."
Prof. Dr. Antonio Krüger, CEO DFKI

Public acceptance

The energy transition will only succeed by working together. This statement expressly includes all citizens as essential players in the energy revolution, as "prosumers." Everyone must understand and come to terms with the new technologies. This conviction is alive at Designetz Saarland, where various institutions have already implemented it in the design phase of their projects. There is a wider range of efforts to involve large segments of the population in the research initiative. These efforts include a Designetz app, demonstrators open to the public, posts and "bus stops" along the "Energy Route" – all in addition to a special communication concept, acceptance research, and public opinion surveys. For all those interested in learning more about the state of the art, comprehensive information is widely available – for example, at DFKI on the Saarland University campus.

More information

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GridAnalysis

ARTIFICIAL INTELLIGENCE FOR SAFER POWER GRIDS

The share of alternative energies in power consumption has increased from around six percent in 2000 to around 42 percent in 2019. This implies an increased share of distributed power generation such as from photovoltaic systems, which no longer flows from a power station to the consumer, but rather from solar cells on the rooftops into the power distribution grid. There is also a greater share of power-intensive distributed usage, e.g., electric cars or electric heating. As a result, electricity flows are increasingly moving within a downstream distribution level and no longer passing through the local transformers of the grid protection systems designed for centralized power plants. Critical internal grid conditions like line overloads or voltage range violations are not detected. Furthermore, the fluctuations in the loads from alternative energies make it difficult to predict future grid conditions and develop preventive measures for use when necessary.

Instead of increasing capacity by a costly and resource-intensive expansion of the grid, the project partners in GridAnalysis want to develop a preventive mechanism for use in diagnosing grid conditions. The aim is to combine conventional power grid computations with machine learning methods like Deep Learning to develop an interdisciplinary hybrid approach. The conventional power grid computations in combination with a case generator can supply training data – even for situations that occur very rarely – for the AI system. The classifiers generated in the process can diagnose grid conditions much faster than a power grid computation and, if necessary, suggest appropriate countermeasures. Project partners htw saar, Stadtwerke Saarlouis, VSE Verteilnetz, and DFKI have many years of expertise in intelligent distribution grid management, specifically from the Designetz and PolyEnergyNet research projects. The GridAnalysis project is funded for a period of three years by the German Federal Ministry for Economic Affairs and Energy (BMWi).

DFKI is developing AI-based systems analysis tools for power distribution grids, an assistance system that provides decision support to the user. AI-based methods are primarily used to forecast photovoltaic feed-in and load profiles, to identify critical network conditions, and to propose countermeasures, if necessary.

“We rely, among other things, on neural networks for AI-based grid diagnostics. In the future, this will enable a faster predictive analysis of large numbers of grid conditions in an acceptable time frame,” said Dr. Boris Brandherm, Project Leader and Senior Researcher at the Cognitive Assistants Lab at DFKI.

This grid simulation is to be tested and evaluated in an actual grid operator’s system landscape, both in local and regional power distribution grids on the basis of defined use cases. The research results of GridAnalysis will form the foundation for a concept for the intelligent exploitation of flexibility, e.g., for the management of electric drive vehicle charging systems.

In the context of funding policy goals, GridAnalysis supplies cross-technology components for integrated systems that may significantly shape the European research agenda in the era of digitalization.

More information

http://gridanalysis.de

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TEST CENTER FOR MARITIME TECHNOLOGIES OPERATING OFF THE HELIGOLAND COAST IN THE NORTH SEA

Since April 23, 2020, eight yellow barrels have been deployed just a few nautical miles off the coast of the island of Heligoland to mark a three square kilometer, 45 meter deep research test area. The land-based logistics for the Test Center for Maritime Technologies were already established in the summer of 2019. Application research on the high seas is now possible above and below the surface.

In addition to studying processes like the cycle of materials at sea, the defined area will primarily be used to test autonomous underwater vehicles and flight systems. Specific advances in mobile robotics can now prove their worth at sea, in waves and currents, with sediment loads and high winds, and in limited visibility conditions. Besides, various test and inspection scenarios can be set up in the test area, depending on the application.

The Test Center for Maritime Technologies is managed by the Fraunhofer-Institute for Manufacturing Technologies and Advanced Materials (IFAM) and was jointly founded with DFKI, Helmholtz Center for Materials and Coastal Research in Geesthacht (HZG), the Institute for Chemistry and Biology in a Marine Environment at the University of Oldenburg, and Jacobs University Bremen. The consortium receives scientific support from the Alfred Wegener Institute (AWI) at the Helmholtz Center for Polar and Marine Research. Within the Test Center for Maritime Technologies, the research partners combine their expertise in artificial intelligence and robotics, materials research, manufacturing technologies, materials and coastal research, marine geology, marine material cycles and energy flows, as well as polar and marine research. This will facilitate the transfer of forward-looking technologies to applications for the maritime sector.

At the same time, industrial partners seeking suitable partners and test environments for the development of robust and reliable systems can take advantage of the scientific know-how and services offered by the Test Center for Maritime Technologies. The services include planning, implementation, and performance evaluations of applications in the test area. Experienced technicians are also available in the areas of logistics, engineering, workshops, and control centers.

More information

www.maritimes-testzentrum.de

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Test Center for Maritime Technologies begins operations in the North Sea off Heligoland.

TreeSatAI

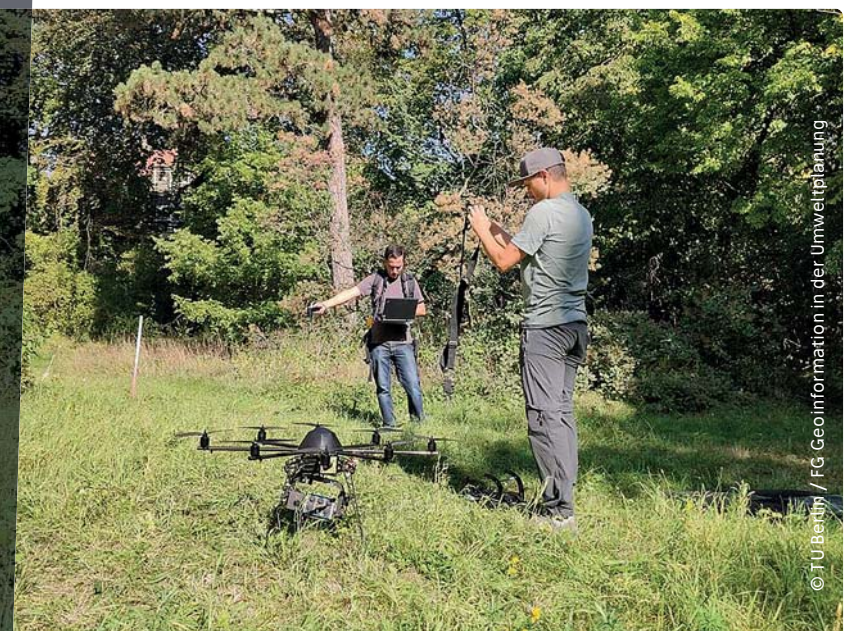
ARTIFICIAL INTELLIGENCE OBSERVING EARTH USING MULTI-SOURCE GEODATA TO MONITOR THE FORESTS AND PRESERVE INFRASTRUCTURE AND NATURE

TreeSatAI develops AI methods for monitoring forests and tree populations at the local, regional, and global levels. Prototypes are under development that use freely accessible geospatial data from various sources – e.g., remote sensing data, administrative information, social media, mobile apps, monitoring libraries, open image databases – to facilitate Deep Learning-based extraction and classification of the number and type of trees. This information is later applied to various use cases in the areas of forestry, nature conservation, and infrastructure monitoring. The German Federal Ministry of Education and Research (BMBF) is sponsoring TreeSatAI.

Remote sensing data from ESA and NASA satellite missions, aerial image data as well as geodata on the state of the environment are increasingly available free of charge and in large quantities. At the same time, texts, photos, and videos on social media platforms like Flickr, Twitter, or Open Street Map provide further access to information about our environment. A manual evaluation of the resulting vast amounts of data, however, is time-consuming and labor-intensive.

The Deep Learning Competence Center and the research department Smart Data & Knowledge Services at DFKI are continuing to develop AI procedures to analyze aerial and satellite images, which should enable local evaluations as well as global analyses. The scientists in the TreeSatAI project are using CNNs (Convolutional Neural Networks) and specialized LSTM models (Long Short-Term Memory) from the field of Deep Learning to support environmental and forestry experts with timely automated development of information about over large forested areas. The major challenges are in acquiring sufficient, high-quality training data to train the algorithms and the expertise from a forestry and environmental perspective to perform the evaluations of the resulting models. To enable numerous challenges encountered in this ambitious project to be mastered, the project combines and applies the various capabilities of the partners.

A drone ready for take-off to support field tests.



© TU Berlin / FG Geoinformation in der Umweltplanung

The following uses cases of TreeSatAI scenarios and prototypes were proposed by the consortia partners, especially the participating small and medium-sized companies:

- When insufficient knowledge about tree species, growth height, age class, and state of health runs up against the increasing number of storms, it often ends with more uprooted trees. Tree damage is a danger to national and international rail and road traffic and costs millions in claims. The technical objective of LiveEO's **infrastructure monitoring** prototype is to control the tree vegetation along railroad lines, roads, and power lines.

- The **nature conservation monitoring** prototype was chosen to support and improve the implementation of international tasks – for example, as set forth in the Convention on Biological Diversity (CBD) – for monitoring the European flora-fauna habitats and invasive species. The LUP Company is developing this prototype to assist and improve the private sector and public efforts to implement monitoring and control plans.

- Vision Impulse, a spin-off company from DFKI, is developing another prototype for environmental protection and **forest monitoring.** The system uses an existing AI platform extended with CNN and LSTM models for the mapping and condition monitoring of forests on a national and European scale. Information will be obtained from large-scale satellite image analysis and from – much more detailed – AI-based evaluations of drone and aerial images of local forest stands.

Drought and beetle damaged forests in the Harz Mountains.

