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GERMAN RESEARCH CENTER FOR ARTIFICIAL INTELLIGENCE

# DFKI NEWS 01 2017



DFKI at CeBIT & Hannover Messe  
Wearable AI and Fashion Fusion Award  
Hand in Hand – Human-Robot Collaboration

# HANNOVER MESSE 2017

April 24-28



„Get new technology first“

The Technologie-Initiative *SmartFactory*<sup>KL</sup> e.V. and the German Research Center for Artificial Intelligence (DFKI), together with the 19 involved partner companies, will present the further development of the INDUSTRIE 4.0 system at booth D20 in hall 8 at Hannover Messe (Hanover Trade Fair) from April 24 to 28, 2017.

The expanded demonstration system of the *SmartFactory*<sup>KL</sup> partner group makes an appearance in a new layout: for the first time, the modules are no longer set up in one line but distributed over three production islands. Products can now be manufactured in different ways because of the use of the flexible transport system comprised of a robot platform as the central element as well as the conveyor belts in the modules.





## Human-Robot Collaboration and Autonomous Systems

*The combination of AI and lightweight robots changes the production processes, reduces ergonomic stresses on workplace activities, and promotes local assembly of custom products. Economically and ecologically, this is very practical as it increases productivity while simultaneously improving customer and employee satisfaction. In the next step, brand new application scenarios are opened by the autonomous systems now being created.*

► In industrial operations, Human-Robot Collaboration (HRC) enables forms of factory work that now include intuitive control of various kinds of robots by employees with the assistance of mixed reality technologies, regardless of location.

Supported by mixed reality products (for example, HoloLens), employees can virtually and flexibly perform tasks in combination with robots and colleagues, or even colleagues at different locations. Mixed reality systems make it possible to manipulate objects in a three-dimensional, virtual representation of the collaborative scenario in real time. Employees can interact with the robots by looking at a virtual representation of the target object and, through gestures, trigger the required action. This means, an action or gesture by a person at one location leads to a direct robotic action at another location. The advantages are many, for example, facilitating new equipment rollouts, training for new procedures, or performing critical updates, reducing machine downtime, and preventing unscheduled production stops (see page 20 and 21).

*“Such lightweight robot designs with humanoid avoidance behavior are already used quite successfully in the automobile assembly sector. The advances in AI will soon make it possible to employ assembly teams consisting of several employees and robots with different abilities, for example, to alleviate the very strenuous overhead work involved in fitting an aircraft wing.*

*An important challenge is to find the right team organization between people and robots, so that human intelligence and Artificial Intelligence can work together to produce the optimal result”*

*Prof. Dr. Wolfgang Wahlster,  
Chairman of the Executive Board, DFKI.*

There is an ongoing and gradual increase in the quality of autonomous robots. The resulting autonomous systems not only have to be reliable, but must also meet additional criteria. These criteria include:

- ▷ **Self-determination:** Ability to rationally explain so a human can understand a decision taken.
- ▷ **Error tolerance and resilience:** Partial task completion in case of malfunction.
- ▷ **Self-directed learning:** Expand the knowledge base without any outside help while the learning has to be possible using only a few examples.
- ▷ **Cooperativeness:** Cooperate with other autonomous systems and people on the team.
- ▷ **Proactiveness:** Anticipate and plan for expected events and the behaviors of others.

Autonomous systems will be deployed to environments that are dangerous or inaccessible for humans, for example, the decommissioning of nuclear power facilities, buildings threatened with collapse, and deep sea or space exploration missions (see page 24).

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Photo: ©Telekom Fashion Fusion

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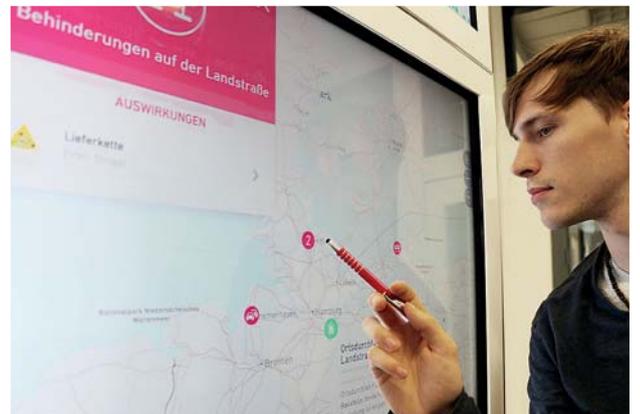
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Issue 39, March 2017, ISSN 2196-2251

Published by:

German Research Center for Artificial Intelligence GmbH (DFKI)

Editorial staff:

Heike Leonhard, Christof Burgard, Reinhard Karger, Armino Ribeiro

Editorial address:

Saarland Informatics Campus D3 2, Stuhlsatzenhausweg 3,  
D-66123 Saarbrücken

E-Mail: news@dfki.de, Phone: +49 681 85775 5390

Photos: DFKI, unless otherwise noted

Cover Photo: ©Telekom Fashion Fusion

Layout, Graphics: Christof Burgard

Translation team: Glenn Peach, Armino Ribeiro, Sylvia Krüger, Heike Leonhard

Production: One Vision Design

Responsible: Heike Leonhard, Corporate Communications

Frequency of publication: Semi-annual

News online: www.dfki.de/newsletter-en

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## Smart Farming World – Smart Services in Agricultural Crops



*Agriculture must be understood today as a form of industrial production, located in a field or in a stable. Just as in the manufacturing sector, digitalization is critical for maintaining agricultural competitiveness – both nationally and internationally. Optimal commercial success now requires that agricultural products be individually planted, harvested, processed, and to an ever increasing degree, must also be completely traceable.*

► The automation and digitization of agricultural equipment generates huge volumes of data. Smart Farming Services, which dramatically increase the significance of the service aspect of agricultural equipment, are themselves a product of the enrichment, compilation, and presentation of data using Artificial Intelligence (AI). Smart Farming Services can be traded via a market place and linked to the machines. They offer not only equipment manufacturers, but also new intermediaries great potential for innovative business models to develop new business areas.

Researchers from the Smart Service Engineering department are introducing Smart Farming Services through the **nPotato** project at CeBIT 2017. The farmer and the driver in the field receive real time information about where and how exactly potatoes are damaged by the potato harvester from bumps and rotations.

The model of the concentricity of a potato shows how Smart Farming Services can be used to support farmers with a view towards making economically optimized decisions while performing the harvest. Based on historic market data, type of potato, and other economic factors, the forecasted profit and loss statement per field is determined and shown directly to the farmer. By means of learning algorithms, the forecast adapts over time, thereby minimizing error. The farmer is already able to see during the harvesting how the machine settings affect profitability within the defined forecasting standard.

nPotato is based on the idea of a “pain sensitive” object (*nociceptive object*), where hits and rotational movements can be evaluated. The concept uses

modern methods of Machine Learning (Deep Learning) combined with the Internet of Things and the latest language technologies. Machine learning methods like Long Short Term Memory (LSTM) are used to classify each hit and detect the overall condition of the nPotato. The results are immediately expressed as speech with the help of language technology methods, which the driver/equipment operator can understand. For the farmer, these conditions are shown as a display of the business situation. By exploiting the latest web technologies, Smart Farming Services allows the efficient integration of third parties in an open system platform.

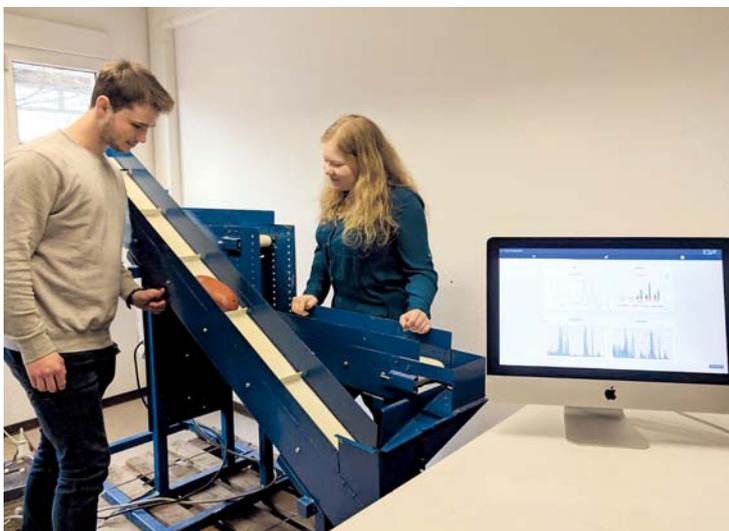
nPotato shows how to bring INDUSTRIE 4.0 to the fields and how to use recorded data to provide innovative agricultural services.

### MORE INFORMATION

- 🌐 [www.smart-farming-welt.de](http://www.smart-farming-welt.de)
- 🌐 [www.smart-service-welt.de](http://www.smart-service-welt.de)

### CONTACT

- 👤 **Prof. Dr. Wolfgang Maas**  
Research Department Smart Service Engineering
- ✉ [Wolfgang.Maass@dfki.de](mailto:Wolfgang.Maass@dfki.de)
- ☎ [+49 681 302 64736](tel:+4968130264736)



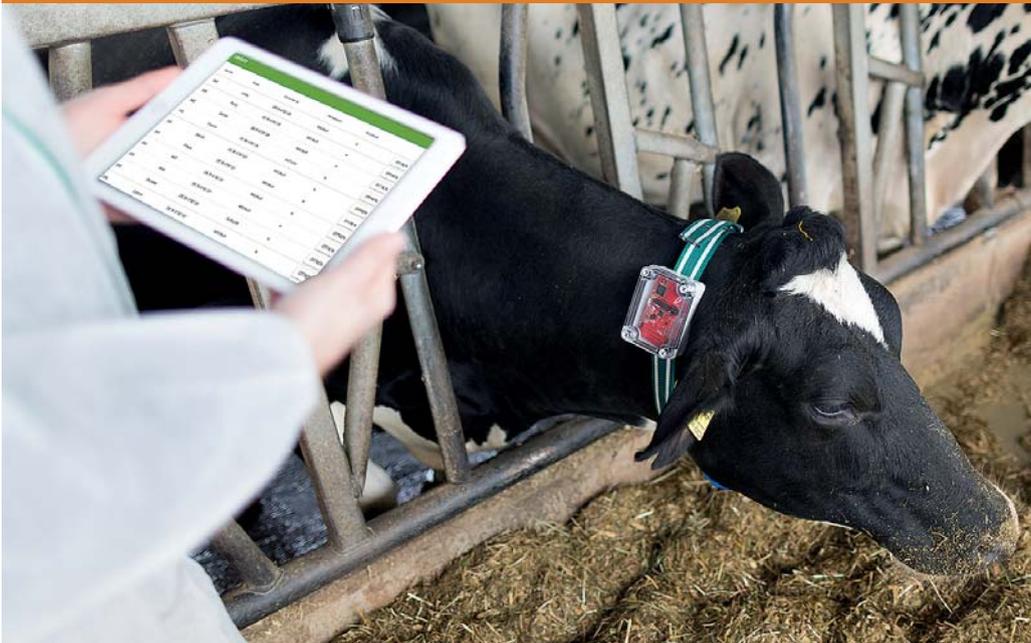
A model of the concentricity of a potato shows how Smart Farming Services supports farmers during the harvesting process.



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on the basis of a decision by the German Bundestag



A sensor-equipped collar records the behavior of individual dairy cows.

## InnoCow – Health Tracker for Cows

*InnoCow develops an automated diagnostic system for dairy cows and is the latest DFKI spin-off. The health of the cows in milk production is evaluated on the basis of behavioral patterns and motion sequences. At a glance, dairy farmers have all the information required, for example, to recognize a sick cow or a cow in heat or to prepare optimal feed amounts for each animal.*

► The sensor aided reproductive and health monitoring system is based on sensors fitted to a collar that record the behaviors exhibited by each dairy cow. The system records the cow's activities: rumination period, feed intake, and time spent in the various functional areas of the stable. The exact location of the cows is captured in real time by means of ultraband (in the stall) and GPS (on the pasture) transmissions. Positioning and acceleration sensors are used to capture defined behavior parameters. The recorded data is evaluated on the InnoCow server. Self-learning algorithms constantly adjust to the behavior of the individual animal, which enables precise analysis and early recognition of estrus or illness in a particular animal.

InnoCow's reproductive and health monitoring system helps the farmer to assess his individual animals and optimize milk production. The farmer can retrieve current messages concerning an animal from InnoCow via an innovative web application. The app also provides a management system to facilitate the efficient management of the entire herd.

InnoCow is user friendly and supplies everything necessary to manage the herd in just one system plus, it performs accurate data evaluations, which results in a lower rate of false reports in contrast to traditional systems.

The automated health monitoring system ensures that disease is detected while still in the early stages. This capability not only benefits animal welfare, but also reduces the costs of vets and treatments.



InnoCow is the winner of the state-wide business plan contest "1,2,3, GO 2016."

The InnoCow initiators are also the winners of the entrepreneur competition "IKT Innovativ 2015" and receive support from German Federal Ministry for Economic Affairs and Energy (BMWi) in establishing the project concept as a DFKI spin-off.

InnoCow is funded under the framework of the Exist Program by the German Federal Ministry for Economic Affairs and Energy (BMWi) and the European Social Fund.

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Federal Ministry  
for Economic Affairs  
and Energy



on the basis of a decision  
by the German Bundestag

### MORE INFORMATION

🌐 [www.innocow.de](http://www.innocow.de)

### CONTACT

👤 **Sebastian Baumbach**

Research Department Smart Data & Knowledge Services  
InnoCow

✉ [Sebastian.Baumbach@dfki.de](mailto:Sebastian.Baumbach@dfki.de)

☎ +49 631 20575 4250



## Virtual Personal Trainer in Your Outfit – Intelligent Training Suit Wins Fashion Fusion Award

*The idea of a virtual fitness trainer emerged as the first winner of the Fashion Future Challenge 2017. The system uses intelligent sensor-equipped clothing and the appropriate apps to record movement and provides individual training feedback.*

► Sensors worn on the body, so called “wearables,” are quite common today in the form of fitness wristband bracelets and smart watches and are no longer purely functional systems, but rather lifestyle accessories. The next evolution is to make this technology invisible and, to a greater extent, integrate it directly in the garment fabrics.

The award winning system is based on a fabric with integrated sensors that uses muscle contractions to capture the shape changing movements, which is considerably more precise than conventional motion sensors. This technology is developed at DFKI. The European research project SimpleSkin served as the foundation for this effort. The intelligent training outfit measures breathing, mus-

cle tension, balance, and pulse to provide feedback on physical performance and correct execution of the exercises.

