Fraunhofer
IOSB

FRAUNHOFER INSTITUTE OF OPTRONICS, SYSTEM TECHNOLOGIES AND IMAGE EXPLOITATION

ANNUAL REPORT 2015/2016

ANNUAL REPORT
2015/2016

PREFACE

Prof. Dr.-Ing. habil.
Jürgen Beyerer

Dear Sir or Madam,

When faced with a technical problem for which there are established solutions, technologies or sophisticated products, one only has to find the right supplier and a competent integrator capable of solving the task cost-effectively and reliably.

If, however, a technical problem arises, for which a standard solution – let alone a suitable approach – has not yet been found, and for the solution of which the latest research results or even new research activities are required, then Fraunhofer, with its many specialized institutes, is the right address.

Fraunhofer IOSB is the first port of call for the fields of

- optronics,
- systems engineering, and
- image analysis.

With its extensive portfolio of competencies, IOSB is Europe's leading center of excellence in these areas.

But scientific and technical skills alone are not sufficient to guarantee the success of an application-oriented research institute. To be a successful innovator also takes an intimate knowledge of the industries and markets for which innovations with commercial value are to be created. Our scientific and technical competencies in the sectors and markets we serve cover the following five business segments:

- Automation
- Energy, water, and environment
- Visual inspection
- Security
- Defense

With the numerous positive results in 2014 and 2015 we again demonstrated our ability to meet the challenges presented by these fields of activity. All of IOSB's sites have undergone a remarkable commercial and scientific evolution, in terms of both quality and quantity. Personnel levels, budget, and business project volume, as well as economic results have reached record levels. The prospects for 2016 are also very promising.

An important challenge remaining for 2016 is to create a professorship for Optronics at the Faculty of Electrical Engineering and Information Technology of the Karlsruhe Institute of Technology (KIT). With this new Chair, the cooperation with another faculty of the KIT relevant for the IOSB will be institutionalized in addition to our existing collaboration with Informatics. In 2015 all necessary contracts between Fraunhofer and KIT have been signed and we hope to establish the chair of Optronics before the end of 2016.

As every year, we want to provide our readers with as comprehensive an insight into the work of our research departments as possible with this annual report. Because of the numerous exciting topics covered by the research and development work of our capable staff, we can all but offer a brief glimpse into our activities here.

Our special thanks goes to our partners and clients in business, in government and in the ministries, and to all of IOSB's sponsors and advisors. The support and cooperation of the federal ministries of Education and Research (BMBF) and of Defense (BMVg) are vital in enabling us to carry out our activities.

Our gratitude also extends to the employees of IOSB and their excellent work. Their expertise, skills, diligence and academic motivation is the cornerstone of our institute's success.

Dear readers, this report aims to provide you with an overview of IOSB, with a few deeper insights into typical projects and examples of our research work. We hope that we have succeeded in striking a good balance that makes for interesting reading and we would welcome your comments.

Karlsruhe, Ettlingen, Illmenau and Lemgo, March 2016

Prof. Dr.-Ing. habil. Jürgen Beyerer

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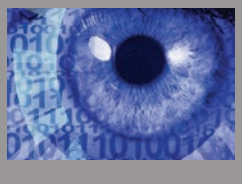


DEPARTMENTS PORTFOLIOS

Objectives

IOSB has the same mission as its parent, the Fraunhofer-Gesellschaft. Practical usability lies at the heart of all research activities of both institutions. With its research the IOSB seeks to advance technology-driven innovation; with market analysis it seeks to advance application-driven innovation; and in cooperation with research and industry partners it supports innovation in society and industry.

What makes the institute special is that it combines core know-how in optronics, system technologies, and image exploitation with application know-how gained through an extensive dialog with its partners.

Short portrait

Established on January 2010, the Fraunhofer Institute of Optronics, System Technologies and Image Exploitation IOSB grew to become Europe's largest research institute in the field of image acquisition, processing and analysis. IOSB's other areas of activity are control and automation technology, and information and knowledge management.