PROJECT SUMMARY

Term	6/1/2020 - 5/31/2022
Partners	TU Berlin: Geoinformation in environmental planning (lead manager) TU Berlin: Remote Sensing Image Analysis Group LiveEO GmbH LUP GmbH Vision Impulse GmbH
Funding Code	BMBF 01IS20014D

More information

www.dfki.de/sds

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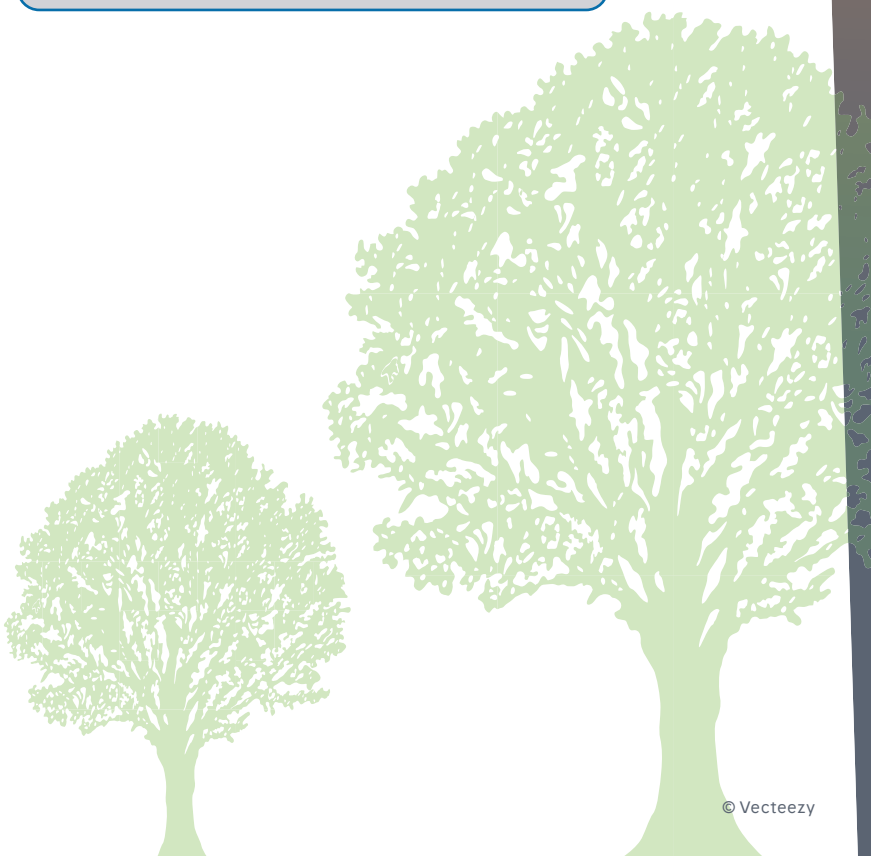

EUROPEAN BIG DATA VALUE FORUM

3 - 5 NOVEMBER . 2020 - BERLIN + VIRTUAL

BUILDING A STRONG EUROPEAN DATA AND AI ECOSYSTEM

The European Big Data Value Forum (EBDVF) is the flagship event of the European Big Data and Data-Driven AI Research and Innovation community. It is an annual event and takes place in the country that is holding the Presidency of the European Council in that year. The conference is organized by the Big Data Value Association (BDVA) and the European Commission (DG CONNECT).

EBDVF 2020 took place in Germany from November 3-5, 2020. The organizers included DFKI, Plattform Industrie 4.0, Plattform Lernende Systeme, and Berlin Partner. The event was produced by DFKI in Berlin as a virtual event because of the continuing spread of the COVID-19 pandemic.

> *"Our aim is to secure technological sovereignty and ensure that Germany and Europe remain competitive. It´s about jobs. It´s about prosperity. It is also about shaping AI to line up with our ethical standards."*
> *Excerpt from the opening remarks by Anja Karliczek, Federal Minister of Education and Research*

The German and European AI and Data communities came together at EBDVF 2020 under the slogan "Building a strong European data and AI ecosystem." The Forum contributed to the discussion of the European data and AI strategy, specifically addressing major topics for Europe, such as the development of European Data Spaces, the importance of technology platforms and trust, the opportunities for market acceptance, and the new data and AI challenges ahead for society.

Anja Karliczek, Federal Minister of Education and Research

EBDVF 2020 focused on how data and AI can contribute to managing the emerging societal challenges, like those brought by the COVID-19 pandemic. This edition of the Forum combined cross-sector tracks with the sector-related tracks for Manufacturing, Autonomous Systems, Transport, Mobility and Logistics, Health, and Smart Society. In addition, the program included multiple research and innovation sessions and start-ups pitches that showcased Europe's Research & Innovation excellence in data and AI.

Khalil Rouhana, Deputy Director of DG CONNECT, European Commission, emphasized the digital transformation, especially the commission's priorities on data and AI. He announced the development of a legal data framework to support the free flow of data across the member states so that data can be collected, stored, and processed in the EU in a trustworthy manner. To be presented at the beginning of 2021, the Data Governance Act is seen as an important legal framework for data sharing. Rouhana said that planned investments of at least 1.2 billion euros will create common data spaces for health, transportation, mobility, energy, environment, and industrial data. Rouhana added that a legal framework for trustworthy and citizen-centric AI, based on the White Paper from the High-Level Expert Group on AI (HLEG) and the accompanying public discussions, should also be released at the beginning of 2021.

Khalil Rouhana, Deputy Director-General DG CONNECT, European Commission

Artificial Intelligence, data, and robotics/embedded AI present opportunities as well as challenges for Europe: an opportunity to improve operations in public and private sectors in Europe – and a challenge to develop Europe's existing strengths in the core competencies AI, data, and robotics into a global market advantage. A partnership of industry, start-ups, governments, investors, researchers, and civic representatives expressed their desire to join forces, to engage, shape, and exploit all the advantages in this valuable European endeavor.

In his opening keynote, Thomas Jarzombek, Commissioner for Digital Economy and Start-ups for the German government, said that AI and data policy have to go hand in hand. "Europe must be an innovator, not only a regulator. With GAIA-X, we are building a secure and safe cloud infrastructure for Europe, which will be the basis of the digital economy. Currently, 350 companies and organizations have joined the partnership. We are dedicated to keep control of our data in Europe and to enable our industry to benefit from this know-how. INDUSTRIE 4.0 is the key to the resilience of our economy."

Thomas Jarzombek, Commissioner for Digital Economy and Start-ups for the German government

AI, data, and robotics are fields that cut across sectors and affect many in the value chains. It is generally accepted that AI, data, and robotics will significantly impact all economic sectors and the United Nations' Sustainable Development Goals (SDGs).

Achieving this diverse impact requires more than a strong technology position in the market. It demands a skilled workforce, standardization, and a regulatory landscape that speeds up deployment and enables market development; it requires a strategy and an understanding of best practices. All of this is facilitated by the partnership, which provides an opportunity to combine and increase the impact of public and private investment, to create greater value for European business and society through the widespread deployment of AI, data, and robotics.

EUROPEAN BIG DATA VALUE FORUM

EBDVF 2020 brought together key decision-makers, industry players, and innovators to discuss the conditions needed in Europe to leverage current AI opportunities for business and society and how a European partnership can support the project. Three general objectives and associated issues for the AI, Data, and Robotics partnership were addressed. The answers will have a broad impact in the areas of science, business, technology, society, and environment:

What are Europe's strengths and how can Europe occupy a strong position in global competition?

How can Europe achieve leadership with a high socio-economic impact?

How can Europe secure its sovereignty over technologies and know-how?

In September 2020, BDVA, euRobotics, ELLIS, CLAIRE, and EurAI published the third edition of the Strategic Research, Innovation, and Deployment Agenda (SRIDA). The five organizations are committed to working closely together to strengthen the AI, Data, and Robotics partnership. (Download: www.bdva.eu/node/1310).

The partnership's vision is to promote European competitiveness, societal benefit, and environmental issues to become a world leader in research, development, and use of value-driven trustworthy AI, data and robotics on a foundation of European laws, principles, and values.

BDV BIG DATA VALUE ASSOCIATION

eu2020.de

More information

www.european-big-data-value-forum.eu
https://youtu.be/VdcnMXs6Zjg

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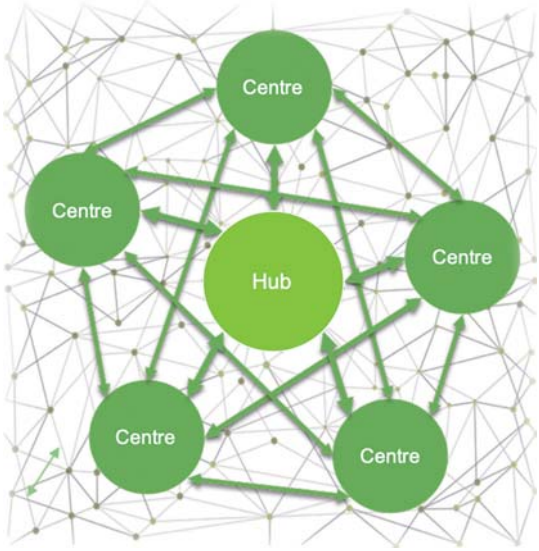
NETWORKING AI RESEARCH IN THE EUROPEAN UNION



DFKI and CLAIRE participating in new projects

The EU is setting the course for the next five to ten years of AI research in Europe. Networks and their funding could become the nucleus for other activities in cutting-edge AI research and AI innovation in Europe. DFKI is participating in three winning projects from the ICT-48 call for proposals "Towards a vibrant European network of AI excellence centres" namely, VISION, TAILOR, and HumanE-AI-Net. Members of the European network CLAIRE (Confederation of Laboratories for Artificial Intelligence Research) will be coordinating and implementing the three projects. In the ICT competition, only five projects were selected for funding, each of which will receive up to twelve million euros over the next three years.

VISION – Coordinating a European AI-Network

Under the leadership of CLAIRE co-initiator Prof. Dr. Holger Hoos, Leiden University, the aims of the project VISION are to coordinate the European networks of AI-Excellence AI4Media, ELISE, HumanE-AI-Net, and TAILOR and to ensure close coordination with the European Commission.

DFKI's assigned role in the project is to organize a targeted exchange between researchers and industry representatives. Theme Development Workshops are designed to bring together researchers, industry, and other stakeholders, such as associations and political decision-makers from the networks, to identify industrial trends and needs in the field of AI and to link them to current research topics.

In addition, orientation guides and best practices are to be developed that will allow the networks to contribute their perspective to a strategic research and innovation road map for AI in Europe. This effort also seeks to include other stakeholders, such as education and training institutions or PPP initiatives, in the work of the networks.

The plans for the new networks of excellence were first introduced at the "CLAIRE: Future of European Excellence in AI" event at the European AI conference Digital ECAI 2020.

TAILOR – Trustworthy AI

Parallel to Project VISION, key players from academic institutions and the European industry are working in the European network of AI centers of excellence to develop the scientific basis for "Trustworthy AI." Using a meaningful combination and integrating approaches from diverse areas like machine learning, optimization methods, and closure planning, we can appropriately address the dimensions of explainability, safety, fairness, responsibility/liability, reproducibility, data protection and privacy, as well as sustainability.

The project leader is Prof. Fredrik Heintz, a researcher at Linköping University in Sweden, President of the Swedish AI Society (SAIS), member of the High-Level Expert Group on AI in the European Commission, and a key supporter of CLAIRE. At the Annual European Conference on Artificial Intelligence (ECAI) this year, a virtual two-day workshop on Trustworthy AI was held for researchers and other experts.

In TAILOR, DFKI will lead a work package focusing on the cooperation between the networked centers of excellence and partners in industry, representing such diverse sectors as the automotive industry, INDUSTRIE 4.0, healthcare, public administration, and the energy sector.

The aim is to identify, define, and prioritize common research topics and core topics that promote the use of a trusted AI in the context of their respective industries. In addition to developing a strategic research and innovation roadmap, suitable formats and structures (e.g., transfer labs, joint doctoral programs) that promote close collaboration are to be developed and tested on the basis of realistic use cases. The results will support the early transfer of research outcomes into operational practice.

HumanE-AI-Net – Human-centric AI systems

Under the lead management of DFKI, the HumanE-AI-Net project is creating a center of excellence network that includes Europe's leading research centers, universities, and major key players in industry. The priority focus is on linking world-leading AI capabilities with key players in related fields such as human-computer interaction, cognitive sciences, and social sciences.

The project leader is Prof. Paul Lukowicz, head of DFKI's Embedded Intelligence research department (see page 20).

CLAIRE

The CLAIRE research network aims to strengthen European excellence in AI research and innovation. More than 380 laboratories and institutions have already joined since its establishment in June 2018.

The aim of the three key research initiatives is to promote cooperation between the best research teams in Europe and to combine forces to tackle the scientific and technological challenges in the field of AI more efficiently.