To accomplish this challenging concept, an interdisciplinary development team is required: Gernot Bahle and Bo Zhou, IT researchers at DFKI’s Embedded Systems department in Kaiserslautern, in addition to Lorenzo Fürg, a sport sciences student at University of Passau. After presenting their concept to the jury and the public at the Berlin Fashion Week, the winners gladly accepted the endowed prize of 20,000 euros.

Another key component of the system is the modular software architecture needed to exchange data with other devices. This software is what enables the compatibility with a wide range of applications on different mobile devices for individual training feedback. This versatile interaction of the training outfit was implemented in cooperation with Carl Zeiss and shown in combination with a head mounted display.

Prof. Paul Lukowicz, head of research for Embedded Intelligence at DFKI is proud of the team and the win: “The success at the Fashion Fusion Awards underscores the huge potential of wearable technologies in a variety of areas like sports, rehab, medical, occupational safety, lifestyle, or other new applications for everyday use.” Lukowicz works at the DFKI Competence Center for Wearable AI together with Prof. Gesche Joost, head of the department of Interactive Textiles at DFKI on other related concepts for sensors, data analysis, and integration of wearable technologies.



The winners (l. to r.): Gernot Bahle, Bo Zhou, Lorenzo Fürg.

Photo: ©Telekom Fashion Fusion

### MORE INFORMATION

🌐 [www.dfki.de/web/competence/wearable-ai](http://www.dfki.de/web/competence/wearable-ai)

### CONTACT

👤 **Prof. Dr. Paul Lukowicz**  
Head of Research Department  
Embedded Intelligence

✉️ [Paul.Lukowicz@dfki.de](mailto:Paul.Lukowicz@dfki.de)

☎️ +49 631 20575 4000

## Interactive Clothing from the DFKI Competence Center Wearable AI

Sensors in fitness clothing, in safety helmets, and in soccer shoes – digital accessories like fitness belts and scarves or jackets that can navigate and alert the wearer to dangers – DFKI's Competence Center Wearable AI is introducing product ideas and design prototypes like these for making functional systems wearable at CeBIT 2017.

### Trainwear – Wearing a virtual personal trainer

The winner of the Telekom Fashion Fusion Award 2017 is a system composed of smart sensors and the appropriate apps, which measures the wearer's movements from muscle contractions and shape changes. Smart training outfits measure breathing, muscle tension, balance, and heart rate to provide feedback on physical performance and proper execution of the exercises (see page 8).

### Smart Helmet – Digital documentation support at the construction site

Designed for use on major construction sites and production halls, Smart Helmet provides indoor positioning, laser distance measuring, and sensors for temperature, air pressure, and humidity. Additionally, it has integrated cameras for video and thermal imaging. The safety helmet can be used for on-site documentation tasks where it records and stores data with respect to location.

### Smart Soccer Shoe – Improving your kicking technique

The position of the foot at the kick, the force of the kick, and the contact angle and speed as well as the spin that the player exerts on the ball are all critical to the success of the shot. Smart Soccer Shoe is equipped with textile pressure sensors that record the angle and speed of the foot as it contacts the ball and wirelessly transmits the results. This product can be used to analyze and improve the player's kicking technique.



Smart Soccer Shoe knows the angle and speed of the ball contact.

### Targeted muscle training with Smart Sportband

Muscle strength is a key factor for sport performance. Equipped with sensor fabric, Smart Sportband records muscle activity, for example, in the arm, leg, or chest muscles and enables the evaluation and analysis of muscle performance.

### Light Scarf DAAN – Staying active despite the handicap

The project aim of DAAN (Design Adaptive Ambient Notification Environment) is to implement a technical platform that can systematically support people with cognitive or physical handicaps. First, the innovative system learns the daily routine of the user so that it can subsequently make action recommendations. The light scarf on display has integrated light conducting fibers woven into the fabric that illuminate in an unobtrusive way and notify the user.

### Smart Maintenance Jacket – Assistance for maintenance work at the Smart Factory

Smart Maintenance Jacket is developed in partnership with Telekom Innovation Laboratories (T-Labs). Using textile sensors, when worn by a maintenance technician, the jacket emits selectable visual, audible, or haptic signals to assist in navigation and warn of imminent danger in a mobile maintenance scenario in an INDUSTRIE 4.0 context. The jacket is developed with the aid of a one piece cutting system that enables the industrial production of electronic clothing.



Smart Maintenance Jacket assists maintenance worker in the repair of a machine in the Smart Factory. Photo: David Gauffin

### MORE INFORMATION

🌐 [www.dfki.de/web/competence/wearable-ai](http://www.dfki.de/web/competence/wearable-ai)

### CONTACT

👤 **Prof. Dr. Gesche Joost**  
Head of Research Department  
Interactive Textiles  
✉ [Gesche.Joost@dfki.de](mailto:Gesche.Joost@dfki.de)

☎ +49 30 8353 58341

👤 **Prof. Dr. Paul Lukowicz**  
Head of Research Department Embedded Intelligence

✉ [Paul.Lukowicz@dfki.de](mailto:Paul.Lukowicz@dfki.de)

☎ +49 631 20575 4000



## AI Technology for Human Activity Recognition of Workers Using Wearable Devices

*With View to Utilizing AI to Assist Operations and Prevent Human Error in Manufacturing*

► In line with initiatives such as INDUSTRIE 4.0 in Germany and Society 5.0 in Japan, the manufacturing industry is accelerating steps towards innovating production using AI and robotics, and the automation of menial tasks. At the same time, IoT technology is being called for to collect and recognize the condition or movement of all things, including people and equipment, to assist in operations and prevent human error. As a result, in recent years, monitoring systems using cameras have been developed for predictive diagnosis of inappropriate worker movement or equipment failure in production lines.

Researchers from the DFKI research department, Smart Data & Knowledge Services and Hitachi developed AI for human activity recognition to recognize the activity of workers using various data collected through the wearable devices, not image data from cameras. Features of the AI developed are as below:

### 1. Technology to recognize gazed objects by using eye-tracking glasses.

This technology is to recognize targeted objects like “screw” or “screwdriver” without being disturbed by its surrounding environment such as background or other objects. This technology extracts the data of gaze points from the movements of eyeballs of workers who wear the eye-tracking glasses and utilizes the image recognition technology by Deep Learning.

### 2. Technology to recognize basic human actions through armband device.

This technology is to recognize basic human actions that require arms movements such as “twist” or “push”. This technology extracts the data relating to body actions from the microscopic and instantaneous signals that are measured by sensors attached to the arms.

### 3. “Hierarchical activity-recognition model” that recognizes workers’ activities by integrating gazed objects and human actions.

This technology integrates the two technologies mentioned above to develop “hierarchical activity-recognition model”, which is to recognize activities such as “twisting a screw.” As a result, recognizing a variety of working activities is capable if all the actions and objects involved in the activities are learned in advance.

Based upon these technological developments, the AI technology that can recognize activities such as “twisting a screw” or “pressing a switch” as part of “inspection task” in real-time was realized.

DFKI and Hitachi will advance the technological development for assisting operations and preventing human error on the front line of manufacturing, where operation guidance and inadequate action detection are required, by utilizing this newly developed AI.

DFKI and Hitachi will exhibit a part of this technology at “CeBIT 2017”, a leading global exhibition of digital business to be held from 20-24 March 2017 in Hannover, Germany.

#### CONTACT DFKI

👤 **Prof. Dr. Andreas Dengel**  
Head of Research Department  
Smart Data & Knowledge Services

✉ [Andreas.Dengel@dfki.de](mailto:Andreas.Dengel@dfki.de)

☎ +49 631 20575 1000

👤 **Dr. Sheraz Ahmed**  
Research Department Smart Data &  
Knowledge Services

✉ [Sheraz.Ahmed@dfki.de](mailto:Sheraz.Ahmed@dfki.de)

☎ +49 631 20575 4818

#### CONTACT HITACHI

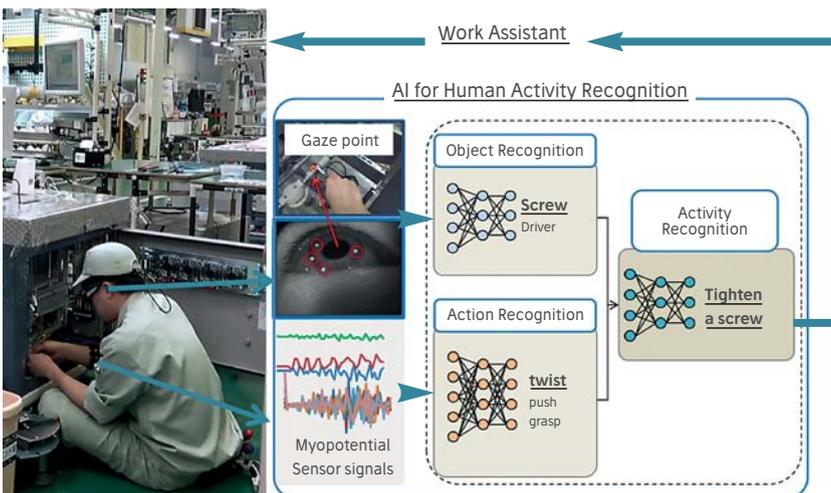
Technology Management Center  
Hitachi, Ltd., Research & Development Group  
☎ +81 50 3135 3409

👤 **Katsuhiko Abe**

✉ [katsuhiko.abe.kf@hitachi.com](mailto:katsuhiko.abe.kf@hitachi.com)

👤 **Shoichiro Fujiwara**

✉ [shoichiro.fujiwara.qx@hitachi.com](mailto:shoichiro.fujiwara.qx@hitachi.com)



## grippeNET App – Monitoring, Analyzing, and Mapping the Spread of Disease

Everyone can help researchers to better understand and predict the outbreak and spread of disease in the future. The grippeNET App lets people participate from their smart devices and add to the collection of valuable information about the spread and course of an infectious disease. In return, the users gain access to timely and comprehensive insights into the data and the analyses.

► The app is part of an EU sponsored research project called CIMPLEX, which develops various tools used to investigate and influence the spread of diseases and other contagious phenomena in complex social systems. Large-scale, realistic data driven models are combined with participative data collection and advanced methods of Big Data analyses. An important aspect of the framework is that it offers extensive display possibilities for various user groups (researchers, decision-makers, citizens) on various platforms (equipment, systems, media).

The grippeNET App was developed to monitor flu-like illnesses, but the concept can also be applied at any time to other diseases. It is used to ask the Swiss public to report flu-like symptoms so the spread can be analyzed. The app was developed in cooperation with grippeNET.ch and serves as an expanded, mobile version of the web page. GrippeNET.ch is operated by scientists from the Eidgenössische Technische Hochschule (ETH) Zurich and the École polytechnique fédérale de Lausanne (EPFL) and is a member of InfluenzaNet, which is a European initiative for scientific public participation studies to monitor influenza-like illnesses, and is currently active in eleven European countries.

Furthermore, the app has already served as a platform for studies in related fields of research, for example, in the field of human-computer interaction. These studies examine what factors play a role in motivating a person to participate. To protect the privacy of all users, potentially sensitive information is aggregated and analyzed directly on the smartphone. The architecture for the app was designed in cooperation with NervousNET, a platform for participative data collection with a focus on protecting privacy and distributed intelligence.

The current version of the application is only available on Android systems and, besides having a heat map showing the spread in



Overview, news, and questionnaire on spread of disease.

Switzerland; it also provides info and news about the topic of influenza. Users can voluntarily provide information and participate in the weekly flu survey. Plans call for the grippeNET platform to be subsequently introduced in Germany and Austria. In the future, the app could also be available on other platforms and in other countries. To create more value added for the users, work is ongoing on new features such as additional statistics and an individual risk analysis.

### MORE INFORMATION

- 🌐 [www.cimplex-project.eu](http://www.cimplex-project.eu)
- 🌐 [www.grippeNET.ch](http://www.grippeNET.ch)
- 🌐 [www.influenzaNET.eu](http://www.influenzaNET.eu)
- 🌐 [www.nervousNET.ethz.ch](http://www.nervousNET.ethz.ch)



### CONTACT

👤 **Prof. Dr. Paul Lukowicz**  
Head of Research Department  
Embedded Intelligence

✉ [Paul.Lukowicz@dfki.de](mailto:Paul.Lukowicz@dfki.de)

☎ +49 631 20575 4000



The CIMPLEX VisFramework provides extensive visualization possibilities.

## Technology from the Deep Learning Competence Center at CeBIT 2017

Researchers at the DFKI Competence Center for Deep Learning are developing learning algorithms for artificial neural networks that can automatically detect natural disasters from satellite images, reliably interpret content from photos and videos, correct grammar in translated texts, and make social networks more trustworthy. The research effort in the area of Deep and Machine Learning extends from basic research to large-scale knowledge transfer. The Deep Learning CC presents two technologies, DeepEye and Capttitude, that apply machine learning and pattern recognition methods to very large data sets.

🌐 <http://dl.dfki.de>

### DeepEye – Deep Learning for Emergency Response and Crisis Management Teams

Natural disasters like earthquakes, forest fires, landslides, and floods are increasingly causing major destruction worldwide. A UN Report shows that natural catastrophes are responsible for economic damage reaching 300 billion US Dollars. Predictive models, preventive measures, and crisis management solutions are more important than ever for civil protection, rescue forces, humanitarian aid organizations, and insurance companies.

► Satellites and aircraft supply geographic data that can be used to predict disasters, or in the event of a disaster, to assist with the management efforts. However, because satellites often overfly a specific location only every few days, information arrives too infrequently and in acute situations, is not up to date. In comparison, very current information is placed on social media by people on site in the affected regions.

Project DeepEye accepts the challenge of identifying a natural disaster in satellite images and enriching the data obtained in this way with multi-media content from social media.

The first step draws on the data provided by the NASA satellite “Landsat 8” system. An image analysis combines the various spectral bands of the satellite data and extracts the geographic zones affected by a natural disaster. The current focus of DeepEye is on identifying forest fires, while future plans call for successively dealing with the other catastrophes as well. Aided by the extracted geographic positioning data,

the second step is to collect relevant media content concerning the event from the micro-blogging platform Twitter.

A multimodal analysis extracts relevant information from text, image, and metadata by means of various machine learning methods like Convolutional Neural Networks. The focus of the analysis is the extraction of contextual aspects to obtain a comprehensive and complete view of a specific event. This prepared data can be used for crisis management, for example, for the “in situ” coordination of the rescue teams.