IOSB has four locations in Germany: Karlsruhe, Ettlingen, Ilmenau and Lemgo (highlighted on the map of the Fraunhofer Gesellschaft on page 23), as well as a representative office in Beijing.

The three core competencies of Optronics, System Technologies and Image Exploitation give the institute its distinctive profile. The field of **Optronics** represents the interface between electromagnetic radiation and electronic signals. It deals with converting information about the appearance of the environment and the objects it contains into electrical signals and electrical signals into optical images.

Image Exploitation covers conditioning and real-time processing of, and automatic and interactive information extraction from images and videos.

System Technologies, which represent a cross-section of expertise and are essential for responding to difficult, comprehensive issues with integrated solutions, may, at first sight, appear to be our most abstract field of research. It covers everything that is required for analyzing, gaining an understanding of, modeling, developing, and controlling complex systems.

IOSB comprises thirteen departments and one joint research group, with the Chair for Interactive Real-Time Systems of the Institute of Anthropomatics at the Faculty of Informatics

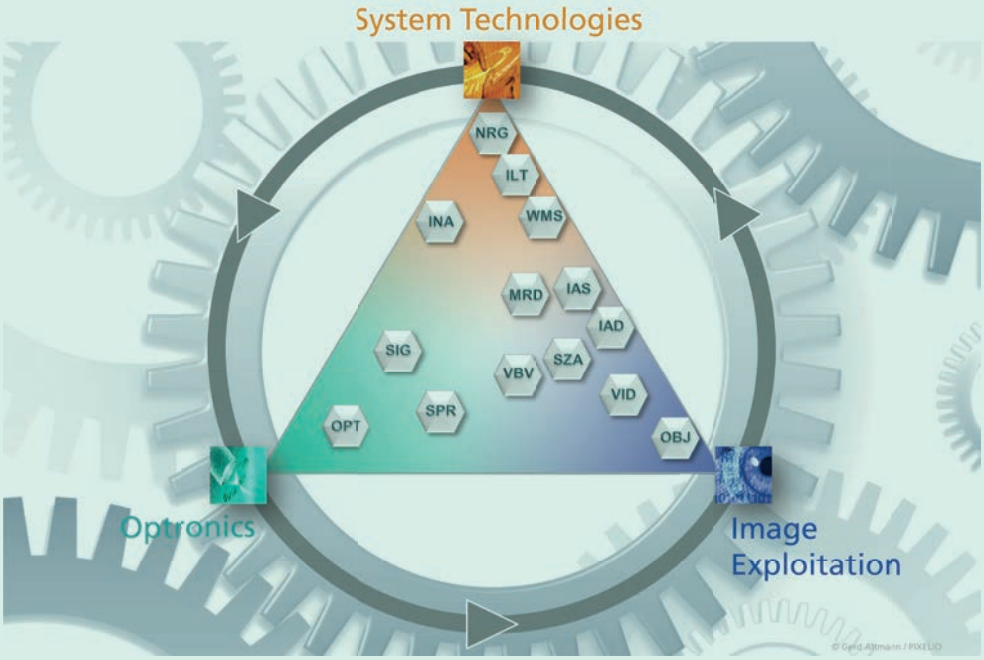


Figure 1

1 *The departments of IOSB and their relation to the core competencies optronics, image exploitation and system technologies.*

Optronics

OPT: Optronics
SIG: Signatorics
SPR: Visual Inspection Systems

System technologies

NRG: Energy
WMS: Water and Mobile Systems
ILT: Information Management and Production Control
INA: Fraunhofer Application Center Industrial Automation
MRD: Systems for Measurement, Control and Diagnosis

Image exploitation

IAD: Interactive Analysis and Diagnosis
IAS: Interoperability and Assistance Systems
OBJ: Object Recognition
SZA: Scene Analysis
VID: Video Exploitation Systems
VBV: Variable Image Acquisition and Processing (Research Group)