More information

https://claire-ai.org
www.humane-ai.eu

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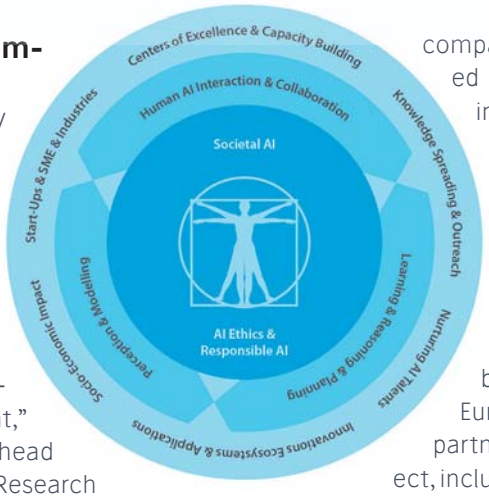
HUMANE AI NET

AI THAT UNDERSTANDS HUMANS

HumanE-AI-Net brings together top European research centers, universities, and leading industrial companies in a Centers of Excellence network, with the aim of establishing AI research as an ethical and human-centric brand and strengthening Europe's position in global competition. This ambitious project was launched in early September 2020 and is funded by the European Union initially for a three-year term.

Trustworthy AI with comprehensible decisions

"To win broad acceptance by society, AI systems must be seen as trustworthy, and the decisions they take must, above all, be reasonable. Such systems have to 'understand' people to be able to adapt to complex real-life situations and act appropriately and ethically in a social environment," said Prof. Dr. Paul Lukowicz, head of the Embedded Intelligence Research Department at DFKI and coordinator of HumanE-AI-Net. "People and machines have different strengths. If we can succeed in developing systems that have the ability to understand our human world view, they will deliver decisions and results that we can comprehend."



The aim is to create AI systems that know what humans need at any given moment and support them in completing their tasks. Throughout the process, humans always remain in control. In this way, the development of human-centric AI systems will be oriented on the European Community's ethical, legal, democratic, and cultural values. The synergy between humans and machines should build trust in the new technology while, at the same time, promising great potential for new applications and business models.

Key players in AI and leading companies

HumanE-AI-Net is based on preliminary research by HumanE-AI and brings key players in AI together with companies and scientists from related fields such as human-machine interaction, psychology, and the cognitive, social, and complexity sciences. In addition to the DFKI Research Departments of Embedded Intelligence (EI), Agents and Simulated Reality (ASR), Speech and Language Technology (SLT), and the Robotics Innovation Center (RIC), 21 European countries and 53 project partners are involved in the joint project, including major corporations such as Airbus, SAP, Philips, and Thales. The European Union is funding the network with 12 million euros. HumanE-AI-Net works closely with the major European AI initiatives CLAIRE and ELLIS.

HumanE-AI-Net will make the results of its research available to the European AI community via the AI4EU-platform and a virtual laboratory. To further share the knowledge, a series of summer schools, tutorials, and MOOCs (Massive Open Online Courses) will be developed, along with an industrial Ph.D. program. Key industrial players from crucial sectors of the European economy will be involved in defining of the research agenda and evaluation results.

More information

www.humane-ai.eu

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EU COUNCIL PRESIDENCY TRANSLATOR – LINKING A MULTI-LANGUAGE EUROPE AND SUPPORTING LANGUAGE DIVERSITY

Languages are an essential element of the European identity; it is no coincidence that linguistic diversity is promoted and celebrated in the EU motto "Unity in Diversity." There are 24 official languages in the EU alone, which can be a hindrance to the free flow of ideas and information as well as trade and cultural exchange. The automated translations available during the German EU Council Presidency are a response to this challenge.

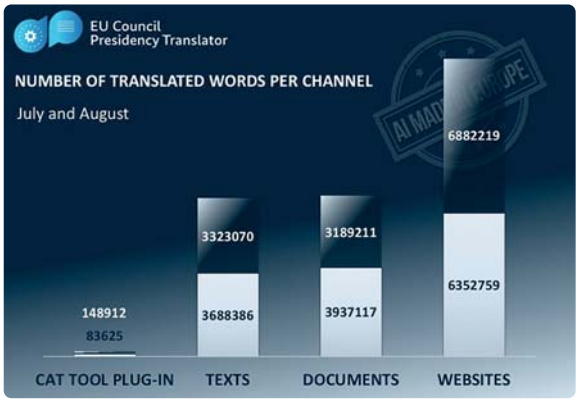
The EU Council Presidency Translator provides free, online machine translations and is available to all interested parties during the German EU Council Presidency – for professional or private purposes.

Based on neural machine translation systems, the EU Council Presidency Translator brings together suppliers from industry (DeepL and Tilde), research (DFKI), and public institutions (European Commission with eTranslation). Besides texts and documents, users can use the Translator to translate entire websites into all 24 EU-languages. Responsible for the development and continuous improvement of this offer are DFKI and the Tilde company, which has already supported six previous council presidencies. The work is funded by grants from the German Foreign Office and coordinated by DFKI. Unlike many other free online translation engines, the EU Council Presidency Translator ensures comprehensive security as user data is neither stored nor analyzed but is immediately deleted after translation.

In close collaboration with the translators of the ministries involved in the EU Council Presidency, DFKI and Tilde have customized a neural engine, focused on the specialized topics at the ministries and the EU Council Presidency. Under the direction of the Federal Foreign Office, translators from the language services of various federal ministries provided very large quantities of manually translated texts and terminology for use in the training of the Translator. The engine is being tested during the presidency in an effort to help developers uncover and eliminate weaknesses in individual systems.

The public response to the EU Council Presidency Translator is showing increasing popularity. The Translator has broken all previous records, having translated more than 14 million words after only one month – adding an impressive 27 million translated words after the second month. Users are invited to submit suggestions that improve the translations and contribute to the continuous development of the EU Council Presidency Translator.

EU Council Presidency Translator



More information

https://presidencymt.eu

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"I SEE GREATER OPPORTUNITIES FOR EUROPE IN THE AREA OF BUSINESS AI."

Interview with **Dr. Feiyu Xu**, Senior Vice President, Global Head of Artificial Intelligence, SAP, where she talks about intelligent solutions and added value for customers in addition to Chinese strengths, European excellence, and the topic of ethical guidelines for AI. Photo: SAP

Feiyu Xu, Senior Vice President, Global Head of Artificial Intelligence at SAP and a member of the SAP AI Ethics Steering Committee since May 2020.

KI IN CHINA AND EUROPA

What are the application areas in which China is leading in the use of AI?

China is particularly strong in the areas of Internet-AI and Perception-AI. Internet-AI refers to applications like search engines, query-answer systems, personal assistants, recommenders, and machine translation. Perception-AI is about the use of AI technologies like computer vision, speech, gestures, and haptics. China is very successful in the commercialization of AI technologies for the consumer market, for example, for e-commerce, search engines, social media, and the gaming industry.

In this context, I can name some very successful Chinese companies, like Alibaba, Tencent, Didi, Baidu, Jingdong, and FlyerTech.

What does Europe need to do to catch up?

The excellent breadth and depth of basic research in Europe is to be recognized. I see great opportunities for Europe in the areas of business AI, for example, Enterprise AI, Industrial robots, health AI, and smart manufacturing.

HUMAN-CENTRIC AI

What do you see as the social challenges related to the use of AI?

One challenge is that many in our society hold the mistaken assumption that AI, in many areas, will replace humans. In a professional context, for example, it must be emphasized that AI contributes to the safety of humans, warning them of danger, assisting, and taking over tasks that are too hard or too dangerous for people. AI will also lead to the creation of new jobs, as experts are needed for the development, operation, and effective use of AI systems.

What must be covered in a code of conduct for companies to promote European values and ethical standards?

We published the SAP guidelines for the ethical use of artificial intelligence in September 2018. They underscore that at SAP, AI has a human-centric focus, is transparent and understandable, and that data protection must be respected.

We designed our principles to reflect our values and overarching goals in relation to AI and to form the basis of our business activities. We have established an SAP standard that corresponds in many areas to the recommendations of the High-Level Expert Group of

the European Commission, which are also reflected in an EU White Paper. All requirements must aline with corporate standards, guidelines, and the European regulations for data protection and security. Our ethics guidelines provide a framework that goes beyond what is legally required. Working with SAP guidelines enables companies to reach decisions without prejudice, with honesty and transparency, as well as to maintain quality and security standards. These principles support SAP's uncompromising stance on data protection and the company's efforts to actively address the social challenges presented by AI.

How important are these standards for your company?

These guidelines are our commitment not only to comply with legal requirements but to go further, pioneering extensive and continuous efforts to manage the ethical and socio-economic challenges of AI.

To what extent should AI be regulated?

The regulation of AI remains a major issue for industrial and technology corporations. The European Commission is currently working on new rules that will apply to AI in Europe. How important is AI to the EU Commission, and what exactly is to be regulated? The definition of AI, in our view, needs to be worked out more clearly – especially, as there are individual areas that ought to be regulated in great detail. Perhaps, what we need is a framework for emerging technologies in the field of software and services overall – not just for AI.

ADDED VALUE FROM AI

Where can we already find AI in SAP products?

Functions supported by AI have already been integrated into several standard SAP products (e.g., S4/HANA). Application areas that come to mind are automation, augmentation, optimization, and recommendation. We also develop various technologies that enable our customers, partners, and us to implement our own AI scenarios, which is necessary for the many processes that cannot be represented by standard solutions. Furthermore, our ethical guidelines concerning AI reinforce trust and cooperation with our customers and partners. This is a very important point for us because we want our smart solutions to generate significant added value for our customers. The SAP mission statement reads: "To help the world run better and improve people's lives." We believe that social, environmental, and economic activity and performance are interlinked and may have a tangible impact on each other. We are committed to a sustainable future for SAP, our customers, and society.

INTELLIGENT BUSINESS SOFTWARE

What areas of AI are of particular interest to SAP?

The subject areas prediction, optimization, and automation of business processes and resources are all very relevant for Enterprise AI and also, in general, for the responsible use of AI. The development of natural and efficient human-machine interaction is another interesting area, where topics like natural language processing, dialog systems, explainable AI, autoML, knowledge graphs, big data analytics, and machine vision take on special significance.

Deep Learning and Machine Learning methods or rule-based processes – which AI approach currently appears more promising for use in enterprise software?

Enterprise AI is very complex. We are combining data-driven solutions with existing knowledge (business objects and business processes) in many applications and, in many other cases, our answer may include human-machine collaboration.

Following her education at Tongji University in Shanghai, **Feiyu Xu** received her doctorate at Saarland University and worked at DFKI for nearly 20 years. Her major research focus included multilingual information systems, information extraction, text mining, Big Data analyses, dialog systems, knowledge graphs, and business intelligence. During her time at DFKI, she successfully managed more than 30 national and international research and development projects. In 2013, together with Prof. Dr. Hans Uszkoreit, DFKI, and Prof. Roberto Navigli, Sapienza University of Rome, she won a Google Focused Research Award for a project that dealt with the automated extraction of conceptual relationships from large knowledge databases. After DFKI, Feiyu Xu moved to Beijing as Head of Lenovo Research AI Lab from March 2017 to March 2020. In this capacity, she established and managed the Lenovo AI Lab.