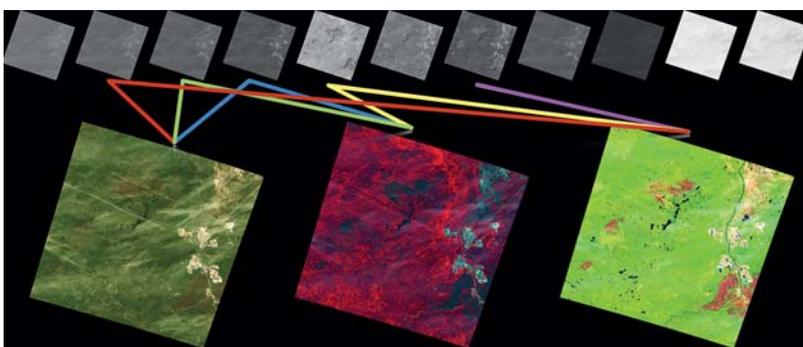
DeepEye continues to use the combination of satellite data and the multimedia content in social media to assist in the next step in crisis management: the generation of a detailed representation of the area of a natural disaster by merging multiple information channels.

#### CONTACT

👤 **Dr. Damian Borth**  
Head of DFKI Deep Learning  
Competence Center  
Research Department  
Smart Data & Knowledge Services

✉ [Damian.Borth@dfki.de](mailto:Damian.Borth@dfki.de)

☎ +49 631 20575 4184



Analysis of satellite imagery to identify forest fires. The eleven spectral bands of the Landsat 8 satellites can be used in a variety of combinations (l. to r.): RGB image, colors highlighting vegetation, highlighting forest fires (red sections).



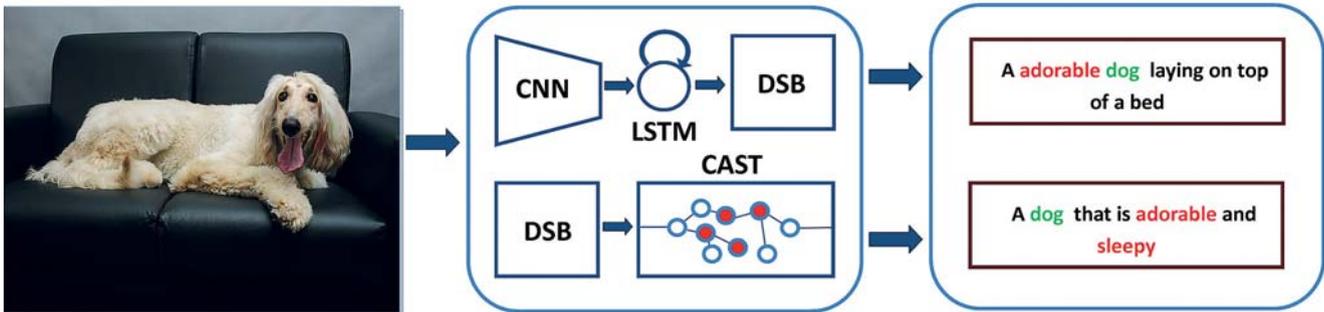
## Captitude – Deep Learning for Captions with Feeling

In the recent past, more powerful computers, faster internet access, and social media have multiplied the volume of online media content. Every day, for example, approximately 80 million pictures are uploaded on Instagram, some of which are titled or have content that is described and evaluated with captions, comments, or with emojis. Frequently, the emotions associated with the images are expressed.

► Delicious foods, cute puppies, breathtaking landscapes – usually an adjective is used to quickly give a descriptive character to a noun. These Adjective-Noun-Pairs (ANP) describe the visual content of a photo together with the feeling that it triggers in the viewer. If this occurs with great frequency, it can be used in the machine description of images, which goes significantly beyond a simple textual reproduction of the visual content.

Captitude (Captions with Attitude) is a system that generates affective photo captions with an emotional component. Two methods are employed to create two different versions of an emotional photo caption.

First, a Convolutional Neural Network (CNN) is used with a Long Short-term Memory (LSTM) Network to generate a set that is subsequently modified with Adjective-Noun-Pairs from another CNN, DeepSentiBank. The second approach uses a graph-based concept and syntax transition (CAST) network. This graph is generated using captions



Overview of the Captitude Architecture. The image input provides two versions of an affective photo caption.

from the YFCC100M dataset, one of the largest datasets in multimedia research, and the combination of concepts (nouns, adjectives, verbs). To expand the vocabulary of the model a similarity metric is used to combine the nodes of semantically similar concepts.

### CONTACT

👤 **Dr. Damian Borth**  
 Head of DFKI Deep Learning  
 Competence Center  
 Research Department  
 Smart Data & Knowledge Services

✉ [Damian.Borth@dfki.de](mailto:Damian.Borth@dfki.de)

☎ +49 631 20575 4184

**CeBIT Hall 6, Stand B48**

## DFKI CoreTex – Neural Machine Translation

► Neural approaches to Machine Translation (NMT) have recently started outperforming Statistical Machine Translation (SMT). Compared to SMT, NMT output is often smoother and more “human like”. In addition, NMT is often able to better capture non-local and reordering phenomena in translation.

The DFKI CoreTex NMT system is based on an encoder-decoder with attention design. We use two bidirectional Long Short-term Memory (LSTM) layers for encoding and four unidirectional LSTM layers for decoding. The engine is character-based to cope with rich morphology, out-of-vocabulary items (OOVs – words not seen in the training data) and unusual and creative spelling common in user-generated content.

The NMT engine performs in the top-ranks on the WMT-16 shared task data set and is easy to tune to specific in-domain data using transfer learning. The engine is implemented in the Lua script language and Torch framework.

DFKI CoreTex Neural Machine Translation is available for professional and research applications.

### CONTACT

👤 **Prof. Dr. Josef van Genabith**  
 Head of Research Group  
 Multilingual Technologies

✉ [Josef.van\\_Genabith@dfki.de](mailto:Josef.van_Genabith@dfki.de)

☎ +49 681 85775 5287

**CeBIT Hall 6, Stand B48**

## Projects in the “Smart Data” Technology Program

“Smart Data Web,” “Smart Data for Mobility,” and “Clinical Data Intelligence” are three of the model projects in the German Federal Ministry for Economic Affairs and Energy (BMWi) sponsored “Smart Data” program being presented by DFKI and its partners at CeBIT 2017. The aim of “Smart Data” technology program is to further develop and evaluate Big Data systems for selected applications in the field of economics.

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Smart Data

### Data Analysis for Information Research and Mobility Services – Smart Data Web and Smart Data for Mobility



The aim of the Smart Data Web (SDW) is to build a bridge between the two previously separated data ecosystems: the public access Internet and the internal information environment of major corporations. Researchers in Smart Data for Mobility (SD4M) are developing a Big Data Analytics platform which provides a foundation for intelligent data management.

► A multi-project, interactive demonstrator shows in real time how Smart Data Analytics extracts, aggregates, and correlates intermodal mobility and supply chain events in Germany from heterogeneous data sources. Smart Data analyses are very useful after being compiled and prepared for information searches and processing in a steadily rising knowledge graph. SD4M introduces a mobile personal travel app for smart phones based on the SD4M platform.

#### MORE INFORMATION

🌐 [www.smart-data-programm.de](http://www.smart-data-programm.de)  
🌐 [www.sd4m.net](http://www.sd4m.net)

#### CONTACT

👤 **Prof. Dr. Hans Uszkoreit**  
Head of Research Department  
Language Technology

✉ [Hans.Uszkoreit@dfki.de](mailto:Hans.Uszkoreit@dfki.de)

☎ +49 30 23895 1800

### Clinical Data Intelligence – Integrated Decision Support in Virtual Reality



Klinische Datenintelligenz

Patient data are generated at different sources and have different formats, for example, text, audio, and image data, or even individual genome data or diagnostic data from an ECG, MRT, or CT. Add to this are the details about the patient, the history of the disease, the medication, and therapy to date. If new digital tools like fitness and health apps or wearables are used, then even more data are generated. In most cases, these data are not networked and the attending physicians have, at best, limited access to the various data sets.

► The aim of the CDI project (Clinical Data Intelligence) is to automate and drastically simplify the evaluation of this comprehensive and complex patient data. All available patient data from the various sources is brought together in a patient data model. Integrating the data in this way creates the basis for further innovative patient care services and medical research. An important result is integrated clinical decision support based on the assessment of all data sources.

#### MORE INFORMATION

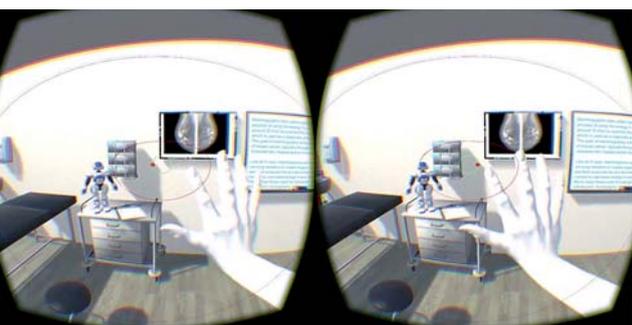
🌐 [www.klinische-datenintelligenz.de](http://www.klinische-datenintelligenz.de)

#### CONTACT

👤 **Dr. Daniel Sonntag**  
Research Department  
Intelligent User Interfaces

✉ [Daniel.Sonntag@dfki.de](mailto:Daniel.Sonntag@dfki.de)

☎ +49 681 85775 5254



At CeBIT, visitors will see a Virtual Reality application being used for integrated decision support. By means of a tablet, the attending physicians can annotate the course of the disease by input pen.

The results of the integrated decision support based on Deep Learning are presented together with additional patient's image data, using the virtual reality data glasses, Oculus Rift. This project is intended to promote telemedicine applications.



🌐 [www.smartdataweb.de](http://www.smartdataweb.de)

## Projects in the “Smart Service World” Technology Program

The German Federal Ministry for Economic Affairs and Energy (BMWi) initiated the technology program “Smart Service World – Internet-based Services for Business” to support projects that are developing innovative Smart Services. DFKI is showcasing Medical All-round Care Service Solutions (MACSS) and SePiA.Pro, two Smart Service World projects from different fields of application at CeBIT 2017.

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## Service Platform for Physicians and Patients – Medical All-round Care Service Solutions



A new kind of prototype is being developed within MACSS (Medical All-round Care Service Solutions) for a patient-centered, smart health service platform. The collaboration involves research, business, health insurers, care providers, patient associations, and the pharmaceutical companies. Using the example of post care kidney transplant patients, we show how their safety can be improved through the integrated service platform. The aim is to facilitate the communication between patients and their attending physicians and increase drug safety.

► MACSS is developing a mobile, bi-directional application that can be easily integrated in the clinical routines of both doctors and patients to transfer therapy and patient-specific data. A safety and authorization concept for the transfer of highly sensitive patient data has already been developed and approved. MACSS integrates patient data from different medical service providers and hospitals for various information services. Innovative technologies are used to aggregate, analyze, and re-combine this medical data for individual treatments in real time. Also, MACSS can be used to help reduce the costs of long term health care.

DFKI supports MACSS in the area of text analysis and information extraction. In this context, innovative methods for processing medical texts are designed to make therapy relevant information more readily accessible to the physicians.

### MORE INFORMATION

[www.macss-projekt.de](http://www.macss-projekt.de)

### CONTACT

**Prof. Dr. Hans Uszkoreit**  
Head of Research Department  
Language Technology

[Hans.Uszkoreit@dfki.de](mailto:Hans.Uszkoreit@dfki.de)

+49 30 23895 1800

**Dr. habil. Feiyu Xu**  
Group Leader SD4M, Text Analytics

[Feiyu.Xu@dfki.de](mailto:Feiyu.Xu@dfki.de)

+49 30 23895 1812

## SePiA.Pro – Service Platform for Intelligent Optimization of Production Systems



The intelligent utilization of sensor data combined with the job parameters in modern production facilities represents one of the greatest challenges in the context of INDUSTRIE 4.0.

► The aim of the SePiA.Pro project is to develop an open, inter-company standardized service platform that applies intelligent evaluation and analysis methods to sensor data and job parameters to enable comprehensive efficiency improvements in the cyber-physical production processes at INDUSTRIE 4.0 production plants. SePiA.Pro is used to implement a combination of value added services (Smart Services) to be provided at the data site. These services must be portable, something that is accomplished by bundling a software package into a smart service archive. Consequently, SePiA.Pro provides a closed, secure, portable, and standardized packaging format for smart services.

DFKI expertise in methods, technologies, and tools for intelligent data analysis is brought to the project to facilitate work on the development and implementation of a highly scalable, industrial data analysis platform.



### MORE INFORMATION

[www.projekt-sepiapro.de](http://www.projekt-sepiapro.de)

### CONTACT

**Prof. Dr. Volker Markl**  
Head of Research Department  
Intelligent Analytics for Massive Data

[Volker.Markl@dfki.de](mailto:Volker.Markl@dfki.de)

+49 30 23895 1850



[www.smart-service-welt.de](http://www.smart-service-welt.de)

## Future for All – DFKI at VISION SUMMIT 2016

► Franz Alt and Peter Spiegel introduced a new guiding principle under the motto “Future for All” at VISION SUMMIT, held at the Allianz Forum in Berlin on November 11, 2016. Among the highly respected guests at the high ranking summit were Prof. Dr. Gesine Schwan, Prof. Dr. Ernst Ulrich von Weizsäcker, and Prof. Dr. Muhammad Yunus, who participated in the workshop “IT Applications for Social Inclusion” organized by Prof. Dr. Hans Uszkoreit and Dr. Aljoscha Burchardt from DFKI.

DFKI activities in this area are consolidated at the DFKI-Berlin Project Office under the theme “Human-Centric AI.” The aim of this effort is to skillfully use technology to create a natural environment for people, which supports creativity, enables barrier-free communication with other people and technologies and provides the required knowledge in all of life’s situations.

The fully booked workshop provided a forum for the introduction and discussion of IT applications that support inclusion in the areas of health, seniors, disabilities, and immigration. Two project results from DFKI Berlin were included: The discussion platform Common Round and Fahum, a communications app for immigrants. Both are also being presented at CeBIT 2017.

Additionally, a joint publication by the workshop participants presents the topic of IT and social inclusion in scientific articles, pro-



**VISION SUMMIT concluding panel with Prof. Hans Uszkoreit, Dr. Franz Alt, Dr. Norbert Taubken (Scholz & Friends), Regine Lorenz (Allianz Foundation) and Peter Spiegel (Genesis Institute).**

duct concepts, and position papers. The publication is intended to form the foundation for further discussion of challenges and solutions.

### MORE INFORMATION

🌐 [www.visionsummit.org](http://www.visionsummit.org)

### CONTACT

👤 **Dr. Aljoscha Burchardt**  
Research Department Language Technology

✉️ [Aljoscha.Burchardt@dfki.de](mailto:Aljoscha.Burchardt@dfki.de)

☎️ +49 30 23895 1838

## Common Round – Digital Debating Culture

► Open decision making over the web often lacks transparency because the complexity of the ongoing debate makes it difficult to follow the lines of argument. Advanced Large Scale Language Analysis for Social Intelligence Deliberation Support – Project “All Sides” is focused on the development of the web-based debate platform Common Round, a new generation of systems to help discussion participants with decision making and acknowledge the different perspectives on the issue.