Director: Prof. Dr.-Ing. habil. Jürgen Beyerer				
KARLSRUHE	ETTLINGEN	ILMENAU	LEMGO	BEIJING
	Division Photonics and Optronic Systems	Advanced System Technology (AST) Branch of Fraunhofer IOSB	Fraunhofer Application Center Industrial Automation INA	Beijing Representative Office of IOSB
Departments: SPR, ILT, MRD, IAD, IAS, VID, VBV	**Departments:** OPT, SIG, OBJ, SZA	**Departments:** NRG, WMS	**Department:** INA	
	Head of division Dr. rer. nat. Reinhard Ebert	**Head of AST** Prof. Dr.-Ing. habil. Thomas Rauschenbach	**Head of department** Prof. Dr.-Ing. Jürgen Jasperneite	**Head of representative office** Dipl.-Ing. Hong Mu

of KIT. The Competence Triangle in Figure 1 illustrates the core competencies contributed by each of IOSB's departments.

With their various key areas, the departments of IOSB cover the entire process chain from signal acquisition through signal analysis to integration into operational systems.

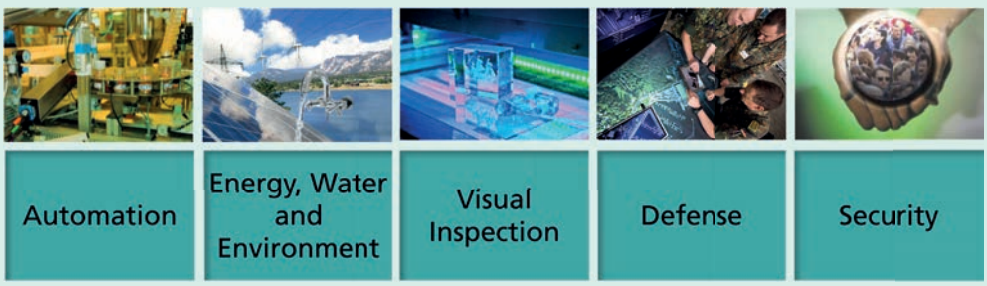
In practical use, systems interact with their environment. This, too, is reflected by the activities of IOSB, which cover all degrees of freedom required for effective system design.

The challenges on which IOSB focuses in its research and development work usually require the integration of a range of different scientific disciplines. Based on this awareness, our departments are positioned within the competence triangle in Figure 1. The abundance of our expertise gives us a great bandwidth of achievable goals. While finding solutions to our tasks requires sophisticated technologies to deal with the various subproblems, the creation of value and benefit requires a well-organized interplay of powerful components in a coherent whole.