RHINELAND-PALATINATE ANNOUNCES AI STRATEGY

ANDREAS DENGEL NAMED AI AMBASSADOR

Minister President Malu Dreyer and Science Minister Konrad Wolf presented the state's AI agenda at a meeting of Rhineland-Palatinate's digitalization cabinet on September 22, 2020. The state government is doubling its investment in the promotion, research, and networking of artificial intelligence.

The Minister President emphasized the importance of the AI strategy for Rhineland-Palatinate: "Artificial Intelligence is a critically important topic for the future. It offers opportunities for economic advancement and improvements to our quality of life in many areas, to cure serious diseases such as cancer, and to generate new knowledge. For our state and its residents to take advantage of these opportunities, we are investing in the transfer of application-oriented artificial intelligence and the linkage of science and business."

In the future, the state will be represented worldwide by two AI ambassadors, Prof. Dr. Katharina Zweig from Technical University Kaiserslautern (TUK) and Prof. Dr. Andreas Dengel from DFKI and the TUK. Both are internationally recognized figures in the field of AI and will play an essential role for the state of Rhineland-Palatinate. Their role as AI Ambassadors is to promote the AI expertise of the many outstanding research institutes on an international level and to support the initiation of global contacts to strengthen Rhineland-Palatinate's position as an international beacon of AI.

"I am pleased that we have Prof. Dr. Katharina Zweig and Prof. Dr. Andreas Dengel as AI ambassadors and Prof. Dr. Anita Schöbel piloting our AI strategy. All are globally recognized AI experts with the abilities to contribute to making Rhineland-Palatinate even more visible, both nationally and internationally, as a center of education and research," said Science Minister Wolf.

Further measures by the state government include establishing the AI Alliance, targeted project and research funding, the establishment of an AI Academy, the appointment of an AI pilot, the establishment of new AI professorships, and the establishment of AI labs. The government in Mainz had earmarked project funding of around 18 million euros for activities aimed at strengthening Rhineland-Palatinate's scientific landscape in the AI field covering the period from 2018 to the end of 2023. Under the new AI agenda, a further 18 million euros will be added over the next few years, effectively doubling the initial sum.

"I am pleased to apply my more than twenty-five years of experience in the management of DFKI during its growth years now to the duties of AI ambassador for the state of Rhineland-Palatinate. As an AI ambassador, I hope my contributions, whether as a mediator, moderator, or translator between research and application, will result in a sharper focus on 'AI made in RLP'."
Prof. Andreas Dengel

As AI ambassador, Prof. Dengel supports the Rhineland-Palatinate AI Strategy.

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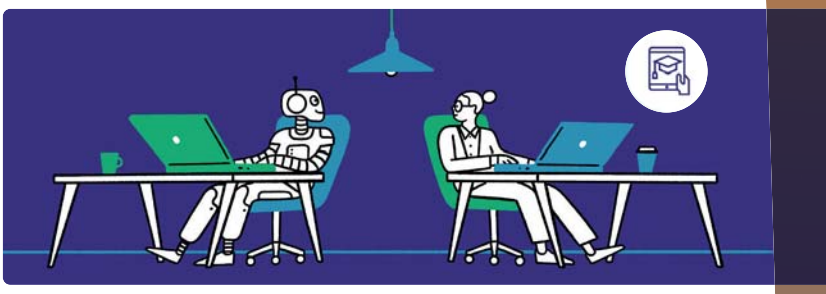
KI-CAMPUS – LAUNCH SIGNAL FOR DIGITAL LEARNING PLATFORM

AI Campus, the learning platform for artificial intelligence, has been available to the public as a beta version with an initial digital learning offer since July. The launch took place nine months sooner than planned because of the demand and the current situation. The learning opportunities and functionalities are being continuously expanded and further developed in a user-oriented approach based on feedback.

The R&D Project "AI Campus – Learning Platform for Artificial Intelligence" is sponsored by the Federal Ministry of Education and Research (BMBF) and has released a beta version in German and English. Students, professionals, and other lifelong learners find open, no-fee licenses for the AI-Campus learning opportunities. The following learning opportunities (**"AI Campus Originals"**), which were especially developed for the AI Campus, are now available:



Charité Berlin – Dr. med. AI:
An interactive learning offer based on a podcast lets learners understand how AI is used in medicine.

Fraunhofer IIS – Machine Learning for Engineering Explained:
An advanced course presents an overview of the methods of "explainable AI".

Young Tinkerers – Schools build AI:
An online course enables students and teachers to integrate the topic of AI into their lessons.

Kiron Open Higher Education – Launchpad to Fundamental Questions on AI:
Based on the comic strip "We need to talk, AI," this is an introductory approach to the major topics in AI.

Entrepreneurship – Introduction to AI
An introductory learning offer clarifies the essential technical aspects and functionalities of AI.

More than 20 additional AI Campus Originals will be created in the near future to cover various AI topics. The podcasts, videos, courses, and even "micro" degrees, are developed by scientists from numerous universities in Germany and Luxemburg as well as the leading experts at DFKI and are provided free of charge.

In addition to creating courses, DFKI contributes its expertise to the development of the curriculum and the learning modules. The project team headed by Dr. Kinga Schumacher is responsible for the production quality of the AI Campus Originals and the curated external content. The researchers are also studying how AI methods can contribute to increased learning success and support learners in their course selections.

Florian Rampelt, head of the AI Campus office at the *Stifterverband* (Donors' association for the promotion of humanities and sciences in Germany): "We deliberately decided to launch the beta version early to help strengthen the opportunities for free digital learning during the Corona period with contributions for self-directed learning in general and for AI expertise in particular. All learners and teachers are welcome to try out the AI Campus at this early stage of development and to support us during the advanced development stage with feedback and ideas."

More information
www. ki-campus.org

KI–Campus

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AI METHOD TO DETECT THE QUALITY OF DONOR CORNEAS

THE „KITATTA“ PROJECT

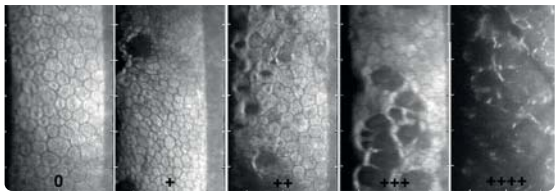
More than 9,000 corneal transplants are performed annually in Germany alone. Despite strict quality criteria, about 4-5% of the transplants show postoperative wart-like changes that impair the cornea's functionality. Until now, there was no way to determine with any certainty whether and to what extent the so-called guttae are present. The potential existed for a pathologically changed cornea to be used in the transplantation. A joint project by the Saarland University Clinic for Ophthalmology and DFKI seeks to develop a better method to assess the quality of donor corneas.

The presence of many guttae can adversely affect the transparency of the cornea. This often leads to irreversible visual impairment, sometimes so severe that a corneal transplantation becomes necessary. Guttae sometimes remain undetected by the inverted mirror microscopy routinely performed in the preoperative stages.

The goal of KIttata (Artificial Intelligence for the Detection and Classification of Corneal Guttata in the Corneal Bank prior to Keratoplasty) is to develop an AI classification algorithm that predicts the suitability of a donor cornea prior to the surgery. This is intended to increase the transplanted cornea's long-term survival rate, reduce the need for re-transplantations, and reduce the associated health care costs.

The probability of the presence of undetected guttae in a corneal graft depends on morphological criteria such as differences in cell color, irregularities in cell shape, presence of vesicles, deformities of the cell membrane, or presence of areas without cells.

Scientists from the DFKI research department Cognitive Assistants are developing a classification algorithm that can recognize whether a given donor cornea is healthy. As input parameters for an AI-supported evaluation algorithm (classifier), they use data acquired by microscopic imaging of the cornea.



Severity of corneal guttata after transplantation from 0 to ++++.

“AI is currently finding many applications in many areas of medicine, including ophthalmology. By using this advanced technology as image analysis and recognition tool, a milestone in the quality assurance of corneal donor tissue could be achieved.”
Prof. Dr. Berthold Seitz, Director of the Department of Ophthalmology at Saarland University Hospital.

“Our goal is to optimize the classification of corneas and achieve more accurate results than the previous methods. For this purpose, we are using deep learning methods and neural models that are derived from information from the corneal bank, i.e., images and parameters,” says DFKI project manager Dr. Jan Alexandersson.

The final results are evaluated by a clinical expert. This enables the adjustment of the model's input parameters and supports the step by step optimization of the model.

PROJECT SUMMARY

Sponsor	Dr. Rolf M. Schwiete Foundation, Mannheim
Volume	215,000 €
Term	1 year
Partners	DFKI Saarbrücken Saarland University Hospital (UKS) - Department of Ophthalmology, Homburg

(l.-r.) Dr. Matthieu Deru, Dr. Jan Alexandersson (DFKI), Katja Schulz, Marvin Schwarz, Dr. Loay Daas (UKS), Dr. Alassane Ndiaye (DFKI), Prof. Berthold Seitz, Tarek Safi (UKS).

More information

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ROBOTICS IN HEALTHCARE

DFKI BREMEN DEVELOPING THE HOSPITAL BED OF THE FUTURE WITH THE ST. JOHN AMBULANCE

Physical strains among nursing staff are one of the main reasons for absenteeism and early retirement. To support workers and give patients more independence, the two DFKI research departments based in Bremen, the St. John Ambulance association *(Johanniter-Unfall-Hilfe)*, and the universities of Oldenburg and Osnabrück have partnered to work on robotic systems and sensor solutions for use in hospital beds. The German Federal Ministry for Education and Research (BMBF) provides funding for the AdaMeKoR project in the amount of 1.8 million euros. The aim is to relieve the strain on nursing staff while, at the same time, enabling greater patient independence.

The research project started on 15 March 2020 with the aim of developing and equipping the hospital beds of the future with a robot arm and control sensors to ensure proper use. The lead manager is the *Johanniter-Unfall-Hilfe*, which is cooperating with the universities of Osnabrück and Oldenburg, and DFKI's Robotics Innovation Center and Cyber-Physical Systems research departments, to develop various components that can turn a hospital bed into a system that can take the strain off of the nursing staff and patients.

A robot arm as a third hand for the physically impaired

The University of Oldenburg is working on sensor systems to analyze the posture of care workers as they go about their tasks, as well as a robot arm to transfer patients. DFKI research departments are also developing concepts for promoting the mobility and transfer of patients between bed and wheelchair with the help of robotic devices. The focus is on the control of robotic support systems and mobilization support, specifically, a robot arm that assists the physically impaired to live with more independence.

The Cyber-Physical Systems department, led by Prof. Dr. Rolf Drechsler, is working on control mechanisms for a Kinova robot arm that allows the use of the device through easily managed methods such as a joystick. The robot arm is essentially used as a third hand. Installed on a bedside stand, the arm is controlled with a joystick or a more complex 3D mouse and can help in reaching and passing objects.

Robotic concepts for the transfer into the wheelchair

The Robotics Innovation Center, led by Prof. Dr. Frank Kirchner, is developing concepts to enable a supported transfer of patients – for instance, from the bed to a wheelchair. Robotic solutions represent the answer as they can be seamlessly integrated into the everyday life of medical staff, are easy to use, and can safely handle people in the heavier weight classes. The most promising concepts will be visualized on the computer for possible implementation.

The project goal is to build a demonstrator to show how robots, sensors, and semi-automated systems can be used in support of two target groups: the nurses and the patients. By monitoring the posture of the nursing staff and relieving the physical strain as well as enhancing patient autonomy, the physical well-being and quality of life of both groups can be improved.