Discussion participants can prepare various kinds of debate on Common Round, which can identify the pros and cons of the arguments and explicitly support those arguments with evidence. In addition, participants can express their opinions about a debate question, argument, or evidence by voting on it using a rating scale. Thanks to such meta-data, the intentions of the discussion members are clearly evident.

The methods of language technology are used to analyze the semantic content and give it a structure. The contributed topics of the debate are automatically classified, with similar arguments being identified and grouped, sometimes even with background information collected from online news sources. To provide access to an international audience, content can also be machine translated, as required.

Common Round’s innovative dialog model with links to language processing, Big Data and Smart Data technologies guarantees a clear overview of the content even in the case of a very large number of participants – a feature that has traditionally been missing from web forums.

### MORE INFORMATION

🌐 <http://commonround.dfki.de>

### CONTACT

👤 **Prof. Dr. Hans Uszkoreit**  
Scientific Director, Spokesperson DFKI-Berlin  
Head of Research Department Language Technology

✉️ [Hans.Uszkoreit@dfki.de](mailto:Hans.Uszkoreit@dfki.de)

☎️ +49 30 23895 1800

👤 **Dr. Leonhard Hennig**  
Research Department Language Technology

✉️ [Leonhard.Hennig@dfki.de](mailto:Leonhard.Hennig@dfki.de)

☎️ +49 30 23895 1821





## Fahum Means Understanding – An Emergency Assistance and Integration App for Refugees

The DFKI, in cooperation with its spin-off company Yocoy developed the “Fahum” app (Arabic for “understanding”), which enables immigrants from Arabic countries to have a dialog, for example, with authorities or on the street, or when shopping. The app is available to be downloaded for free.

► The relevant dialog is guaranteed to be correctly translated – thanks to the “Always Correct Translation” technology (ACT®) from Yocoy. Specifically, the translations are not word for word. Rather, Fahum provides flexible dialog building blocks that permit the participants to enter their concerns, questions, and information in their own language and subsequently, to receive the answers in that language – in written or spoken form. Topics include: government administration and processes, health, housing and shelter, and social cohesion.

The dialogs are expanded via lexica and the possibility to take and integrate pictures. The developers place great emphasis on the intonation, precisely because inadequate translation provokes many misunderstandings. The dialogs can be played as a language file, making the system very attractive and also appropriate for language learning.

The app also includes many links to important Arabic language information sources for refugees, which are posted online at the Fahum website.

Syrian students, refugees, and other native speakers have volunteered to assist with the content, choice of topics, and translations. The appealing design was created by the creative team at the Berlin company, Eatch Interactive.

The Technologiestiftung Berlin (Technology Foundation) and Rotary Club Hamburg-Wald-dörfer contributed to the development of the app. The aim is now to ensure maximum awareness of the app so that refugees can get the help and relief necessary to overcome the language barrier. Additional support is also needed to expand the dialogs and to make the app available in other languages like Urdu, Paschtu, and Farsi. Fahum is available for free download now in the App Stores for Android and iOS.

### MORE INFORMATION

[www.fahum.de](http://www.fahum.de)

### CONTACT

**Dr. Sven Schmeier**  
Research Department Language Technology

[Sven.Schmeier@dfki.de](mailto:Sven.Schmeier@dfki.de)

+49 30 23895 1815



DOWNLOAD  
BEI GOOGLE PLAY



DOWNLOAD  
BEI APPLE ITUNES





Dr. Maite Melero (Pompeu Fabra University, Barcelona), Algirdas Saudargas, Paul Rübzig (Head of STOA Panel), Gábor Zsolt Pataki (STOA office).

## Equal Treatment for Europe's Languages – DFKI at EU Workshop “Language equality in the digital age”

*Some European languages, particularly English, receive extraordinary support from language technologies, whereas many others, especially, the ones spoken by minority populations are being threatened with “digital language extinction.” That is the conclusion of a 2012 study of “European Languages in the Digital Age” published by the Europe-wide network of excellence META-NET – an open alliance of developers and users of language technologies from research, manufacturing, and public administration communities.*



Member of European Parliament (MEP) Algirdas Saudargas conducted the workshop „Language equality in the digital age“.

► The current state of technological support for Europe's languages was the subject of the workshop “Language equality in the digital age” held on January 10, 2017 at the European Parliament in Brussels. Discussions were based on the META-NET study and covered a variety of framework factors and approaches. The STOA Panel (Science and Technology Options Assessment) of the European Parliament organized the event with MEP Algirdas Saudargas (Lithuania) and Dr. Maite Melero (Pompeu Fabra University, Barcelona) conducting the meeting.

The event scheduled five presentations, each featuring a different aspect of the overall topic of language technology and multilingualism; such as outlining the current state of the art, identifying obstacles, and perspectives on future developments. Significant contributions were made by two invited speakers from the Language Technology department of DFKI. Prof. Dr. Hans Uszkoreit explained, in his presentation “Human Language Technologies and Public Policies,” the relationships between current research in the areas of AI, Big Data, and Deep Learning and proposed several recommended activities. A report by Dr. Georg Rehm titled “Human Language Technologies in a Multilingual Europe” highlighted the ongoing validity of the alarming results of the META-NET study. Considering that at least 21 European languages are facing digital extinction, machine translation tools can not only be used to tear down language and communication barriers, but also to aid in the digital preservation of European languages. Towards this end, a major, longterm flagship initiative –

the “Human Language Project” – must be established by the EU Parliament, EU Commission and member states to promote basic research, applied research, and also to encourage the commercialization of new research breakthroughs with regard to the multilingual digital domestic markets. The goal of such a targeted funding program should be no less than to achieve a fully automated, in depth understanding of language.

All presenters voiced their support for the proposed “Human Language Project.” Several members of the European Parliament have argued in favor of even more support for Europe’s languages through language technology.

Parallel to this workshop, a study commissioned by the STOA Panel is being prepared that includes a detailed assessment and a series of policy action recommendations for the government: an initial draft was included among the workshop handouts. The study is to be discussed in the European Parliament as soon as it is published in February 2017. Putting these recommended policy actions into operation is more than desirable in saving Europe’s languages digitally and permanently as well as for supporting European language technologies through a major funding program.

#### MORE INFORMATION

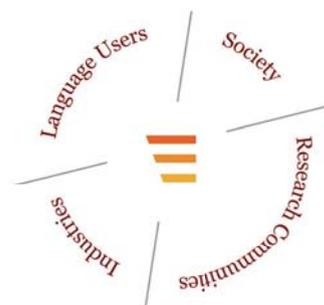
-  [www.stoa.europarl.europa.eu/stoa/cms/home/workshops/language](http://www.stoa.europarl.europa.eu/stoa/cms/home/workshops/language)  
 Website of the workshops
-  [www.meta-net.eu](http://www.meta-net.eu)  
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-  [www.meta-net.eu/whitepapers](http://www.meta-net.eu/whitepapers)  
 META-NET Study “Europe’s languages in the digital age” (2012/2013)
-  [www.meta-net.eu/sra](http://www.meta-net.eu/sra)  
 Strategic Research Agenda for a Multi-Lingual Europe 2020 (2013)
-  <http://cracker-project.eu>  
 CRACKER
-  [www.cracking-the-language-barrier.eu](http://www.cracking-the-language-barrier.eu)  
 Cracking the Language Barrier Federation
-  <http://cracker-project.eu/sria>  
 Strategic Research Agenda for Multi-Lingual, Digital Domestic Markets (2016)



**Dr. Georg Rehm**, research department Language Technology, DFKI and Secretary General META-NET

#### CONTACT

-  **Dr. Georg Rehm**  
 Research Department Language Technology  
 Coordinator CRACKER and Secretary General META-NET
-  [Georg.Rehm@dfki.de](mailto:Georg.Rehm@dfki.de)
-  +49 30 23895 1833



Multilingual Europe Technology Alliance



The exoskeleton transmits the movements of the user directly to the robot.

## Exoskeleton for Telemanipulation

*Telemanipulation refers to the deliberate control of robots over long distances. This capability is extremely important when systems are to perform complex tasks at locations that are dangerous or difficult for humans to access and maneuver, for example, in the deep sea or space. DFKI's Robotics Innovation Center is showing an upper body exoskeleton for use in the teleoperation of the humanoid AILA robot at the BMBF exhibit stand at CeBIT 2017. The passive exoskeleton transmits the user's movements directly to the robot, which performs fine-motor tasks on a circuit switchboard – thanks to the manipulative abilities of the human operator.*

► The upper body exoskeleton is a preliminary study of the active system (also developed at the Robotics Innovation Center in the BMBF sponsored CAPIO project), which is equipped with electric motors and enabled with force feedback. In other words, force information can be relayed from the remote controlled robot over a haptic force feedback system to the human body. The exoskeleton user can feel, for example, when the robot encounters an obstacle, in effect, giving the human the feeling that he or she is part of the action. The concept of upper body assisted, two-arm-telemanipulation – that is the possibility to involve both arms and the body movements in the teleoperation task as well as the introducing the corresponding force feedback to the human body – is a new approach, never before implemented in a comparable system.

The exoskeleton systems developed at the Robotics Innovation Center are exceptional for the optimal adaptation to the human kinematic design and the application of specific control concepts. In addition to telemanipulative applications in space or deep sea environments, these portable robotic systems are also well-suited for use in the field of medical rehabilitation. DFKI scientists have been working on a DLR research project called RECUPERA in collaboration with the Rehaworks Company. Together they are developing a mobile, full body exoskeleton that can implement rehabilitative concepts and support the movements and intended actions of people with neuro-motoric disabilities (for ex-

ample as a result of stroke). Additionally, as an intuitive human-machine interface, the exoskeleton can help reduce physical stress and prevent employee injuries in an industrial manufacturing, assembly, and logistics scenario.

### MORE INFORMATION

🌐 [www.dfki.de/ric](http://www.dfki.de/ric)

### CONTACT

👤 **Dr. Elsa Andrea Kirchner**  
Research Department  
Robotics Innovation Center

✉ [Elsa.Kirchner@dfki.de](mailto:Elsa.Kirchner@dfki.de)

☎ +49 421 17845 4120

**CeBIT** Hall 6, Stand A34

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## Hand in Hand – Human-Robot Collaboration in INDUSTRIE 4.0

*Mixed Reality Production 4.0 – Mixed Reality systems for cross-site production in INDUSTRIE 4.0*

► Researchers at DFKI present Mixed Reality Production 4.0, a new form of multiple site Human-Robot Collaboration (HRC). Adaptable and trainable lightweight robots at the exhibit stand of the Federal Ministry of Education and Research interact with their human and robotic colleagues at the DFKI exhibit. Supported by mixed reality and virtual reality systems, employees at one location in combination with robots and colleagues at another location can flexibly perform the task of handling hazardous materials.

CeBIT visitors can experience first-hand how the actions of a human at one site directly control a robot's actions at another site. The exhibit is supplemented by displays of what the first-person view of the mixed reality looks like through HoloLens goggles.

The demonstration shows how three identical robots at the DFKI stand are telemanipulated by an operator with HoloLens goggles physically located at the neighboring BMBF exhibit stand. The exhibit is expanded by the telemanipulation of two robots (Universal Robotics UR and the logistics robot MiR 100) via live-circuit with the HRC 4.0 Innovation Lab in DFKI-Saarbrücken.

Mixed reality systems make it possible to manipulate objects in a three-dimensional virtual representation of the collaborative scenario in real time. The user can interact with the robots by watching a virtual representation of the target object and, through gestures, trigger the required actions by the robot.

Additionally, telemanipulation is demonstrated in the immediate vicinity. Three robots at the BMBF stand (ABB Yumi, Universal Robotics UR, and MiR 100) perform tasks together with the operator. The operator controls the activities in a mixed reality environment (HoloLens) by means of gestures. The robots execute the com-

mands, grasp and move objects to a tray or table mounted on the logistics robot. In this way, objects are safely transported between the lightweight robots. The aim here is to achieve the standard of error-free robot action in some remote "hazardous material" scenario.

Practical application areas in an industrial manufacturing context are remote maintenance, telepresence, teleproduction and teleoperation as well as Human-Robot Collaboration.

📍 **Save the Date in Future Talk, CeBIT 2017**  
Hall 6, Stand A54

**Wednesday, March 22, 3:00-3:30 p.m.**

**„Hand in Hand: Human-Robot Collaboration  
in INDUSTRIE 4.0 – Mixed Reality Production 4.0“**  
Mohammad Mehdi Moniri

### CONTACT

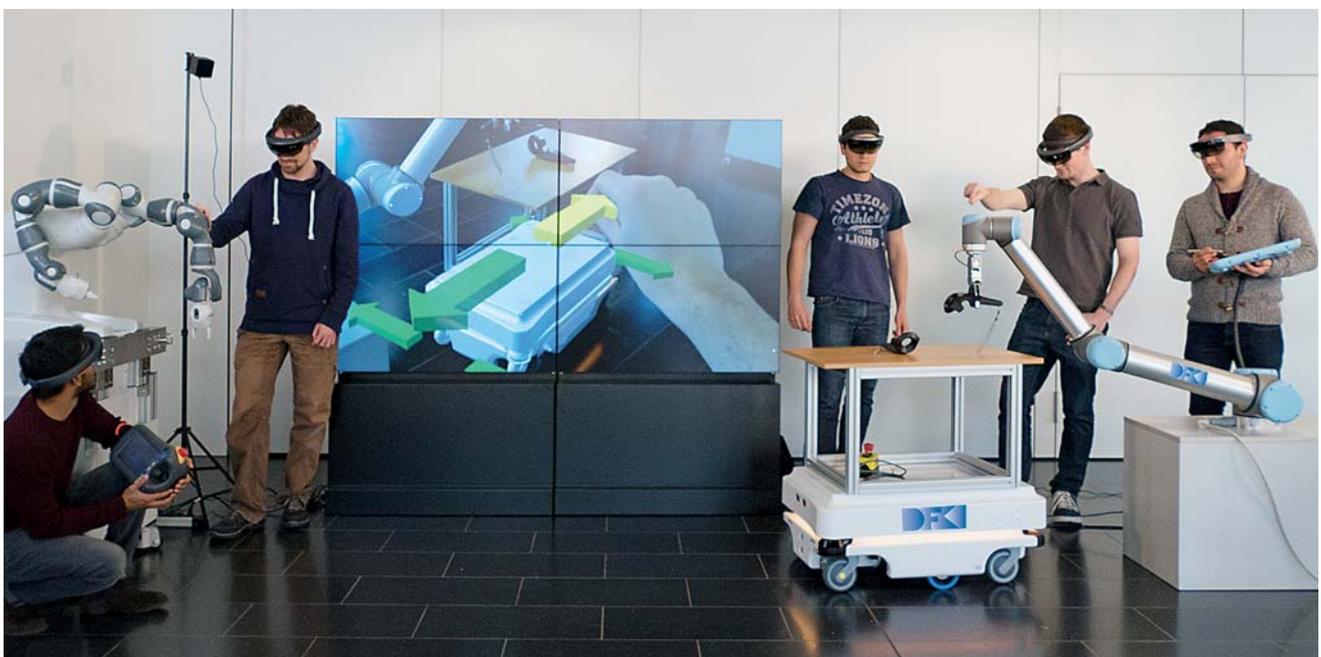
👤 **Mohammad Mehdi Moniri**  
Head of Mixed Reality Development

Research Department  
Intelligent User Interfaces

✉ [Mohammad\\_Mehdi.Moniri@dfki.de](mailto:Mohammad_Mehdi.Moniri@dfki.de)

☎ +49 681 85775 5264

**INNOVATIONSLABOR MRK 4.0**  
Mensch-Roboter-Kollaboration für Industrie 4.0



Mixed Reality for telemanipulation in the context of Human-Robot Collaboration.