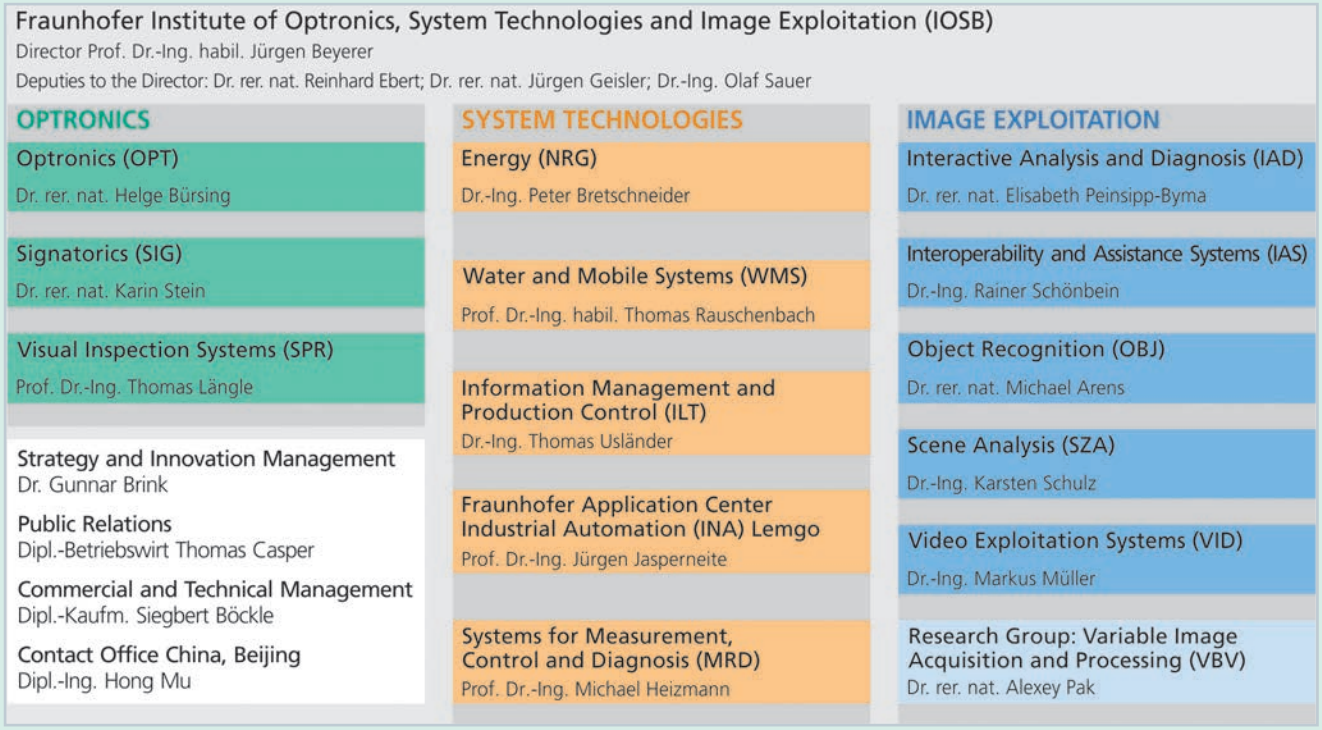
In order to leverage this potential, in-depth expertise in automation technology, system architecture, software engineering, network engineering, information and knowledge management, interoperability technologies and a systematic design of human-machine systems is required. Typical for problems beyond a certain degree of difficulty and complexity is that ideal solutions are not merely automatisms but rather human-machine systems, in which – in addition to hardware and software – the organization into an overall process is crucial.

In addition to its research and development activities, IOSB has systems evaluation and assessment capabilities. An example is IOSB's thermal range model software package TRM 4, with which the performance of the overall system – consisting of vision device and observer – is determined quantitatively. Based on the knowledge of all components and associated human capabilities, this software is used to assess systems based on technical features and laboratory measurements. With its unbiased evaluation competence, IOSB supports clients in planning and developing components and systems, in developing concepts and planning facilities, and in procurement.

Our business units unite the expertise of IOSB in its various markets. As well as calling for scientific and technology skills, best-of-class solutions also need in-depth industry knowledge. The five business units are listed in alphabetical order in Figure 2. Developing dynamically, they provide specific solutions, services and products tailored to the needs of their specific markets.



2 *Business Units of IOSB.*



3 *Organization chart Januar 2016.*

The departments participate in the business units according to the allocation of their activities to those markets.

Of great importance for IOSB are its close ties with the Karlsruhe Institute of Technology (KIT), which complements its research capabilities. With the Chair for Interactive Real-Time Systems at the Institute for Anthropomatics of the Faculty of Informatics, consulting activities of university chairs at IOSB, membership of university professors in the Board of Trustees, lecturing by IOSB staff and more, cooperation with the KIT is already multi-faceted.

An intensified collaboration with KIT in the research work at the Ettlingen site to sustainably integrate the entire range of IOSB's activities in the science region of Karlsruhe is also being planned. To this end a Chair in Optronics is to be established at the Faculty of Electrical Engineering and Information Technology of KIT.