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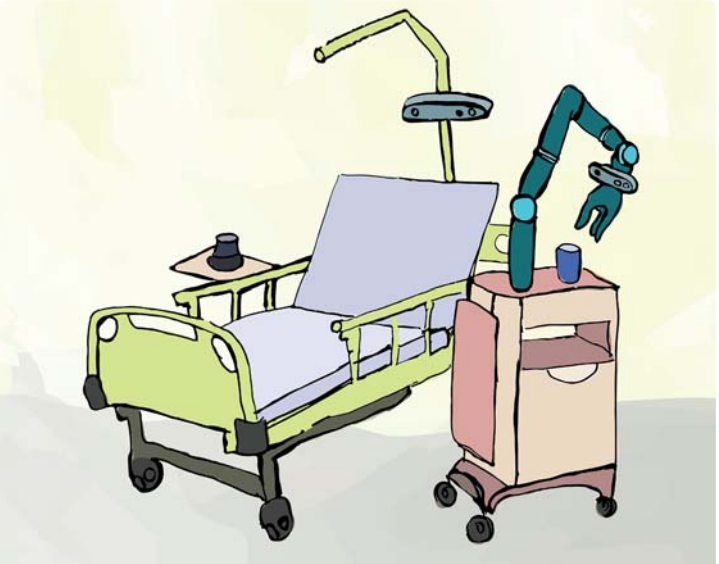
AdaMeKoR
Adaptives Mehrkomponenten-Robotersystem



Visualization of the robot arm used to support people with physical limitations in need of care.

ROBOTS LEARN TO UNDERSTAND HUMANS

RESEARCH BEGINS ON PROJECT EXPECT

In the recently started EXPECT project, DFKI experts from the areas of multimodal interaction, embedded brain reading, and interactive machine learning will jointly investigate how EEG measurements of brain activity may contribute to flexible, context-sensitive human-machine interaction.

The aim is to develop an adaptive, self-learning platform that is able to derive human intentions from gestures, speech, eye movements, and brainwaves from various types of active interaction.

DFKI is one of the pioneers in the mobile multimodal use of EEG data for interaction with robotic systems. "AI systems will someday support humans not only in areas where they have limitations. Such systems rather will act as personal assistants. But first, to fulfill this task, they must understand humans, derive intentions, and provide context-sensitive support. Brain data represents one possibility to give the robot a direct insight into human intentions. An important field of application, for example, is in stroke rehabilitation," says Dr. Elsa Kirchner, project manager for the Robotics Innovation Center.

The project develops, evaluates, and tests methods for automated identification and joint analysis of human multimodal data. The investigation of the question of how fundamentally important brain data are for the prediction of human intentions is advanced through further systematic experiments.

Maurice Rekrut, project manager for the research department Cognitive Assistants: "In the EXPECT project, we investigate to what extent we can find correlations between different modalities in brain activity to make human-robot interaction more intuitive and natural. We want to design an interactive concept on the basis of a pure brain-computer interface. We are also working on concepts for multimodal input that provide the best option for interaction in every situation."

The technologies to be developed in EXPECT can be used in a wide range of applications – for example, in space travel and extraterrestrial exploration, robot-supported rehabilitation and assistance, as well as in INDUSTRIE 4.0 and industrial human-robot collaboration.

PROJECT SUMMARY

EXPECT (Exploring the Potential of Pervasive Embedded Brain Reading in Human Robot Collaborations)

Sponsor	Federal Ministry of Education and Research (BMBF) within the R&D framework "IKT 2020 – Forschung für Innovationen"
Funding code	01IW20003
Volume	1.6 million euros
Term	4 years

More information

www.dfki.de/en/web/research/projects-and-publications/projects-overview/project/expect

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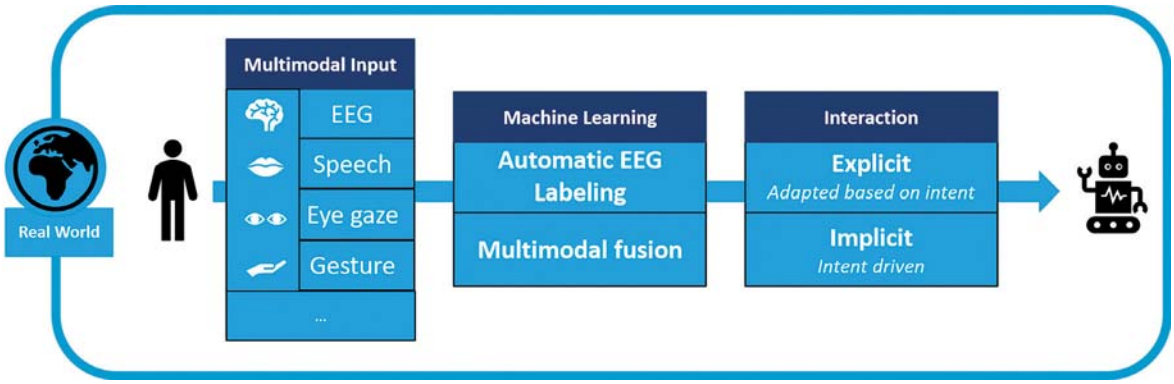

Brain-machine interfaces measure brain-wave signals and use them to derive control commands for computers, machines, and robots.

CAN WE PREDICT THE PATH OF A PANDEMIC?

DFKI AND FRAUNHOFER ITWM ARE SUPPORTING PANDEMIC MANAGEMENT IN THE CITY OF KAISERSLAUTERN

How will coronavirus data reports develop in the coming months, and what is the effect of relaxing or restricting social contacts? DFKI and Fraunhofer ITWM are working together with the City of Kaiserslautern on an analysis and forecasting model for municipalities in an effort to give to this question a solid scientific basis.

After careful evaluation, a council of experts selected the forecasting models EpiDeMSE of Fraunhofer ITWM and SoSAD (Social Simulation for Analysis of Infectious Disease Control) of DFKI to create a stable numerical basis, especially for Kaiserslautern.

SoSAD calculates how people meet and become infected at work, in schools, or during their leisure time. The model is fed with various parameters such as disease progression and behavioral patterns of actual cases, taking into account not only general social behavior but also individual preferences in working and leisure activities. The model is adapted for Kaiserslautern with a wide range of real data obtained, for example, from the city's ongoing DFKI Smart City Living Lab project. The calculations reveal what measures are reasonable and appropriate and those which may be less so.

EpiDeMSE is a mathematical model that simulates the spread of infections on the basis of time and region analyses. These simulations provide information about the course of the epidemic on several levels, estimates of the number of unreported cases, and forecasts of the further course of the epidemic, while taking into account the effects of more or less restrictive measures and the occupancy of intensive care beds. The two projects perfectly complement each other and provide long term decision support. Future plans call for a merger and adjustments for other municipalities in the region.

"We integrate data, knowledge, and findings from medicine, social research, and psychology to map individual behaviors as well as group dynamics that are relevant to the spread of the virus. We want to assist the emergency management team in estimating and evaluating the effectiveness of the measures and their consequences. At the beginning of a pandemic, essential data and relevant information for simulation are often not available. AI processes fill in any gaps in the data, and our models present plausible disease progression. Kaiserslautern is the first case where such a model has been specifically adapted to a municipality so that we can provide the city with a basis for the best possible decisions."
Prof. Dr. Ingo Timm

© Vecteezy

Prof. Ingo Timm (l.) and his team at DFKI Kaiserslautern's branch offices at the University of Trier are studying the topic of Cognitive Social Simulation.

Photo: Fraunhofer ITWM

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EVAREST

The project studies the creation and exploitation of data products in food production. Based on a producer-independent, open, hybrid data platform and a concept for economic and legal usage, EVAREST enables the secure (legal) use of data as an economic asset and provides user-specific Smart Services for various stakeholders. Funded by the German Federal Ministry for Economic Affairs and Energy (BMWi) and now midway through its term, the project is taking stock.

THE EVAREST RESEARCH PROJECT – ADDED VALUE FROM SMART DATA

On July 14, 2020, at the fourth virtual meeting of the consortium headed by Prof. Dr. Wolfgang Maaß, DFKI's Smart Service Engineering research department, project partners and representatives of DLR (project sponsor) focused on the completed development of the architecture as well as the associated research.

The agenda items included demonstrations of data product description objects (DPDO), preparation of knowledge graphs based on DPDOs, and newly designed data product patterns. Discussions also included the status of legal compliance, security architecture, smart contracts, and business model development. The findings to date will be transferred starting in November to a DIN SPEC, a document describing a technology that has not yet been standardized.

The web-based EVAREST distributed data platform was presented in a proof of concept. This presentation showed a smart search for data products, a view of own data product portfolios, the analysis tools, and the creation and semi-automated annotation of a data product, all in the context of reducing CO2 levels. A project partner from Aachen searched for the newly created data product and selected it for purchase using a prototype business process. At the conclusion of the smart contract, a microservice executed "on edge" went out to the data provider, and the new data product was sent from Saarbrücken to Aachen. The original data never left its location. The advanced development of the EVAREST data platform should lead to a GAIA-X reference implementation.

The foundation of the EVAREST architecture is the TUCANA service platform. TUCANA represents a browser-based collaborative learning approach for the execution of data analytics in peer-to-peer networks; it uses exclusively web technologies (e.g., Javascript); it supports the modularization of services, model training, and use on devices (tensorflow.js); it supports sensor communication (mqtt) and peer-to-peer communication (WebRTC) with role-based access control (oauth 2.0).

Prof. Dr. Wolfgang Maaß introduced TUCANA in the „Web and Machine Learning" workshop at the World Wide Web Consortium (W3C) in September. His talk titled **"Collaborative Learning"** is part of the **"Web Platform Foundations for Machine Learning"** track, which is concerned with expanding the integration of machine learning in web technologies.

The EVAREST project partners, besides DFKI, also include the Agrarmarkt Informationsgesellschaft, Swiss chocolate maker Lindt & Sprüngli, the Institute for Industrial Management FIR at RWTH Aachen, Software AG, and Saarland University. In addition to the Federation of German Food and Drink Industries (BVE), the German Institute for Food Technologies (DIL) also became an associated project partner this year.