## Selected Lectures, Presentations and Discussions at CeBIT

Monday, 03/20/2017

11:00-11:30 a.m. **IT-Planungsrat** / Hall 7, B42

**Saarland Police employ mobile reporting of traffic accidents**

Prof. Dr. Peter Loos, Head of Institute for Information Systems (IWi) at DFKI

Monday, 03/20/2017

5:20-5:50 p.m. **IoT-Forum** / Hall 12, B53

**Japanese-German Research Cooperation on AI for INDUSTRIE 4.0**

Prof. Dr. Wolfgang Wahlster, CEO, DFKI

### DFKI im Future Talk, CeBIT 2017

Monday, 03/20/2017

2:00-2:30 p.m. **Keynote: What can we learn from a crisis?**

**Deep Learning from synthetic data for self-driven cars!**

Prof. Dr. Philipp Slusallek, Head of Research Department Agents and Simulated Reality, DFKI

Tuesday, 03/21/2017

12:30 a.m.-1:00 p.m. **Deep Learning. How come, what for, why? –**

**Compact lecture and one-on-one, open question period!**

Dr. Damian Borth, Deep Learning Competence Center, DFKI

Wednesday, 03/22/2017

3:00-3:30 p.m. **Hand in Hand: Human-Robot Collaboration in INDUSTRIE 4.0 – Mixed Reality Production 4.0**

Mohammad Mehdi Moniri, Mixed Reality Development, DFKI

Friday, 03/24/2017

11:30-12:05 a.m. **New paths to knowledge – How are the requirements for innovation and education changing?**

Prof. Dr. Christoph Igel, Educational Technology Lab, DFKI

1:30-2:05 p.m. **The world as a networked system and the future of mankind**

Prof. Dr. Paul Lukowicz, Head of Research Department Embedded Intelligence, DFKI

3:00-4:00 p.m. **Panel Discussion: Digital Sovereignty, Topic: Artificial Intelligence**

Prof. Dr. Paul Lukowicz, DFKI / Prof. Dr. Wilhelm Bauer, Fraunhofer-Institut, IAO / Paul Ohmberger, Hekatron / Jens Mühlner, T-Systems International, Charta Digital Networking; **Moderation:** Robert Thielicke, chief editor Technology Review

CeBIT Hall 6, Stand A54

## Augmented Things – Operating Instruction on Demand

Have you ever looked at a device and wondered how to use it? Sewing machines, drills, wireless speakers, or automated ticket sales – all these objects were developed to make life easier. However, in the first few minutes, it can often be difficult to figure out how to use them. *Augmented Things* is an application specifically designed to enable the user to interact with an object via a smartphone or tablet and demand information about what to do next.

► The user views the object through the camera of a smartphone and obtains an augmented view of the object with the appropriate operating instructions. The app does not need to store any infor-

mation about the object and there is no requirement for an Internet connection to communicate with the object.

At CeBIT this year, DFKI's Augmented Vision department is presenting the first prototype of this application. In the near future, everyday devices or even field equipment or the measuring and control equipment used in industrial manufacturing will store their operating instructions on a chip in digital form. The *Augmented Things* app provides direct access to this information by "scanning" the object. Metadata is read out and transmitted via Bluetooth to an Augmented Reality viewer for display.

The tool is readily scalable and provides an extremely intuitive and natural way to search for additional information. *Augmented Things* is the first universal interface for the Internet of Things.



Augmented Things – Devices show on demand how they are to be operated.

### MORE INFORMATION

🌐 [www.dfki.de/av](http://www.dfki.de/av)

### CONTACT

👤 **Dr. Alain Pagani**  
Research Department Augmented Vision

✉ [Alain.Pagani@dfki.de](mailto:Alain.Pagani@dfki.de)

☎ +49 631 20575 3530

CeBIT Hall 6, Stand B48

## B-Human – Five-time World Champion at CeBIT 2017

Now appearing for the second time at CeBIT: Five-time World Champion and Eight-time European Champion – Team B-Human is presented to visitors at the DFKI exhibit stand by the University of Bremen and DFKI's Cyber-Physical Systems department.

► Two of the NAO robots – a mid-fielder and a goal keeper – face off against each other at regular intervals on a 3 x 4 meter playing surface. The demonstration also includes a penalty kick shoot-out. If you miss the live-demo, you can watch the World Cup 2016 again on a large screen with Team B-Human managing to regain the Standard Platform League title after three years in a final championship match in Leipzig.

The Bremen team currently consists of 10 NAO robots and 19 students from the University of Bremen. Supervisors are Dr. Thomas Röfer from the Cyber-Physical Systems department of DFKI managed by Prof. Dr. Rolf Drechsler and Dr. Tim Laue from the University of Bremen. Team B-Human has participated in the German Open RoboCup and the World Cup in the Standard Platform League since 2009. The league owes its name to the fact that all teams use the same robot model, namely, the humanoid robot known as NAO designed by SoftBank Robotics. The teams differ only in the software they develop for the robots. The NAOs actions during the games, in which teams of five robots always play against each other, are completely autonomous thanks to this software. The robots must be capable of recognizing their environment, making decisions, and then jointly implement them. The experienced Bremen researchers traditionally release their software following each world championship, which facilitates the entry of new teams in the Standard Platform League.

The RoboCup competition is an international initiative to promote research in the fields of Artificial Intelligence and Robotics. The common goal of the research scientists is to develop a team of autonomous, humanoid robots that will have the ability to play and win against the reigning human World Cup Champions by the year 2050. To achieve this goal, various major research focus areas have been established in the different leagues and team requirements



B-Human robots during outdoor competition.

Photo: Peter Schulz

are continuously increased. Introduced last year, for example, was a black and white ball in miniature format and the referee's whistle to signal the start of the game.

### MORE INFORMATION

[www.b-human.de](http://www.b-human.de)

### CONTACT

**Dr. Thomas Röfer**

Research Department Cyber-Physical Systems

[Thomas.Roefer@dfki.de](mailto:Thomas.Roefer@dfki.de)

+49 421 218 64200



World Champions B-Human happy to be on the winner's platform.

Photo: Judith Müller



Intelligent Human-Robot Collaboration (iHRC) enables risk-free teamwork with people and robots.

Photo: Volkswagen AG

## Networked Autonomous Systems Answer the Challenges of Tomorrow

*Robots that work safely alongside humans or explore hostile environments, smart buildings that reduce energy consumption, and self-driving cars that take you to your desired destination – all this and much more awaits visitors to CeBIT at the "Networked Autonomous Systems" stand from acatech – National Academy of Science and Engineering and DFKI in collaboration with Deutsche Messe in Hall 12 (Stand B63).*

► These networked autonomous systems can contribute to solving key social and economic challenges in the future. Systems connected to the Internet of Things will make their own decisions, solve complex tasks, learn, and react properly to unforeseen events. At the exhibit stand for Networked Autonomous Systems, visitors can experience a number of demonstrations dealing with a variety of applications, for example: in the areas of manufacturing, road and rail safety, the immediate living environment, or robotic exploration of space. Besides DFKI and acatech, many other exhibits are provided by well-known companies and research institutes, in particular, from the field of robotics, the automobile and automotive industries, and electronics and software development.

Among the exhibits, visitors will also find displays provided by the Working Group on Autonomous Systems, which is coordinated by acatech. The group is composed of more than 60 experts from the research, business, and public administrative communities and includes Prof. Dr. Wolfgang Wahlster, CEO of DFKI, and Prof. Dr. Frank Kirchner, head of the DFKI Robotics Innovation Center, who are responsible for developing recommendations as well as example applications in the use of autonomous systems.

### DFKI Robotics Innovation Center and University of Bremen present: Space Rovers – Autonomous walking and driving with SherpaTT and Coyote III

Walking and driving rovers can be seen at the joint exhibit stand of the Robotics Innovation Center and the University of Bremen: the exhibit features the SherpaTT rover and the micro-rover Coyote III, which successfully completed their Utah Field Trials (FT-Utah) at the end of 2016 by demonstrating its capability to operate on the Martian-like surface of the desert situated in the US state of Utah. The system, developed under the DFKI TransTerra project, underwent a 4-week field testing program that involved a control station located in Bremen and a simulation of a complete mission sequence.

The two rovers, along with a base station to charge the batteries and transmit data, established a logistical chain that also included several payload containers. SherpaTT has an active suspension system that makes it extremely well-suited for negotiating rough terrain. It had the task of autonomously exploring the surroundings and taking soil samples by using its robotic arm. The smaller Coyote III took on the role of shuttle, to transport the soil samples back to

the base station. To establish the satellite communications link with the robots in Utah, scientists at "Mission Control" used, in addition to a mobile control cell in Utah, another control center at the Robotics Innovation Center in Bremen. Control featured a two-armed, upper body exoskeleton as the input and control device. This enabled intuitive control of the robot by the operator using natural movement patterns.

The FT-Utah project was sponsored by the Space Agency of the German Aerospace Center (DLR) with funding provided by the German Federal Ministry for Economic Affairs and Energy (BMWi).

**DFKI Robotics Innovation Center and Volkswagen present:  
Intelligent Human-Robot Collaboration (iHRC)**

Another project being presented at the Networked Autonomous Systems exhibit by DFKI's Robotics Innovation Center features a collaboration with Volkswagen Group (VW): the iHRC (intelligent Human-Robot Collaboration) project. Until now, the work packages and work places in industrial manufacturing and assembly have mostly separated humans from robots, because the safety of the human workers could not be guaranteed. In the iHRC project, DFKI and VW seek to achieve risk-free cooperation in the same work space and dynamic interaction between very different colleagues. The cooperating partners have integrated sensor software and a standard robot to create a system that enables close and direct collaboration between humans and machines. Thanks to overlapping detection and capture of the surroundings by sensors, the system is able to perform collision-free, dual-arm manipulation in a shared human-robot work space. The robot is controlled by simple gestures based on a modular and vendor independent software architecture called ROCK that was also developed at DFKI Robotics Innovation Center: A hand signal is sufficient to stop the robot. With a wink, the machine returns to its work or supplies components and tools. As soon as a human approaches the robot's work area without giving any signal, the machine autonomously slows its working speed and moves away.

**MORE INFORMATION**

[www.dfki.de/ric](http://www.dfki.de/ric)

**CONTACT**

**Prof. Dr. Wolfgang Wahlster**  
Scientific Director, CEO of DFKI

[Wolfgang.Wahlster@dfki.de](mailto:Wolfgang.Wahlster@dfki.de)

+49 681 85775 5252



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SherpaTT weighs approximately 150 kg and, with its active suspension, is particularly well-suited to explore rough terrain.

## BPM for INDUSTRIE 4.0 – Process-oriented Production Planning with the SmartLEGO® Manufacturing Module

*Dynamic planning, control, and risk assessment of production processes using the process execution data from the SmartLEGO® manufacturing module.*

► The demonstrator illustrates the use of business process management (BPM) methods to make dynamic adjustments to production plans. The concepts of process mining complement the planning process, shorten lead times, and enable risk assessments. That is dependent on continuous process monitoring and intelligent linkage with machine data. The dynamic adjustment of plans permits an early response to potential problems, for example, a risk of delay can be proactively identified and avoided through resched-

uling. Beyond this, it is possible to integrate urgent work orders into production without requiring a complete re-planning of other orders.

The scenario includes a modular production line with different product types as well as upstream and downstream order processes and warehousing. The tracking of individual products through production is displayed in real time by means of RFID sensors. The status display informs the user about the current order processing status as well as the risk of possible delays while also allowing for interventions to the production plans on the basis of automated recommendations for action.



### MORE INFORMATION

- 🌐 [www.dfki.de/iwi](http://www.dfki.de/iwi)
- 🌐 <http://refmod-miner.dfki.de>

**CeBIT Hall 6, Stand E28**

### CONTACT

👤 **Tim Niesen | Sharam Dadashnia | Prof. Dr. Peter Fettke**  
Institute for Information Systems (IWi) at DFKI

✉️ [\[Tim.Niesen | Sharam.Dadashnia | Peter.Fettke\]@dfki.de](mailto:[Tim.Niesen | Sharam.Dadashnia | Peter.Fettke]@dfki.de)

☎️ +49 681 85775 5144 | 5336 | 5142

## Deep Learning and Business Process Management Meet the Internet of Things – Cooperation with Software AG

*Successful digitalization is shown by ARIS and RefMod Miner in the SmartLEGO® Factory*

► This year, DFKI's LEGO® Showcase, in partnership with Software AG, highlights an end-to-end solution that is technically implemented by the intelligent interplay of ARIS and RefMod-Miner.

The planning and modeling of a flexible production process, the required IoT networks, and the embedding of it all into a business landscape, takes place in ARIS. RefMod-Miner takes this as the basis for production planning and control, which is further expanded by a forecasting component that enables predictions about subsequent production steps. Deep Learning methods are used to support these predictions and connect the broader concepts of Artificial Intelligence with business process management tools. Additionally, Software AG and the Showcase demonstrate aspects of mobile workplace assistance, modeling of IoT objects and networks, as well as performance analysis and "Dashboarding" (Performance KPIs) using the ARIS Process Performance Manager and ARIS Aware software products.

The collaboration with Software AG is an impressive demonstration of just how a successful transfer of current research can provide added value to an operational practice.