At IOSB's Ilmenau and Lemgo sites the cooperation with the Technical University of Ilmenau and the University of East Westphalia Lippe has also been strengthened through professorships and is proving highly fruitful.

ORGANIZATION CHART

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Jürgen Beyerer

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Object Recognition
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Scene Analysis
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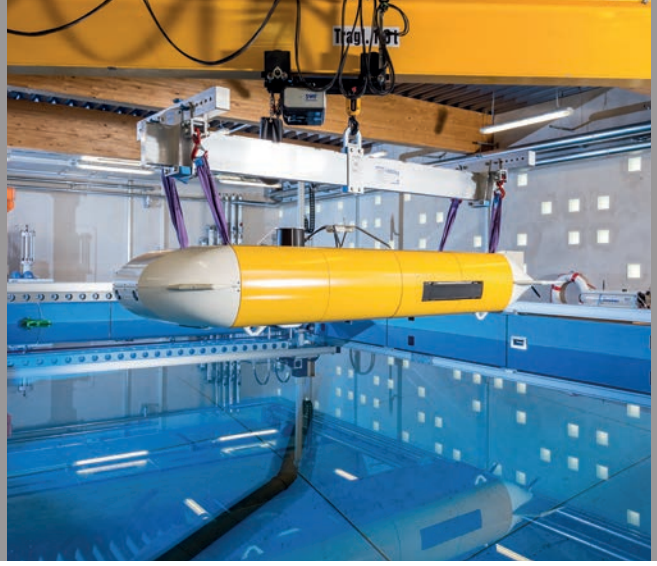
DEDAVE
Project Profile
Deep Diving
Autonomous Vehicle



Our test basin in Ilmenau enables experimenting, testing and optimising of underwater vehicles or robots.

The German government made a clear commitment to deep sea mining at the Maritime Conference 2015 in Bremerhaven. The deep sea must be measured and characterized in order to develop resources and reduce environmental pollution. In addition, thousands of undersea cables for communication and energy transport lie in the deep sea between the continents, and are regularly maintained and renewed about every 30 years. The route must be regularly mapped and monitored for this purpose. Marine research wants a better understanding of the unknown world of the deep sea with its ecosystems with totally unknown living creatures, the development of sediments, mineral deposits and rocks, sea volcanism and continental drift. Sea mines and bombs, sunken ships and steel containers, whose location is unknown, lie somewhere on the seabed and endanger construction and laying of cables, pipelines, oil-producing devices and other equipment. The bereaved and the public want to know where missing aircraft lie on the seabed of the deep sea.

There are thus many good reasons why there is a desire to map and research the unknown world on our doorstep. However, visible light has only a very limited range in seawater. Light and radio are not suitable for data transmission over medium and long distances in the sea. Divers can dive only to a depth of about 50m due to the high water pressure, while conventional submarines can descend only to a depth of a few hundred meters. Submersibles such as the Trieste, which already submerged to a depth in excess of 10,000 meters years ago, are extremely expensive and can only submerge and explore at one point. To be able to travel 20,000 leagues along the seabed like Captain Nemo in his submarine Nautilus, as described by Jules Verne in his famous, eponymous novel more than 150 years ago, remains technically impossible.

However, there is a good solution which nonetheless enables the seabed, the nature of the deep sea and technical equipment on the seabed to be observed and mapped, i.e. the sonar measurement techniques: These techniques are based on the fact that sound travels with a lot less loss under water than in the air. Sonar systems, which consist of a transmitter and antenna, can be attached to the ship's hull, towed vessels, remote-controlled robots and autonomous submersing and navigating platforms. A mother ship is always needed as an operating base.

It is easiest if the sonar system is attached to the ship's hull. However, the rise and fall of the waves disrupts the measurements. The sound is emitted from the transmitter across up to many thousands of meters and is intercepted again with antennas after reflection on the seabed. High sound pressure is required to measure objects at a distance of thousands of meters. However, sonar systems work at similar frequency ranges as the natural senses of marine mammals such as whales and dolphins. High noise exposure can scare and harm marine mammals.