More information

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www.w3.org

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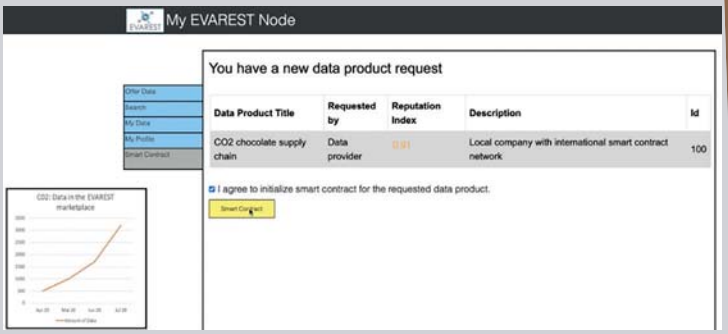

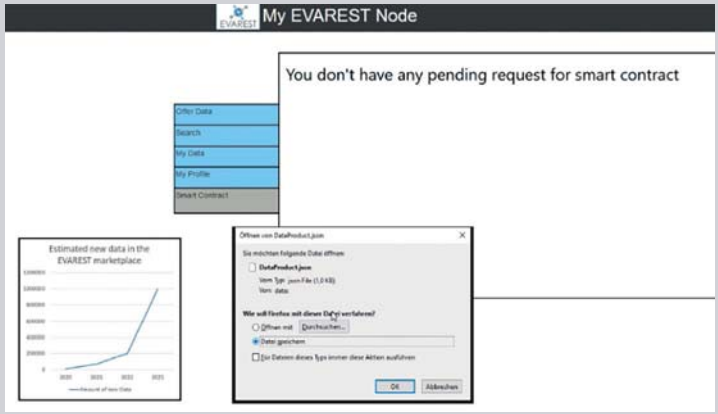

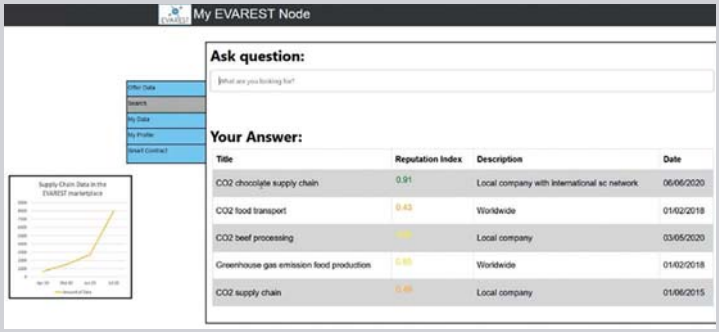

DESIGN THINKING WORKSHOP FOR RESILIENT PRODUCTION – PROJECT SPAICER

SPAICER – short for “Scalable adaptive production systems through AI-based resilience optimization” – is a project that aims to develop a new data system that enables a company to detect potential interruptions in production with the help of artificial intelligence

The primary subject of the project is resilience management in industrial production. Until the end of the project term in March 2023, partners will be working on a data-driven ecosystem based on life-long, collaborative, low threshold, smart resilience services. They are applying AI methods and INDUSTRIE 4.0 standards with a focus on predicting interruptions (anticipation) and optimized, real-time adjustments in production planning for active faults (reaction). The SPAICER project is coordinated by DFKI‘s Smart Service Engineering (SSE) unit, under the direction of Prof. Dr. Wolfgang Maaß.

The project consortium met for the first time in its entirety at the Design Thinking Workshop in September 2020, held at the SAP “AppHaus” in Heidelberg. Using a systems approach, the 14 project partners seek to develop the target concept of a resilient company and resolve the complex problem definition for the project. Essential in the Design Thinking approach are three important principles – a multidisciplinary team, a variable space, and an iterative, six-phased Design Thinking process.

The workshop focused on example case studies that were developed in collaboration with industry partners and deal with the topics of self-optimization, optimization of production planning, knowledge transfer, and proactive transformation. The project partners from research and industry worked in group sessions, systematically discussing scenarios and approaches to develop storyboard prototypes for companies with industrial production activities. The results of the group work were presented to the entire consortium at the close of the sessions. Specific target issues, SPAICER components, and a so-called game plan to specify the next steps in the project were also developed.

To ensure the safety of all 25 workshop participants despite the COVID-19 pandemic, the team at the SSE research area worked out a detailed hygiene concept in an iterative process together with the crisis manager of DFKI-Saarbrücken, Prof. Dr. Stephan Busemann. The concept is intended to serve as a blueprint for future workshops in times of Covid-19.

Workshop participants at a distance: A detailed hygiene concept makes it possible to hold face-to-face to events.

More information

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ALWAYS PREPARED TO THINK ANEW

SMARTFACTORY KAISERSLAUTERN CELEBRATES FIFTEEN YEARS

"The term ‚SmartFactory' traces its origin back to Kaiserslautern," said Prof. Detlef Zühlke. "Today, it is in use worldwide. But we are the original, so to speak." The founder of the SmartFactory KL Technology Initiative (SF KL) – the official name of SmartFactory Kaiserslautern – began his vision with seven companies in 2005; today there are about 50, including several major research institutes.

"Our scientific approach has always been of the highest quality. But the breakthrough came at the Hannover Trade Fair in 2014 with the introduction of our first INDUSTRIE 4.0 demonstrator, a joint project with industry. The demonstrator was proof that INDUSTRIE 4.0 is not just a buzzword, but rather a practical concept."
Prof. Dr. Detlef Zühlke

Production Level 4 Demonstrator.

And that is what makes SF KL so unique to this day: the consistent combination of theory and practice; and the willingness to explore new paths.

From INDUSTRIE 4.0 to Production Level 4

Zühlke was succeeded by Prof. Dr. Martin Ruskowski in 2019, who is also head of the Innovative Factory Systems department at DFKI and Head of Chair of Machine Tools and Control Systems at the Technical University of Kaiserslautern. "The unique selling point of SF KL is the close working relationship between our researchers and the experts from actual industries," said Ruskowski. "Several joint working groups are finding answers to the needs of these companies. We also implement the results in our demonstrator, which is under continuous development in our Innovation Lab."

In 2019, SF KL released an upgrade to INDUSTRIE 4.0 (I4.0) and gave it the name Production Level 4. "The time was right to subject I4.0 to analysis," said Ruskowski. "Production Level 4 is both a recommitment to the original ideas of I4.0 as well as to the further development and application of the experience made to date to the latest technical possibilities."

Production Level 4 transforms production lines to agile networks

"Autonomous production is not far away," added Ruskowski. "Only those who consistently embrace modular production will still be viable in the future." SF KL thinks in terms of the functionalities of machine modules and how to provide these to the manufacturing process. In the manufacturing process, the product and the modules autonomously agree on what work is to be done. Only after having done this does the product look for the next capability required for its final production. "The agreement may be found on the production floor or anywhere else in Europe," said Ruskowski. "That is the thinking behind the founding of SF EU with European partners by our colleague Prof. Zühlke."

SF LIVE "15 Years at SmartFactory KL"

On September 17, 2020, SF KL launched a new live streaming format that will now be broadcast monthly (every 3rd Thursday of the month, at 1:00 pm) on the SmartFactoryKL Youtube channel. The kick-off was a panel discussion with representatives of ZVEI and VDMA, as well as Zühlke and Ruskowski. "COVID-19 is redefining the meaning of trade exhibitions," said Ruskowski. "We have long accepted digital formats as a necessity. We were already using them at SPS 2019 and we are very flexible in our presentations." SmartFactory Kaiserslautern is always thinking anew!

More information

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AI FOR BIOPHARMACEUTICAL PRODUCTION – SARTORIUS BECOMES THE 33rd DFKI SHAREHOLDER

The Göttingen-based life science group has worked with DFKI for quite some time in a joint research laboratory developing the modern AI tools for applications used in the production of advanced medications.

"I am convinced that this partnership will result in some important innovations for our industry. Above all, AI can unfold its powerful capabilities in the accelerated development of more efficient medical drug manufacturing processes. In the medium term, we think the use of AI processes will make the development of active pharmaceutical ingredients faster and more cost-effective than the time-consuming and cost-intensive trial-and-error processes commonly in use today. New therapeutics will be available earlier and to more patients."
Dr. Joachim Kreuzburg,
Executive Board Chairman of Sartorius

AI tools in biopharmaceutical production

Ongoing research by Sartorius and DFKI includes deep learning algorithms and methods for image recognition of cells and organoids, analysis and modeling of biological systems, and simulation and optimization of production processes used for biopharmaceuticals.

In August 2019, DFKI and Sartorius opened the Sartorius AI Lab (SAIL) on the DFKI campus. At this joint research facility, the use of artificial intelligence in Sartorius products and platform solutions is tested and further developed. As an independent laboratory and a protected data room, SAIL is also available to Sartorius partners and is also used as successfully as a mutual training environment. Specialists from Sartorius work in the DFKI research ecosystem and, for example, use its deep learning hardware and expertise. In return, DFKI research benefits from Sartorius's expertise in life sciences. SAIL is now being further expanded with a special "wet lab," where innovative AI processes can be combined directly with cellular and molecular biology experiments.

"AI will certainly have a significant impact on life science research in the future as it makes fundamental new research approaches and methods possible. However, the application of AI tools is still in its infancy, since it is a much greater challenge to close the current gap between AI knowledge and AI application because of the complexity of biological relationships. In this context, the SAIL wet lab, where biologists and data scientists can conduct joint experiments and research, is the next step in enabling faster, more efficient biomedical and biopharmaceutical research and development," added Prof. Dr. Oscar-Werner Reif, CTO at Sartorius.

Prof. Dr. Andreas Dengel, Managing Director of DFKI in Kaiserslautern and Head of the Smart Data & Knowledge Services Research Department, said: "Our goal is to develop industry-relevant AI technologies for long-term use. We can accomplish this through our transfer labs and joint projects with industrial partners and shareholders. We are already successfully working with Sartorius on the use of AI tools to optimize biopharmaceutical production processes, and we look forward to consolidating this collaboration."

More information

www.dfki.de/en/web/news/detail/News/sartorius-dfki-research-laboratory
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AI FOR DIGITAL ADMINISTRATION: THREE ONGOING STUDIES

DFKI is strengthening its AI capabilities in the field of public administration. Three studies exploring the potential of artificial intelligence (AI) for digital administration systems are underway. The studies are sponsored by the **National E-Government Competence Center (NEGZ)**, where more than 100 experts are involved in modernizing the state and digital administration. As a cross-disciplinary competence center, NEGZ promotes the transfer of knowledge and a factual scientific basis by establishing a network of science, politics, government, and business.

Artificial Intelligence to Support Administrative Processes in Public Services

The State Office of Social Affairs in Saarbrücken supports this study, which explores the potential use of AI in two large-scale processes: the determination of the severely disabled and integration assistance. These special activities are rather complex, and both require large amounts of information to be processed on a case-by-case basis, which is why the use of AI has considerable potential to increase efficiency in the execution of the processes.

AI systems can perform some of the work and enable the employees to concentrate more on the processing steps that require human skills, e.g., empathy in communicating with the people involved.

Voice Control of e-Government Services in Germany

Voice control is increasingly becoming established as a standard means of interaction for various services and applications. The study explores the question of what infrastructure must be available for voice-controlled e-Government services in Germany and what areas of governmental processes could be supported by voice interaction in future scenarios. For example, voice interaction could be used to support tax returns from preparation to submission. The procedural descriptions and application scenarios for the tax environment can also be transferred to the implementation catalog of the Online Access Act (OZG).

Robotic Process Automation in Digital Administration

This study explores the potential use of Robotic Process Automation (RPA) in selected processes and includes the use of innovative AI methods and cognitive decision support services. The study focuses on public administration and presents the benefits of RPA in practical applications.

The study also examines the range of RPA services already available in commercial products and determines which application concepts are likely to appear feasible in the near future.

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NEGZ
Nationales E-Government Kompetenzzentrum e. V.

The machine learning (ML) computing center at DFKI is growing: Five NVIDIA DGX A100 high-performance computers are now in operation to perform AI algorithms, making DFKI a leading provider of ML.

DFKI GETS NEW NVIDIA DGX A100 SYSTEM FOR MACHINE LEARNING RESEARCH

The new system doubles the processing power of DFKI's Machine Learning Cluster, from the current roughly 20 to 45 PetaFLOPS. One PetaFLOP equals one quadrillion calculations per second. For comparison, if you gave every person in the world a pocket calculator and everyone used it to perform 125,000 calculations within one second, the computing power would be roughly equivalent to one PetaFLOP. The third-generation NVIDIA DGX system, with eight of the world's most advanced NVIDIA A100 Tensor Cores, delivers an output of five petaFLOPS of AI performance. At the same time, the energy consumption of the highly efficient data center is being further optimized – previous systems consumed about five kilowatts per petaFLOP, the DGX A100 consumes only about 1.2 kW.