### MORE INFORMATION

- 🌐 [www.dfki.de/iwi](http://www.dfki.de/iwi)
- 🌐 <http://refmod-miner.dfki.de>
- 🌐 [www.softwareag.com](http://www.softwareag.com)

### CONTACT DFKI

👤 **Prof. Dr. Peter Fettke**  
Institute for Information Systems (IWi) at DFKI

✉️ [Peter.Fettke@dfki.de](mailto:Peter.Fettke@dfki.de)

☎️ +49 681 85775 3106

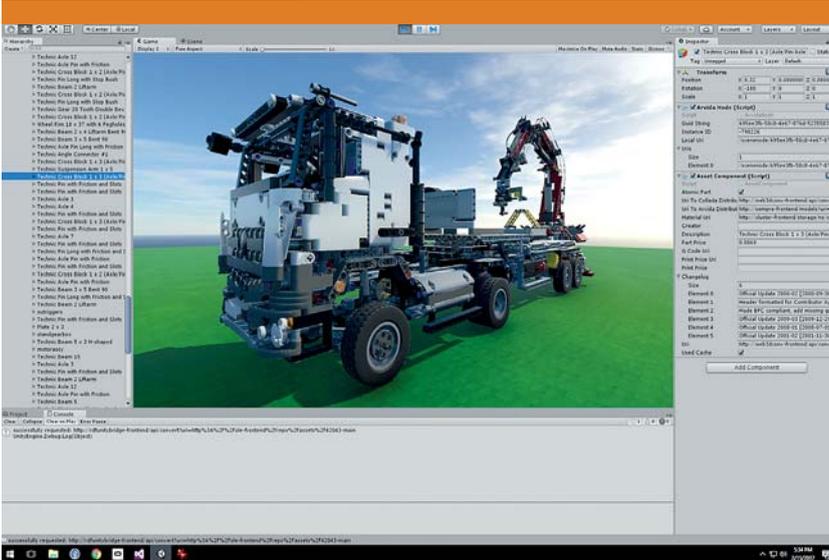
### CONTACT SOFTWARE AG

👤 **Bärbel Strothmann**  
Software AG Corporate Communications  
Senior Manager Public Relations

✉️ [Baerbel.Strothmann@softwareag.com](mailto:Baerbel.Strothmann@softwareag.com)

☎️ +49 6151 92 1502

**CeBIT Hall 4, Stand C11**



## Integrated Virtual Engineering Using the ARVIDA Reference Architecture

The term *Virtual Technologies (VT)* refers to interactive application systems along the entire continuum of reality-virtuality in a mixed reality environment. The use of VT has been an integral part of process and IT systems at industrial enterprises for quite some time in the areas of concept design and development, training and education, as well as labor support.

► Industrial VT application systems, particularly those that use Virtual Reality (VR) and Augmented Reality (AR), require a smooth interplay between the different technological components, such as virtual human models, motion capturing systems, engineering simulation and analysis modules, or haptic output devices.

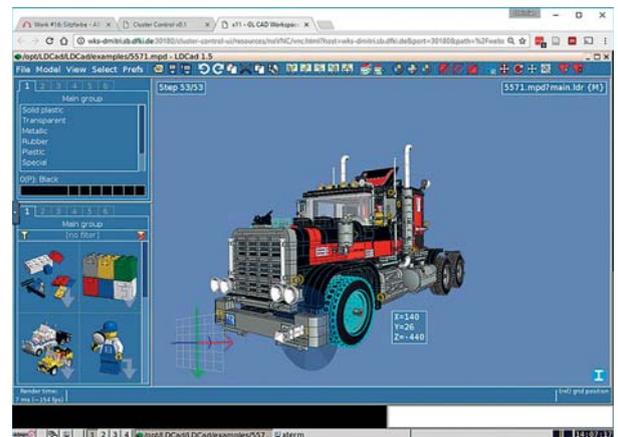
The functional requirements of these VT application systems have steadily increased up to the point where – for a digital company – the process and decision making steps can only be made by means of a virtual product model.

Historical trends and industrial demands have resulted in the creation of exceptionally diverse functional, but also proprietary VT application systems. VR systems, in many cases, emerge from a basic system and highly specialized functional components. Most modern VR systems do use a modular concept but that usually lacks interoperability outside of its own product family.

The requirement for integrated, flexible, and reasonably priced VT support in a digital manufacturing company for industrial design, development, and production processes is, essentially, a demand for industrial VT application systems that provide improved extendability, re-usability, and combinability – and go beyond the restrictions of proprietary product families or even organizational structures.

The Federal Ministry of Education and Research (BMBF) funded the ARVIDA research project. The aim of the project is to generate concepts, technologies, and reference architectures that enable the development of integrated VT applications for INDUSTRIE 4.0 systems featuring the use of existing as well as experimental web standards and technologies.

Specifically, the project partners have been working on semantic interface descriptions for the relevant VT functional components. The developed architecture includes the differentiation of the individual sub-components of a VT application, the specification of the required data, as well as a meaningful structure and format. The resulting semantic ARVIDA vocabulary permits a machine readable representation of the application artifacts using RDF data models (Resource Description Framework). The ARVIDA vocabulary specifications follow the W3C defined and standardized rules for distributed, web-based applications.



In the context of an engineering change process, the CeBIT demonstrator shows how changes may be implemented quickly, flexibly, and with a reasonable effort by the automated provision of the required data and tools based on the ARVIDA reference architecture.

### MORE INFORMATION

[www.arvida.de](http://www.arvida.de)

### CONTACT

René Schubotz  
Research Department  
Agents and Simulated Reality

[Rene.Schubotz@dfki.de](mailto:Rene.Schubotz@dfki.de)

+49 681 85775 5303

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## Intelligent Assistance for Knowledge Management Related to Interdisciplinary Emergency Hospital Admissions

► Interdisciplinary emergency admissions play a major role in emergency medical care in Germany. The significant increase in the number of emergencies, combined with the use of different information systems and medical procedures, plus high time and cost pressures, place the highest demands on the training of emergency care and rescue service personnel. Emergency admissions face the challenge of time-critical diagnosis and initial treatment of patients of various ages as well many various illnesses and injuries.

The full spectrum ranges from outpatient treatment of mild illnesses or injuries to shock room care of the seriously ill and severely injured patients. As a rule, emergency room teams consist of people with a range of different qualifications and professional expertise. The need for interdisciplinary and cross-professional cooperation is especially important in emergency room operations.

The aim of **A.L.I.N.A.**, a collaborative project to study intelligent assistance services and personalized learning environments for the advancement of knowledge and management of interdisciplinary emergency admissions, is to develop “in situ” intelligent assistance services and provide them to the target groups at each step of the emergency care process via mobile web-based phones.

The digital learning and assistance programs are designed for mobile use so they can be used as needed and where needed. This design aspect ensures direct help in the event of a deployment, so the response team can focus on a very specific, critical emergency situation. Furthermore, the learning content can be conveniently and flexibly used for further education and advanced training in a personalized learning environment, in addition to being time and place independent.

This research and development project is managed by the University Medical Center at Göttingen in collaboration with partner organizations: Otto-von-Guericke University in Magdeburg, Heilbronn University, and the Education Technology Lab (EdTec) at DFKI. The EdTec Lab develops the intelligent-adaptive assistance services that form the basis of support. A.L.I.N.A. has been funded by the Federal Ministry of Education and Research (BMBF) for a term of three years with 1.3 million euros since November 2014.



Photo: Laerdal Medical

The A.L.I.N.A demonstrator at CeBIT shows that a basic, life-saving, cardiopulmonary resuscitation measure can be performed on the SimMan 3G (patient simulator from Laerdal Medical) with the aid of assistance services.

### MORE INFORMATION

[www.alina-projekt.de](http://www.alina-projekt.de)

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### CONTACT

**Prof. Dr. Christoph Igel**  
Head of Research  
Educational Technology Lab at DFKI

[Christoph.Igel@dfki.de](mailto:Christoph.Igel@dfki.de)

+49 30 23895 1052

**CeBIT Hall 6, Stand B48**



At the DFKI Educational Technology Lab, A.L.I.N.A develops learning and support options for emergency teams.

Photo: Laerdal Medical



The Smart Data delegation headed by Dr. Andreas Goerdeler, German Federal Ministry for Economic Affairs and Energy (BMWi).



## Smart Data Forum and the Digital Health Roadshow in the USA

*A delegation representing DFKI and the German Federal Ministry of Economic Affairs and Energy as well as experts and entrepreneurs from the fields of IT, medicine, health insurance, nursing and hospitals visited selected healthcare facilities in the USA in October 2016.*

▶ The trip was initiated by the Smart Data Forum for the purpose of exchanging current views on major research topics, technical and regulatory hurdles in data driven innovation projects, and potential areas of cooperation with American colleagues.

Of primary interest were the facilities in New York and Boston. Both cities have become centers of excellence in digital health after making hefty investments in health research and new facilities in the recent past.

The delegation, headed by Dr. Andreas Goerdeler, German Federal Ministry for Economic Affairs and Energy (BMWi), participated in various events and workshops and presented the early results from the BMWi-sponsored healthcare projects: SAHRA – Smart Analysis-Health Research Access, KDI – Clinical Data Intelligence, and MACSS - Medical Allround-Care Service Solutions. DFKI is a consortium partner in the KDI and MACSS projects.

The start of the road show was a joint evening event for American and German health specialists at the German Center for Research and Innovation in New York with approximately 100 guests. Other stops along the way were the Data Science Center of New York University and Columbia University, the specialized health technology accelerator DreamIT in New York, the German Accelerator Life Science in Boston, the Dartmouth Hitchcock Medical Center in New Hampshire, and the Google Research Labs in New York and the SAP Labs in Boston.

### The exchange focused on innovative research approaches in the priority subject areas below:

- ▶ Monitoring and treatment of chronically ill patients through the use of new sensors,
- ▶ The use of Artificial Intelligence methods for the valuation of numerous historical cases of disease for pattern recognition of disease progression and for possible improvements in therapies,
- ▶ Acceleration of knowledge transfers from research labs to medical practice,

- ▶ Opportunities of Next Generation Sequencing, in particular, for a better understanding and individualized treatment of genetically induced or advantaged diseases.

The participants managed to make many new contacts and identified a number of similar projects and research priorities. After a very positive assessment of this roadshow, the Smart Data Forum is concentrating its energies on another road show to the Asian region, scheduled for May 2017. The focus this time is on the topic of “Smart Data and Industry” with stops planned in Singapore, China, and Japan.

#### MORE INFORMATION

🌐 [www.smartdataforum.de](http://www.smartdataforum.de)

#### CONTACT

👤 **Dr. Jack Thoms**  
 Research Department  
 Intelligent Analytics for Massive Data

*Collaborations, Networking, and Knowledge Transfer Smart Data Forum*

✉ [Jack.Thoms@dfki.de](mailto:Jack.Thoms@dfki.de)

☎ +49 30 23895 1832

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## Hybrid Teams for INDUSTRIE 4.0 – Project Hybr-iT

The aim of the Hybr-iT joint research project funded by the Federal Ministry of Education and Research (BMBF) is to intensify flexible collaboration between humans, robots, and production systems. An innovative approach in Human-Robot Collaboration (HRC) is taken to design participatory work structures: Self-organization and communication by team members will be interlinked and effectively coordinated with traditional production scheduling. The project's official kick-off event took place at DFKI in Saarbrücken on January 11, 2017.

► Hybr-iT provides a substantial contribution towards achieving future requirements for conversion capability and optimal capacities in manufacturing and assembly plants. INDUSTRIE 4.0 promises to make production more economically profitable – even for low volume runs. The foundation of production technologies are the extremely versatile manufacturing systems that can flexibly and quickly adapt to constantly changing requirements. Although available production systems are already largely digitalized, networked, and even partially capable of conversion, they are not adequately equipped for the actual collaboration between humans and robots. In addition to these manufacturing challenges, Hybr-iT addresses the issues of socio-technical controllability.

Hybr-iT focuses on the development and industrial testing of hybrid teams, in which humans and robots work together with software-based assistance systems in intelligent production environments. Hybr-iT researches and evaluates the components required for planning and optimizing hybrid teams in an industrial context – in terms of their integration in existing IT and production systems and as necessary for their control in a production operation. Prof. Dr. Wolfgang Wahlster, overall project manager in Hybr-iT and CEO of DFKI explained further: “We take a holistic view of the individual disciplines of Human-Robot Collaboration, intelligent planning environments, assistance systems, and knowledge based robotics. The human workers in the production processes should be assisted by robots, making teamwork safer, more efficient, and ergonomic for people.”

From an IT perspective, this will involve heavily distributed systems with very heterogeneous sub-systems (such as plant and robot controls, safety, logistic, database, assistance, tracking, simulation, and visualization systems), which are implemented together in a comprehensive resource oriented architecture (ROA).

The results of the Hybr-iT project are to be applied and evaluated in the production processes of the automotive and aviation industries that involve a high level of manual assembly work.

### Project partners

- Airbus Operations
- Federal Institute for Occupational Safety and Health (BAuA)
- Broetje-Automation
- DFKI (lead manager)
- EngRoTec
- KUKA Robots
- The Captury
- Volkswagen

**Project volume:** approx. 10 million euros

**Project period:** Nov. 1, 2016 – Oct. 31, 2019

### MORE INFORMATION

🌐 [www.hybr-it-projekt.de](http://www.hybr-it-projekt.de)

### CONTACT

👤 **Dr. Anselm Blocher**  
Research Department  
Intelligent User Interfaces

✉️ [Anselm.Blocher@dfki.de](mailto:Anselm.Blocher@dfki.de)

☎️ +49 681 85775 5262

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Hybr-iT kick-off meeting at DFKI Saarbrücken.



The demo modules of the SmartFactory consortium are dispersed among three production islands to enable flexible production.

Photo: SmartFactory<sup>KL</sup> / C. Arnoldi

## Cross-site Production Thanks to Flexible Transport System

The Technologie-Initiative SmartFactory<sup>KL</sup> e.V. and the German Research Center for Artificial Intelligence (DFKI), together with the 19 involved partner companies, will present the further development of the INDUSTRIE 4.0 system at booth D 20 in hall 8 at Hannover Messe (Hanover Trade Fair) from April 24 to April 28, 2017. By virtue of using a flexible transport system, a cross-site, flexible production process will be presented.

► The expanded demonstration system of the SmartFactory<sup>KL</sup> partner group makes an appearance in a new layout: for the first time, the modules are no longer set up in one line but distributed over three production islands. Products can now be manufactured in different ways because of the use of the flexible transport system comprised of a robot platform as the central element as well as the conveyor belts in the modules.

After the product is processed in four modules according to standardized definitions, the Manufacturing Execution System (MES) uses the information it has received about the plant topology from the Integration Bus to decide where the product is to be transported to for its further processing. While the flexible transport system distributes the product on the Hannover Trade Fair only within a small radius, the system can be applied on different production lines, in different factory halls or even at different production sites in the actual use. Since a product's decision cycle is controlled by the memory saved in the RFID tag and respectively directed by the applied IT structure, it always finds the right module for the next processing step.

### Use case originates from the working groups of SmartFactory<sup>KL</sup>

The basic skeleton for the expanded INDUSTRIE 4.0 system was created in the SmartFactory<sup>KL</sup> working groups. "We owe this application case to the round-table collaboration of industry and science. Because the partners interacted at eye level, as appropriate for the spirit of our initiative, they were able to jointly develop these new research topics successfully," explained Prof. Dr.-Ing. Detlef Zühlke, Chairman of the Board of Technologie-Initiative SmartFactory<sup>KL</sup> e.V. and Head of the research department "Innovative Factory Systems" at the German Research Center for Artificial Intelligence.

### Standards enabling a flexible system expansion

The rearrangement of the INDUSTRIE 4.0 demonstration system is essentially based on three standards. They include the RFID tag description that is defined

**smartFactory<sup>KL</sup>**

📍 The partner companies involved in the SmartFactory<sup>KL</sup> INDUSTRIE 4.0 system are: Belden/Hirschmann, Bosch Rexroth, CISCO, EPLAN Software & Service, Festo, HARTING, IBM, iTAC, LAPP KABEL, Mettler Toledo, MiniTec, PHOENIX CONTACT, Pilz, proALPHA, SAP, TE Connectivity, TÜV SÜD, Weidmüller and Wibu-Systems.

from the data structure and data coding of the product memory, the standardized OPC UA communication as well as the standardization of hardware which means that the docking station and the modules operate with a standardized mechanical basic function.

### MORE INFORMATION

🌐 [www.smartfactory.de](http://www.smartfactory.de)

### CONTACT

👤 **Prof. Dr. Detlef Zühlke**  
Head of Research Department  
Innovative Factory Systems and  
Chairman SmartFactory<sup>KL</sup>

✉ [Detlef.Zuehlke@dfki.de](mailto:Detlef.Zuehlke@dfki.de)

☎ +49 631 20575 3400



## DFKI Provides IT Components for the Smart Power Grid of Tomorrow

Designetz is one of five “showcases” selected by the German Federal Ministry for Economic Affairs and Energy (BMWi) under the framework of the “Smart Energy Showcases – Digital Agenda for the Energy Transition” (SINTEG) program. The research effort at DFKI is funded with approximately 2.5 million euros.

► “Designetz: A modular concept for the energy transition” – from isolated solutions to an efficient energy system of the future,” is the technically most comprehensive demo project to date for the integration of alternative energies into the supply system. The goal is to realistically show how smart grids, sometimes with 100% renewable energy sources providing the input, can ensure a safe and efficient power supply and to study what concepts and technologies are needed to achieve it.

“Researchers at DFKI have helped to drive the energy transition from the beginning with innovative IT approaches. We are combining this IT know-how in energy systems with the latest machine learning methods to trigger some pressure in the energy sector of the economy and initiate a wave of digitalization,” said DFKI CEO Prof. Dr. Wolfgang Wahlster. Dr. Boris Brandherm, DFKI’s Designetz project manager explained: “In this collaborative Designetz project, DFKI develops AI methods for forecasting the generation and consumption of alternative energies on the basis of mass energy data, contributing in this way to Germany’s energy transition.”

DFKI focuses on AI methods for the prediction, analysis, and optimization based on mass energy data as well as security and privacy, and a data and services platform. Studies include concepts and programming solutions to build a reference architecture and process models for “Security-by-Design” and “Privacy-by-Design” for the critical infrastructure of the energy sector and their implementation in an integrated data and services platform. Energy data must be transferred securely, purposefully, and reliably to the individual software components while retaining the ability to both assign and restrict use and access authorizations. To this end, DFKI integrates its KIARA and SUCH middleware systems and adapts them with respect to the participating heterogeneous institutions, system components and data, scalability, quality-of-service, and modularity. DFKI uses various AI-methods like case-based reasoning, Deep Learning, and dynamic Bayesian networks for the forecasting process.

The official kick-off of Designetz was on January 1, 2017 and the project has a duration of four years with a consortium of 46 experienced partners from the energy sector,

**DESIGNETZ**  
VERBUNDEN MIT KREATIVER ENERGIE



industry, and research and development. The lead manager is innogy SE. The energy transition project extends across three federal states: North Rhine-Westphalia, Rhineland-Palatinate, and Saarland. The federal government (BMWi) sponsors the project with about 30 million euros. The total project volume is about 66 million euros. Saarland is strongly represented, for example, by the Hager Group, Scheer, DFKI, Saarland University, htw saar, and the public utility Stadtwerke Saarlouis. VSE company is the representative of the lead project manager in Saarland.

### MORE INFORMATION

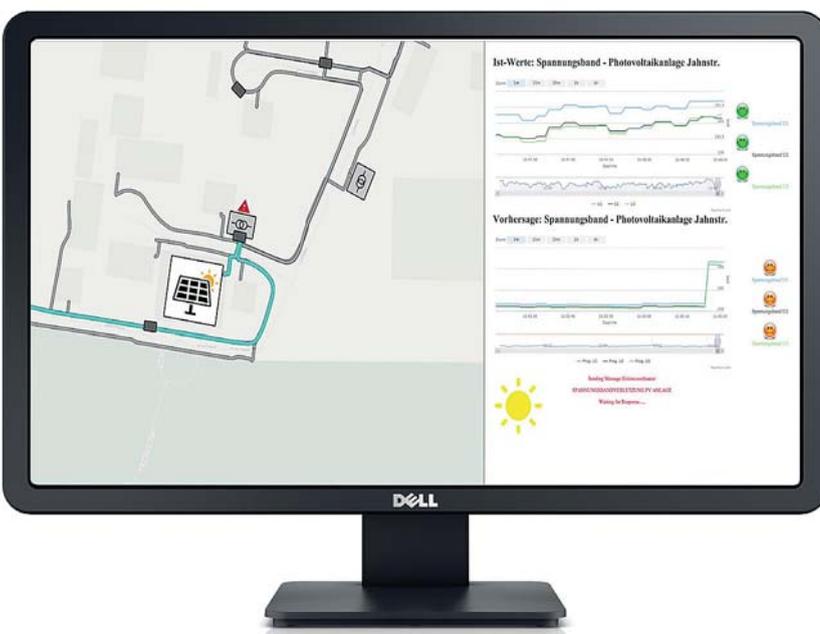
- 🌐 [www.designetz.de](http://www.designetz.de)
- 🌐 [www.bmwi.de/DE/Themen/Energie/Netze-und-Netzausbau/sinteg.html](http://www.bmwi.de/DE/Themen/Energie/Netze-und-Netzausbau/sinteg.html)

### CONTACT

👤 **Dr. Boris Brandherm**  
Research Department  
Intelligent User Interfaces

✉ [Boris.Brandherm@dfki.de](mailto:Boris.Brandherm@dfki.de)

☎ +49 681 302 3496



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## ► DFKI INTERVIEW – DR. ALASSANE NDIAYE



### Dr. Alassane Ndiaye

is a senior software engineer (R&D) at DFKI Saarbrücken.

*He is working in the department of Intelligent User Interfaces since 1998, where he has contributed to multiple research projects in addition to industry and transfer projects.*

#### 🗣️ What is the application potential of your research?

My current R&D work involves AI-based forecasting procedures for the generation of renewable energy supplies. This is a major topic in light of the national energy policy calling for the transition to alternative power sources.

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

While still a student, my diploma thesis was written under SFB 314 “Knowledge-Based Systems” and my topic, specifically, was the development of natural language dialog systems. After receiving my diploma from Saarland University in Prof. Wahlster’s department in the early 1990s, I had the opportunity to continue my work in the area of user modeling and dialog systems as a research assistant in SFB 378 “Resource Adaptive Cognitive Processes”. Continuing my career at DFKI, I turned my attention to industry and transfer projects. Meanwhile, I am pleased to see that many of my research topics have reached product maturity, for example, in the areas of information retrieval, translation, virtual assistants, and multi-modal dialog systems.

#### 🗣️ What are the greatest challenges and opportunities for AI systems

The rapid advances in AI systems in recent years are staggering. In my opinion, the key to success is to be found in the improved combination and integration of various AI methods. Also, of course, we must not overlook the socio-political aspects.

#### 🗣️ What do you enjoy doing when you are not working as a research scientist?

I devote my leisure time to my family, friends, and attend lectures on the topics that interest me, such as socio-political, historical, and – certainly because of my origin – intercultural and trans-cultural issues. Global coexistence works best when you “know about others.”

#### 🗣️ Are there any parallels with your professional activities?

Human and artificial intelligence both go hand in hand with the ability to place yourself in the position of the other person and anticipate or readjust your actions. More attention must be given in AI research to the emotional and social intelligence aspects of human social interaction. As a doctoral candidate, I had the chance to pursue these aspects.

#### 🗣️ What are your current projects?

Currently, I am responsible for the DFKI contributions to the “Designetz” project, specifically, the work packages “Grid operations and system services” and the exciting “Energy grid with innovative solutions” demonstrator. We use AI methods and tools (like machine learning and casebased reasoning) to make a significant contribution to securing the energy supply; on the one hand by developing procedures for forecasting the generation of alternative energies and, on the other hand, by performing a forward looking assessment of grid status while optimizing the downstream grid control instructions. In brief, we are developing AI procedures for the prediction and optimization in the context of energy mass data. I also continue to be active in the acquisition and execution of industry and transfer projects.

#### CONTACT

👤 **Dr. Alassane Ndiaye**

✉️ [Alassane.Ndiaye@dfki.de](mailto:Alassane.Ndiaye@dfki.de)

☎️ +49 681 85775 5396

## Researchers Develop the Office of Tomorrow

### TU Kaiserslautern and DFKI Open Living Lab – smart office space



What will the office of the future look like? That is the question researchers at TU Kaiserslautern and DFKI are studying at the new Living Lab – smart office space. They are developing new techniques and concepts for the office of tomorrow in a near reality environment. Rhineland-Palatinate's Science Minister Professor Konrad Wolf was the guest of honor at the official kick-off event on November 25, 2017.

► Too cold, too hot, too loud, too dry, no privacy – these are just a few of the points concerning office space mentioned during a survey by the International Facility Management Organization performed in the year 2009. The responses clearly show that office comfort still leaves a lot to be desired. In particular, the frequent complaints about thermal conditions indicate a widespread dissatisfaction in the workplace. Similarly, the lighting and noise levels are not conducive to concentration.

Improving the comforts of the office for everyone is the goal of Professor Sabine Hoffmann, chair of the Building Systems and Engineering department at TU Kaiserslautern, and her team in the new DFKI Living Lab – smart office space. “The offices of the future will have customized workplaces that adjust to the needs of the individual and account for individual preferences,” said Hoffmann. “Automation technology can be used to control, for example, temperature, lighting, and ventilation at every workplace. People will be able to regulate their own immediate environment.”

Besides the comfort, the scientists are also committed to energy efficiency. “Office buildings, in particular, consume huge amounts of energy. The new intelligent systems can provide great savings in heat, electricity, and water,” Hoffmann continued.

Professor Dr. Andreas Dengel, head of the Smart Data & Knowledge Services department at DFKI, is also working with his team to develop the hardware and software designed to simplify office routines. He explained: “Intelligent assistance systems will enable the offices of tomorrow to comfortably manage knowledge, while promoting creativity and productivity. Furthermore, the use of modern information technologies, for example, sensor-detected activity, promises enormous potential for a more flexible work environment.”

At the grand opening event Minister Professor Konrad Wolf emphasized the realistic research environment and its potential for innovation: “Innovation and application oriented research is literally on display in terms of the closeness to basic research in the Living Lab – smart office space. I am confident that additional spin-offs will result from this innovative approach and this joint project will further contribute to strengthening the reputation of Kaiserslautern as a successful center of research.”

#### MORE INFORMATION

[www.livinglab-smartofficespace.com](http://www.livinglab-smartofficespace.com)

#### CONTACT

*Living Lab smart office space*  
Trippstadter Str. 122  
D-67663 Kaiserslautern

**Prof. Dr.-Ing. Sabine Hoffmann**  
Kaiserslautern University of Technology  
Special Research Subject  
Building Systems and Engineering

[Sabine.Hoffmann@bauing.uni-kl.de](mailto:Sabine.Hoffmann@bauing.uni-kl.de)

+49 631 205 2909

**Prof. Dr. Andreas Dengel**  
Head of Research Department  
Smart Data & Knowledge Services

[Andreas.Dengel@dfki.de](mailto:Andreas.Dengel@dfki.de)

+49 631 20575 1000



Together with “Smart Factory” and “Smart City,” “smart office space” is the third DFKI Living Lab in the city of Kaiserslautern.



## DFKI Service Offering

As an internationally renowned Center of Excellence for innovative software systems based on Artificial Intelligence (AI) methods, DFKI is offering the following services with more than 25 years of experience in basic and applied R&D

- ▶ Technology transfer of the award-winning research results of DFKI
- ▶ Innovation coaching and start-up consulting in the public-private partnership sector
- ▶ Individual design, development and implementation of innovative application solutions
- ▶ Market studies, expert surveys, feasibility analysis and empirical user studies
- ▶ Component development with AI-functionality, enhancing the performance of complex software systems
- ▶ Scientific advice on the selection and implementation of complex software solutions
- ▶ Customization, implementation, deployment and maintenance of DFKI AI-solutions
- ▶ Scientific evaluation and benchmarking of software solutions
- ▶ Application-oriented basic research
- ▶ Independent assessment of IT-security and privacy
- ▶ Technology workshops, training and practice
- ▶ Scientific monitoring of data collections and their evaluation
- ▶ Business engineering: Process analysis and development
- ▶ Innovation coaching and turnaround management
- ▶ Strategic and technical due diligence consulting for companies in the ICT sector
- ▶ Technical and organizational support for the standardization in the IT sector (Including W3C, ISO)
- ▶ Design, construction and operation of Living Labs

## Prof. Wolfgang Wahlster as First Computer Scientist Honored with the Johannes Gutenberg Endowed Professorship

Artificial Intelligence for the People – Digitalization with Understanding: The second wave of digitalization on the basis of machine intelligence is the focus of the 18th Johannes Gutenberg Endowed Professorship for the summer semester 2017. Besides occupying the Chair for Computer Science at Saarland University and his responsibilities as CEO of DFKI, Prof. Wolfgang Wahlster is organizing a series of ten evening events in his capacity as one of the endowed professors in Mainz. Wahlster has been closely associated with Mainz since 2002 as a full member of the Academy of Sciences and Literature.

**More Information**  
[www.stiftung-jgsp.uni-mainz.de](http://www.stiftung-jgsp.uni-mainz.de)



**Prof. Wolfgang Wahlster next to the Gutenberg statue at the Johannes Gutenberg University in Mainz.**

Photo: Stefan F. Sämmer, JGU

## Prof. Wahlster is the new President of GDNÄ

On January 1, 2017 Prof. Dr. Wolfgang Wahlster assumed the office of President of the Society of German Researchers and Physicians (GDNÄ).