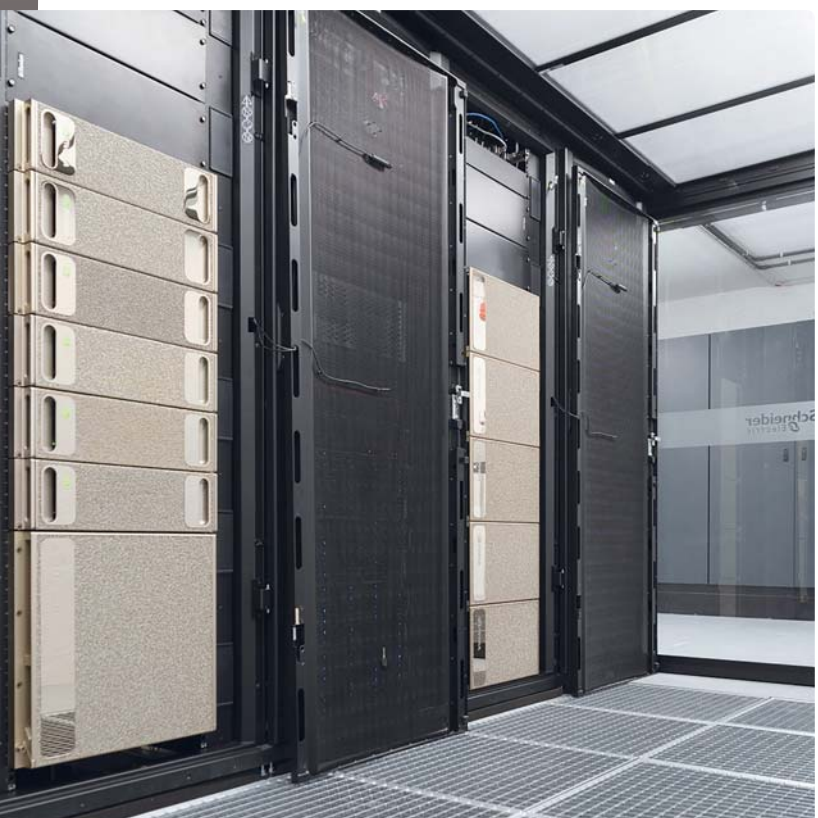
DFKI's AI infrastructure uses the NVIDIA Mellanox InfiniBand network to connect the DGX systems to a low-latency, ultra-fast fabric that facilitates multi-system AI training and solves computational problems in the shortest possible time.

DFKI is one of the first in the world to use the new system. AI research on learning systems and their explainability will be accelerated and complex AI algorithms will be available for practical use in industry.

"A high-performance platform like the NVIDIA DGX A100 is an essential foundation for data-rich and computationally intensive AI methods," said Prof. Andreas Dengel, Managing Director DFKI Kaiserslautern and head of the Research Department Smart Data & Knowledge Services. "In view of the huge increase in data volumes in the various fields of application, many of our projects as well the market now demand the optimal combination of high-performance AI computing systems and sophisticated algorithms."

"DFKI's cross-border research requires an equally advanced AI infrastructure that can provide insights to drive their research forward," said Tony Paikeday, senior director of product marketing for DGX systems at NVIDIA. "The NVIDIA DGX A100 is the ultimate tool for accelerating scientific exploration. It provides the computing resources DFKI needs for analytics, training, and inference, and delivers unprecedented calculation density, power, and flexibility."

In addition to integrating the DGX A100 system, DFKI uses optimized containers for deep learning frameworks such as TensorFlow and PyTorch that are easily accessed via NGC, NVIDIA's hub for GPU-optimized software for deep learning, machine learning, and high-performance computing.



DFKI has been working successfully with the world market leader in computer graphics and AI for several years.

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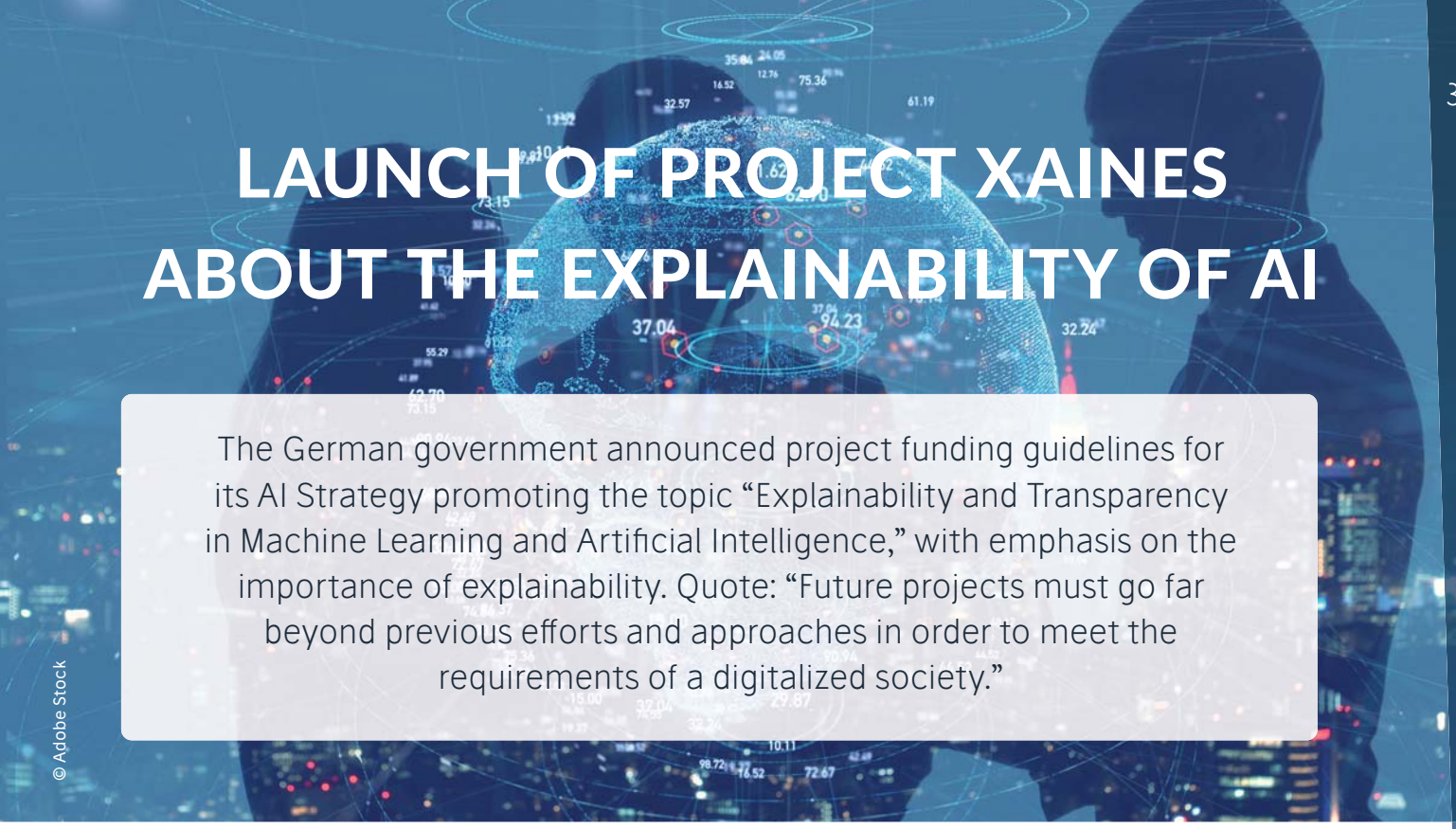

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LAUNCH OF PROJECT XAINES ABOUT THE EXPLAINABILITY OF AI

The German government announced project funding guidelines for its AI Strategy promoting the topic "Explainability and Transparency in Machine Learning and Artificial Intelligence," with emphasis on the importance of explainability. Quote: "Future projects must go far beyond previous efforts and approaches in order to meet the requirements of a digitalized society."

Explainable or transparent AI contrasts with the concept of the "black box" in machine learning, where even the developers cannot explain why (data-driven) AI methods reach the decisions they do. Today's Deep Neural Networks (DNN) are regarded as models that create this black box effect. In response, DFKI launched the XAINES project for Explainable AI or, in short, XAI in September 2020.

XAINES wants to ensure explainability but also to generate explanations (narratives). The goal of the XAINES project is not only to figure out why AI methods reach certain results but also to learn how to generate these explanations. Language is essential in establishing a basis for the explanation and in generating the narrative. The narrative, for example, should become part of the AI certification environment that experts like test engineers can use. Data scientists or development engineers also benefit from an interactive process during the design phase that provides better insight into how and why the emerging component behaves the way it does. This process can be thought of as a "white box," where the explanatory capability is contained in the operative component itself.

The project team is focusing on the application areas of highly automated driving, interactive medical decision support, and automation in the construction industry. More specifically, the scientists are concerned with the question of how explanatory narratives can be obtained from (speech-) marked sensor data streams as well as from predictive models and how well these actually serve as explanations.

Seven DFKI research areas are collaborating in this project: Agents and Simulated Reality, Smart Data and Knowledge Services, Embedded Intelligence, Multilinguality and Language Technology, Speech and Language Technology, Algorithmic Business and Production, and Cognitive Assistants. The German Federal Ministry of Education and Research has funded XAINES until August 2024.

More information

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SENSAI COMBINES KNOWLEDGE GRAPHS WITH DEEP LEARNING METHODS

Excel sheets, accounting data from the ERP system, e-mails and intranet, and more recently, even chats and notes on platforms like Microsoft Teams – all these are information sources for knowledge workers like managers or project leaders. These sources are heterogeneous, distributed, and not networked. To bring them together, evaluate them, and use them as a basis for decision-making requires some meticulous research and intensive knowledge work.

The interest in knowledge graphs to represent data, information, and knowledge from various sources in ontology-based graph structures is on the rise in research and industry. Deep Learning (DL) is concerned with Graph Neural Networks (GNN), which are used to meet the challenge of integrating knowledge in graph-based networks.

Project SensAI (Self-organizing Personal Knowledge Assistants in Evolving Corporate Memories) combines DL processes and architectures with the research experience at DFKI in the field of corporate memory. The aim is to explore novel approaches to human-centric assistance for knowledge workers and to exploit these for potential use in actual problem scenarios at companies. SensAI examines the creation of personal and organizational knowledge graphs from sparse, disordered, and diverse corporate data, as well as how to combine knowledge graphs and DL to leverage the potential of both of these worlds. The Federal Ministry of Education and Research (BMBF) has funded the project for a term of three years.

The concept relies on personal knowledge graphs to represent the mental model as well as the working environment of the user. Combined with organizational knowledge graphs that make heterogeneous data machine-readable and link data silos, these personal graphs represent both the user's own information space (files, e-mails, projects, topics, etc.) and those of the company. Such combinations enable a multitude of knowledge services.

The goal of the SensAI researchers is to develop a self-adapting, personal knowledge assistant that can be embedded in the work environment of the user and in the corporate memory. Representations of the entire information space and a stream of captured evidence from user activities are used to generate context with its own life cycle. The outcome is expected to provide context-specific assistance in all phases – emergence, construction, further development, detailing and splitting, and even in forgetting, due to decreasing relevance.