He succeeds Prof. Dr. Eva-Maria Neher, founder and head of XLAB, Experimental Lab for Young People in Göttingen. Among the scientists who shaped the society are such personalities as Alexander von Humboldt, Carl Friedrich Gauß, Hermann von Helmholtz, Werner von Siemens, Albert Einstein, and Max Planck.

“Science must continue to encourage more citizens’ dialog to promote acceptance of the cutting-edge innovations in the digital age and allay fears of losing control and overloading in a highly technological world,” said Wahlster on taking office.

## Prof. Philipp Slusallek Named as Khronos “Expert”

The head of DFKI’s research department for Agents and Simulated Reality was named by the Khronos Board as a Visual Computing “Expert” in November 2016. “Experts” are members who make a direct contribution to standardization activities. In addition to his long standing work with Khronos and W3C, Slusallek is actively working on topics like WebVR, XML3D and related concepts (e.g., XFlow, shade.js), compiler concepts, and real-time ray tracing. The Khronos consortium, with more than 100 members, is dedicated to developing and managing license-free standards in the multimedia sector. Khronos is the most important standardization organization for key technologies like OpenGL for 3D-Web graphics, Vulkan, WebGL, OpenVX and OpenCL, Collada, and glTF.



**More Information**  
[www.khronos.org](http://www.khronos.org)

## Visual Summary at Completion of Guided Autonomous Building Project

The aim of the Guided AB research project (Energy efficiency, comfort and security thanks to networked and self-learning building and home systems) was to develop an innovative approach to flexible building automation and a home networking system in the context of an “intelligent” apartment building. Guided AB was sponsored by the German Federal Ministry for Economic Affairs and Energy (BMWi) under the “Autonomics for INDUSTRIE 4.0” technology initiative. Researchers at DFKI’s Agents and Simulated Reality department developed a 3D image display of an apartment building in the component project 3D Dual Reality – user interface. Specific results can be seen in an image film, which was produced in cooperation with ARTENGIS. The film is available on the DFKI YouTube channel.



**More Information**  
[www.guided-ab.de](http://www.guided-ab.de)  
[www.youtube.com/dfkivideo](https://www.youtube.com/dfkivideo)

## “EINFACH WISSENSWERT” Exhibit – Grand Opening at the House of Science

The exhibit called “EINFACH WISSENSWERT (English: *Simply worth knowing*): The Health Sciences” is dedicated to providing current information about a wide range of health issues and is happening from February 17 to April 22, 2017 in the House of Science, a non-profit organization. DFKI-Bremen is participating along with six other facilities in and around Bremen by contributing a presentation about smart applications at the Ambient Assisted Living Lab (BAALL). Welcome remarks were given by Prof. Dr. Eva Quante-Brandt, State Senator for Science, Health, and Consumer Protection and Prof. Dr. Gerold Wefer, Chairman of the Board of the House of Science (Haus der Wissenschaft). The program features talks and keynotes on the exhibition topics to be presented in the “Knowledge at 11” series.



**More Information**  
[www.hausderwissenschaft.de](http://www.hausderwissenschaft.de)

## “Knowledge Management” Evolves to “Smart Data & Knowledge Services”

The DFKI research department formerly known as “Knowledge Management,” and headed by Prof. Dr. Andreas Dengel, is now called “Smart Data & Knowledge Services.” The name change is the result of the advances in development that have taken place and the challenges digital transformation poses to data analysis and knowledge services. The research focus is on tools, models, and innovative solutions that address the multi-dimensional information potential found in large scale multimedia data sources. This requires sophisticated, combined, model-based as well as data-driven approaches to machine learning, to analyze data series, to classify events, to find relationships and patterns, or to detect anomalies. The result will provide possibilities to enable decision support, to make predictions, or to optimize processes. The effort involves activity, entity, and pattern recognition problems, but also context modeling and mutual exploitation of the developments in adaptive and autonomous systems.

## Japanese Special Task Minister Visits Kaiserslautern

On January 11, 2017 Yosuke Tsuruho, Special Minister for Science and Technology visited DFKI-Kaiserslautern as head of a delegation from the Japanese General Consul. Against the backdrop of the “5th Science and Technology framework program” and the “Society 5.0” concept, the visit was intended to expand cooperation with the German government and German research institutes. The Japanese government attaches great importance to digitalization, for example, in the production of goods, medicine, transportation, energy, finance, and education. AI technologies are at the core of the concept where, in recent years, Japan has substantially boosted investment. DFKI has long maintained close and diverse relationships with Japanese universities, businesses, and government institutions.

## 8<sup>th</sup> ITH Conference 2017 for “Innovative Technologies for Commerce”

Digitalization of the markets, personalized coupons, and AI technologies as the new drivers in retailing or innovative delivery concepts for online transactions – retail sector faces not just great challenges, but also new paths and opportunities. This year, the Innovative Retail Laboratory (IRL) Conference will be held on September 28 - 29 in St. Wendel and again is presenting the latest retailing developments and trends from research and industry. Saarland’s Minister for Economics, Labor, Energy, and Transportation is the official sponsor. The IRL is an application oriented research lab of DFKI, which together with the cooperation partner GLOBUS develops and evaluates innovative technologies for the retail sector and implements them in a realistic application scenario.

**More Information and Registration**  
[www.dfki.de/ith2017](http://www.dfki.de/ith2017)

## VDI Future Conference on “Humanoid Robots 2016” under the direction of Prof. Kirchner

The Association of German Engineers (VDI) Knowledge Forum organized the conference which took place on December 13-14, 2016 in Aschheim near Munich.

Devoted to discussing the possibilities, opportunities, and challenges in the field humanoid robotics, the conference was chaired by Prof. Dr. Frank Kirchner, head of DFKI Robotics Innovation Center.

In his opening remarks, he presented the general topic of Artificial Intelligence and its benefits, for example, with machine learning methods used with ever more complex humanoid robots.

DFKI Robotics Innovation Center contributed a presentation on the subject of “Generic Manipulation Skills for Complex Robotic Systems” by Dr. José de Gea Fernández and also, Dr. Daniel Kühn’s presentation on the “Multi-Functionality and the Hominid Robot Charlie.”



Kaiserslautern Site

Saarbrücken Site

Bremen Site

Project Office Berlin

## German Research Center for Artificial Intelligence

### Company Profile

#### ► Established

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

#### ► Executive Board

- Prof. Dr. Dr. h.c. mult. Wolfgang Wahlster, CEO
- Dr. Walter Olthoff, CFO

#### ► Supervisory Board

- Prof. Dr. h.c. Hans-Albert Aukes, Chair
- Dr. Susanne Reichrath, Representative of Saarland's Minister President for Higher Education, Science and Technology, Vice Chair

#### ► Locations

Kaiserslautern (registered office), Saarbrücken, Bremen, Berlin (project office). Further operating sites in Osnabrück and St. Wendel

#### ► Shareholders

Airbus Group, BMW AG, CLAAS KGaA mbH, Deutsche Messe AG, Deutsche Telekom AG, Empolis Information Management GmbH, Fraunhofer Gesellschaft e.V., Google Inc., HARTING AG & Co. KG, Intel Corporation, John Deere GmbH & Co. KG, KIBG GmbH, Microsoft Deutschland GmbH, Nuance Communications Deutschland GmbH, RICOH Company Ltd., Robert Bosch GmbH, SAP SE, Software AG, University of Kaiserslautern, Bremen University, Saarland University, Volkswagen AG, VSE AG

#### ► Equity Holding

GraphicsMedia.net GmbH, Kaiserslautern - Ground Truth Robotics GmbH, Bremen - Sem-Vox GmbH, Saarbrücken - Yocoy Technologies GmbH, Berlin

#### ► Key Figures 2015

- Annual Budget 2015: € 42.5 million
- Total Assets 2015: € 115.9 million
- Professional staff: 485
- Graduate student staff: 356

### Intelligent Solutions for the Knowledge Society

► 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, and branch offices in Osnabrück and St. Wendel. 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 eighteen research departments and research groups, eight competence centers and seven 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, 485 highly qualified researchers, administrators and 356 graduate students from more than 60 countries are contributing to more than 240 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, 98 staff members have been appointed professors at universities in Germany and abroad.

### CONTACT

 **Reinhard Karger M.A.**  
Corporate Spokesperson

 +49 681 85775 5253

 +49 681 85775 5485

German Research Center for  
Artificial Intelligence GmbH  
Campus D3 2  
66123 Saarbrücken, Germany

 [uk@dfki.de](mailto:uk@dfki.de)

 [www.dfki.de](http://www.dfki.de)



## Research & Development

### ► Research Departments and Research Groups

#### Kaiserslautern Site

- ▷ Prof. Dr. Prof. h.c. Andreas Dengel:  
Smart Data & Knowledge Services
- ▷ Prof. Dr. Paul Lukowicz:  
Embedded Intelligence
- ▷ Prof. Dr.-Ing. Hans Schotten:  
Intelligent Networks
- ▷ Prof. Dr. Didier Stricker:  
Augmented Vision
- ▷ Prof. Dr.-Ing. Dr. h.c. Detlef Zühlke:  
Innovative Factory Systems

#### Saarbrücken Site

- ▷ Prof. Dr. Josef van Genabith:  
Multilingual Technologies
- ▷ Prof. Dr. Antonio Krüger:  
Innovative Retail Laboratory, St. Wendel
- ▷ Prof. Dr. Peter Loos:  
Institute for Information Systems
- ▷ Prof. Dr.-Ing. Wolfgang Maaß:  
Smart Service Engineering
- ▷ Prof. Dr. Philipp Slusallek:  
Agents and Simulated Reality
- ▷ Prof. Dr. Dr. h.c. mult. Wolfgang Wahlster:  
Intelligent User Interfaces

#### Bremen Site

- ▷ Prof. Dr. Rolf Drechsler:  
Cyber-Physical Systems
- ▷ Prof. Dr. Frank Kirchner:  
Robotics Innovation Center (RIC)
- ▷ Prof. Dr. Joachim Hertzberg:  
Plan-Based Robot Control,  
RIC Branch Office Osnabrück

#### Project Office Berlin

- ▷ Prof. Dr. Christoph Igel:  
Educational Technology Lab
- ▷ Prof. Dr. Gesche Joost:  
Interactive Textiles
- ▷ Prof. Dr. Volker Markl:  
Intelligent Analytics for Massive Data
- ▷ Prof. Dr. Hans Uszkoreit:  
Language Technology

### ► Living Labs

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

Advanced Driver Assistance Systems Living Lab, Bremen Ambient Assisted Living Lab, Innovative Retail Lab, Robotics Exploration Lab, Smart City Living Lab, Smart Factory, smart office space

### ► Competence Centers

#### Coordination of research activities in particular areas

Ambient Assisted Living, Case-Based Reasoning, Deep Learning, Multimedia Analysis & Data Mining, Semantic Web, Safe and Secure Systems, Smart Agriculture Technologies, Wearable AI

## Scientific Excellence and Transfer

### ► International Scientific Advisory Board Bi-annual evaluation of publically funded projects

- ▷ Prof. Dr. Markus Gross, Eidgenössische Technische Hochschule Zürich (ETH), Switzerland, Chairman

### ► Leading-Edge Research

#### DFKI is the only German institute for computer science to participate in each of the three leading-edge research clusters

- ▷ Cluster of Excellence “Multimodal Computing and Interaction” funded by the German Research Foundation (DFG)
- ▷ Leading-Edge Cluster “Software Innovations for the Digital Enterprise” funded by BMBF
- ▷ European Institute of Innovation and Technology (EIT Digital)

### ► Networks of Excellence

At present, DFKI is a coordinator or core partner in two European Networks of Excellence

### ► Promoting Young Talent

DFKI is a founding member and core partner of the Academy Cube and the Software Campus to promote managerial talent in the IT industry

### ► Academic Chairs

98 former staff members have been appointed professors at universities in Germany and abroad

### ► Spin-offs

78 spin-off companies have created more than 2,500 highly skilled jobs

## Committees and Academies

### DFKI is represented by its scientific directors on numerous committees and academies

### ► Scientific and Government Committees

Big Data Value Association, Brazilian Institute of Robotics (BIR), Center of Innovation Program of the Japanese Ministry of Education (COI), Feldafinger Kreis, Management Board of the International Computer Science Institute in Berkeley, Münchner Kreis, National Institute of Informatics (NII, Tokio), Program Committee of the National Aeronautics and Space Research Centre DLR, Research Alliance of the German Federal Government, Steering Committee of the German Informatics Society (GI), and others

### ► Business Committees

Deep Sea Mining Alliance (DSMA), Governance Board of the Intel Visual Computing Institute, and others

### ► Scientific Academies

Academy of Sciences and Literature, Berlin-Brandenburg Academy of Sciences, European Academy of Sciences, German National Academy of Sciences Leopoldina, National Academy of Science and Engineering, Royal Swedish Academy of Sciences, and others

# INTELLIGENT SOLUTIONS FOR THE KNOWLEDGE SOCIETY

- ▶ INDUSTRIE 4.0 and Innovative Factory Systems
- ▶ Smart Data – Intelligent Analytics for Massive Data
- ▶ Wearable Computing and Interactive Textiles
- ▶ Knowledge Management and Document Analysis
- ▶ Softbots, Digital Assistants, and Chatbots
- ▶ Educational Technologies
- ▶ Development of Provably Correct Software
- ▶ Smart City Technologies and Intelligent Networks
- ▶ Information Extraction and Intelligent Web Retrieval
- ▶ Deep Learning
- ▶ Multiagent Systems and Agent Technology
- ▶ Multimodal User Interfaces and Language Understanding
- ▶ Visual Computing and Augmented Vision
- ▶ Mobile and Collaborative Robotic Systems
- ▶ Autonomous Systems
- ▶ Shopping Assistance and Intelligent Logistics
- ▶ Semantic Product Memories and Digital Twins
- ▶ Safe and Secure Cognitive Systems and Intelligent Security Solutions
- ▶ Ambient Intelligence and Assisted Living
- ▶ Driver Assistance Systems and Car2X Communications
- ▶ Cyber-physical Systems
- ▶ Multilingual Technologies



[www.dfki.de](http://www.dfki.de) | [info@dfki.de](mailto:info@dfki.de)

Kaiserslautern Site  
Trippstadter Straße 122  
D-67663 Kaiserslautern  
Phone: +49 631 20575 0

Saarbrücken Site  
Saarland Informatics Campus D 3 2  
D-66123 Saarbrücken  
Phone: +49 681 85775 0

Bremen Site  
Robert-Hooke-Straße 1  
D-28359 Bremen  
Phone: +49 421 17845 0