The main focus is on GNN as well as graph and word embedding. Challenges arise in training the models with sparsely filled knowledge graphs and the limited size of the data sets, and of preserving privacy despite personalized assistance. Possible solutions under study include artificial data as supplemental training input, transfer learning from already known domains, and embedding. The dynamic extension of knowledge graphs by learning from their use at each step of the workflow ensures the evolution of the graphs and allows for adaptions to the established practices

More information

https://comem.ai/sensai

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DFKI STAFF INTERVIEW

With **Dr. Heiko Maus**, DFKI Kaiserslautern

Dr. Heiko Maus is the head of the Knowledge Work group at the DFKI department of Smart Data & Knowledge Services under the direction of Prof. Dr. Andreas Dengel

What do you see as potential applications for your research?

We study information and knowledge workers in complex information spaces. Our philosophy is to focus on the users themselves, create direct benefits, and give them incentives to engage with the system. We embed assistance into the daily work, connect personal information spaces, and break open data silos. The context is derived from their own activities and data for further use in providing know-how tailored to their needs as well as for capturing knowledge from work.

When did your interest in Artificial Intelligence begin and how have AI processes changed since that time?

As a student working at DFKI almost thirty years ago, I began to use workflows to improve business processes with AI. I found like-minded people who shared a fascination with developing personalized assistance from the user's electronic footprints. The early result was agile support for routine daily tasks. And, lo and behold, we found that we could use it ourselves! Our approach was born – true to the motto "Eat-your-own-dog-food," we created the system for self-use. The topics of mental models and the semantic desktop being developed in the department at the time offered ideal conditions for us to pursue this further. Since 2011, I use our CoMem for my personal knowledge management. It has grown from an individual semantic desktop to infrastructure for corporate memory. We use CoMem as a team, but it is also being used as a pilot in industry. It is moving AI out of research and closer to the user, which makes it an exciting time for us. We can generate ideas and then try them out in real scenarios.

What are the greatest challenges and opportunities for AI systems?

I see great potential in how AI generates added value for companies by opening and linking data silos, but with a human-centric approach. We think of our vision in terms of an "information butler". And, if we can guarantee privacy and explainability, I see a great opportunity against the Big Tech corporations.

What are your favorite interests outside of your work as a research scientist?

I read a lot of English language science fiction from different decades, listen to progressive rock, and also like to go see it at live concerts.

Do you see any parallels to your professional work?

Science fiction poses many "What-if" questions and plays them out again and again, often with unexpected side effects. This provides interesting food for thought and inspiration, as well as a certain caution against having an overly optimistic belief in technology. The music's progressive element may be related to the joy a computer scientist feels in solving complex problems.

What are your current work projects?

As a team leader, I am involved in several projects ranging from application-oriented basic research to topics like digital forgetting, evolutionary knowledge graphs, and industrial research. We are currently developing our corporate memory CoMem in collaboration with the energy service provider enviaM. A company Wacom, a maker of graphic tablets, is using our knowledge graphs with Semantic Ink for the semantification of handwritten notes.

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AI in the shipping industry – Prof. Krüger and Prof. Zielinski visit the Briese shipping company

Prof. Dr. Antonio Krüger, CEO of DFKI and Prof. Dr. Oliver Zielinski, head of DFKI's Marine Perception research department, visited Captain Klaus Küper, head of research at the Briese Shipping Company, on August 11, 2020.

The shipping company operates a large fleet of modern research vessels, including the "Sonne" for the Federal Ministry of Education and Research (BMBF) and represents a huge capacity and a great deal of expertise in the use of artificial intelligence in the areas of navigation, ocean carriers, and logistics. Whether for the detection of plastic waste using intelligent on-board sensor technology, or data stream analysis to optimize ship systems, or AI-supported human-machine interaction on the high seas, the exchange between DFKI and the Briese shipping company shows that marine research, modern shipping, and the development of intelligent systems can learn a lot from each other.

Reinhart Koselleck Project – Prof. Drechsler receives millions for innovative research for the second time

The German Research Foundation (DFG) has once again approved a Reinhart Koselleck Project for Prof. Dr. Rolf Drechsler. The grant provides more than 1.5 million euros over a period of five years.

Drechsler studies digital logic circuits in this project titled "PolyVer: Polynomial verification of electronic circuits." These are the components that make electronic data processing possible in the first place. To execute their tasks, these digital devices must operate with fault-free circuits. In the research project, the computer scientist wants to try out special procedures that test as many systems as possible under all conditions.

Philipp Blandfort awarded Haass Doctoral Prize 2020

The Haass Foundation has selected Philipp Blandfort in the social sciences discipline for his dissertation "Computational Approaches to Subjective Interpretation of Multimedia Messages."

Examination board and disputants: (l. to r.) Marius Kloft, Prof. Andreas Dengel (auditor), Dr. Philipp Blandfort, Prof. Shanley Allen (auditor), Thomas Lachmann (chairperson), and Thomas Schmidt.

The mathematician is the first PhD candidate to be sponsored by the interdisciplinary, post-graduate school of Cognitive Sciences. His research deals with the automated recognition of problematic multimedia content, like threatening gestures in photos or obscene texts on social media platforms. More specifically, the issue is whether we can teach computers to subjectively interpret image messages. In other words, is there a way to replicate human interpretation of images for machine learning?

The Haass Foundation was founded to support students, graduates, and doctoral candidates in the faculties of Social Sciences and Economics at the Kaiserslautern University of Technology.

More information: https://haass-stiftung.uni-kl.de/foerderung/haass-promotionspreis/

Best Paper Award for Prof. Niels Pinkwart

The paper titled "Automatic Assessment of Student Homework and Personalized Recommendation" written by Xia Wang, Tom Gülenman, Claudia de Witt, Christina Gloerfeld, Silke Wrede, and Niels Pinkwart, Head of the DFKI Educational Technology Lab, was the winner of the "Best Full Paper Award" at the IEEE International Conference on Advanced Learning Technologies (ICALT). The paper is a product of the cooperation between DFKI and the University of Hagen within the AI.EDU Research Lab.

ECAI 2020 – Level the field for „Human-Centric AI"

The 24th European Conference of AI (ECAI) was held virtually from August 29 to September 8, 2020. The event's motto this year was "Paving the way towards Human-Centric AI." DFKI research area "Agents and Simulated Reality" was represented by Prof. Dr. Philipp Slusallek, co-founder and member of the CLAIRE core team, as he and others participated in the event "CLAIRE: Future of European Excellence in AI", which took place on September 4, 2020. The event was attended by more than 140 people who listened as selected speakers and panel members from the CLAIRE Extended Core Team presented an initiative to promote excellence in all areas of AI across Europe. The experts also gave an overview of the next steps to achieve critical mass and global impact for "AI made in Europe." The new ICT-48 TAILOR project also brought together experts and researchers from the new TAILOR centers of excellence network for a two-day workshop on "Trustworthy AI." The workshop moderator was Fredrik Heintz, member of the CLAIRE Extended Core Team.

Computer scientist Noshaba Cheema wins Deutsche Telekom's Women's MINT Award

The prize in the category "Artificial Intelligence" was awarded to the DFKI researcher for her work in the Agents and Simulated Reality research department on a method to simulate human fatigue when operating devices with outstretched arms. The procedure works on the basis of virtual agents and requires no human data.

The results demonstrate how AI agents can be used in virtual user testing and how a biomechanical motion model can help to generate more natural-looking movement. The method maps the subjective effort expended very accurately without simulating muscles and their energy expenditure. The result's predictions are more accurate than from previous approaches. The prize was announced and awarded on June 24, 2020, in the framework of a virtual ceremony.

German Research Center for Artificial Intelligence
Company Profile

The German Research Center for Artificial Intelligence (DFKI) was founded in 1988 as a non-profit public-private partnership. It has research facilities in Kaiserslautern, Saarbrücken and Bremen, a project office in Berlin, a Laboratory in Niedersachsen and branch offices in St. Wendel and Trier. In the field of innovative commercial software technology using Artificial Intelligence, DFKI is the leading research center in Germany.

Based on application oriented basic research, DFKI develops product functions, prototypes and patentable solutions in the field of information and communication technology. Research and development projects are conducted in twenty one research departments, nine competence centers and eight living labs.Funding is received from government agencies like the European Union, the Federal Ministry of Education and Research (BMBF), the Federal Ministry for Economic Affairs and Energy (BMWi), the German Federal States and the German Research Foundation (DFG), as well as from cooperation with industrial partners. Twice a year, a committee of internationally renowned experts (Scientific Advisory Board) audits the progress and results of state-funded projects. In addition, BMBF evaluates DFKI regularly. The most recent assessment was again very successfully concluded in 2016.

Apart from the state governments of Rhineland-Palatinate, Saarland and Bremen, numerous renowned German and international high-tech companies from a wide range of industrial sectors are represented on the DFKI supervisory board. The DFKI model of a non-profit public-private partnership (ppp) is nationally and internationally considered a blueprint for corporate structure in the field of top-level research.

DFKI is actively involved in numerous organizations representing and continuously advancing Germany as an excellent location for cutting-edge research and technology. Far beyond the country's borders DFKI enjoys an excellent reputation for its academic training of young scientists. At present, approx. 660 highly qualified researchers, administrators and 440 graduate students from more than 65 countries are contributing to more than 250 DFKI research projects. DFKI serves as a stepping stone to leading positions in industry and successful careers as founders of spin-off companies. Over the years, more than 140 staff members have been appointed professors at universities in Germany and abroad.

More information

www.dfki.de

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1988, non-profit organization (public-private partnership)

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International Scientific Advisory Board
Bi-annual evaluation of publically funded projects:
Prof. Dr. Andreas Butz, Ludwig-Maximilians-Universität, München (Chairman)

Key Figures 2019
Annual Budget: ca. € 57,5 million
Total Assets: ca. € 133 million
Professional staff: 660
Graduate student staff: 440

Intelligent Solutions for the Knowledge Society

Living Labs

Testing, evaluation, and demonstration of innovative technologies in comprehensive application scenarios

Advanced Driver Assistance Systems Living Lab, Bremen
Ambient Assisted Living Lab, Immersive Quantified Learning Lab (IQL), Innovative Retail Lab, Robotics Exploration Lab, Smart City Living Lab, SmartFactory-KL, Smart Office Space Living Lab

Competence Centers

Coordination of research activities in particular areas

Ambient Assisted Living, Autonomous Driving, Deep Learning, Emergency Response and Recovery Management, AI for Environment and Sustainability, Semantic Web, Safe and Secure Systems, Smart Agriculture Technologies, Wearable AI

HUMAN-CENTRIC AI

INDUSTRIE 4.0, Digital Twins, Semantic Product Memories • Smart Data – Intelligent Analytics for Massive Data • Wearable Computing and Interactive Textiles • Deep Learning and Machine Learning • Knowledge Management and Document Analysis • Softbots, Digital Assistants, and Chatbots • Educational Technologies • Verification and Evaluation of Safety-critical Applications • Cognitive Social Simulation • Information Extraction and Intelligent Web Retrieval • Multiagent Systems • Experience-based Learning Systems • Visual Computing and Augmented Vision • Mobile and Collaborative Robotic Systems • Multimodal User Interfaces and Autonomous Systems • Shopping Assistance and Intelligent Logistics • Safe and Secure Cognitive Systems and Intelligent Security Solutions • Ambient Intelligence and Assisted Living • Driver Assistance Systems and Autonomous Driving • Cyber-physical Systems • Multilingual Technologies and Language Understanding • Business Process Management and Smart Services • Affective Computing

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