It is not mammal welfare, however, that induces researchers and surveying

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Prof. Rauschenbach, DEDAVE project leader and Dr. Gunnar Brink, responsible for business development and marketing of the autonomous underwater vehicle.

This pressure chamber can generate a pressure of 1200 bar corresponding to 12 000 m ocean depth.

companies to mount their sonar systems to submersibles which submerge into the depths, and then travel at a few meters with a much lower energy sonar system over the area to be examined and record data, but the ideal combination of maximum measuring accuracy and resolution combined with a relatively high area coverage. Users complain, however, about the susceptibility to failure of the systems that are available on the market, which are often operational on less than 50 days of the year despite high prices of several million euros per system. To date, there are less than a handful of manufacturers of deep sea diving robots worldwide. None of these manufacturers have their corporate headquarters in the European Union.

This is where the DEDAVE project of the IOSB comes into play. DEDAVE has its rounded, rectangular cross section since all AUVs travel relatively slowly and because of its special „free-flooded" construction. Thus it differs from almost all other AUVs, which have the traditional torpedo shape. Due to its special design, the cargo area of DEDAVE acts like that of a space shuttle, and is tidier and can be used more flexibly. The space for this payload is much larger than that of our competitors. If there are better tools on the market in future, the customer will be easily able to update his AUV. Thus an investment in DEDAVE is expandable and future-proof. Researchers can thus also build and test devices that they have developed themselves. DEDAVE is smaller and more compact than the alternative products, thus even a quad system easily fits on one ship. Due to the high costs of the mother ship, the area coverage can thus be increased with little additional costs and the benefits can be multiplied.

Solid production planning and corresponding documentation were already being undertaken in parallel to the development of the DEDAVE prototypes. Incidentally, this use of quality tools such as „Advanced Product Quality Planning" was already awarded with the Quality Award of the Quality Initiative of Berlin-Brandenburg on September 17, 2015.

What are the next steps? In January 2016, a deep sea test will be conducted in the Atlantic Ocean by the research vessel „Poseidon" with the support of the major German research institute GEOMAR. Subsequent deep sea tests are planned by the PLOCAN test site in Gran Canaria. Once these tests are conducted, the plan is to establish a spin-off company which will already achieve the first sales of DEDAVE systems in 2016.

Does Fraunhofer want to compete with existing companies in Germany and the EU with its development of marketable products and the targeted formation of spin-off companies? We do not see ourselves as the better entrepreneurs. The DEDAVE project aims to explore new paths for introducing innovative technologies into the economy.

To date, the relevant manufacturers in Germany and the EU have not dared to invest in this future-oriented technology. Perhaps one of the reasons for this reluctance is the fact that the current actors, major companies like Kongsberg in Norway or Teledyne in the US, have tended to acquire start-ups, rather than develop the products in-house. Teledyne acquired the small Icelandic company GAVIA in 2010, Kongsberg purchased the spin-off Remus of the prestigious American research institute Woods Hole in 2007 for a remarkable purchase price. A third of the market-leading products with the brand name Bluefin is even manufactured and distributed by the research institute Battelle.

It seems as if small units in research institutes were the correct „incubator" for this type of system technology. Thus it is a normal path to innovation whereby the technology together with the customer base and market experience are acquired by one of the large corporations after an initial development phase in a research institute and spin-off. Fraunhofer also wants to benefit in future from this type of use of innovations and it is for this reason only that it is assuming an active, entrepreneurial role in the early phase of product and corporate development.

SmartFactoryOWL

A RESEARCH FACTORY FOR INDUSTRIAL AUTOMATION

A research factory is a manufacturing system, which is flexible and resource-efficient as well as adaptive to humans and can therefore be operated intuitively. It is a highly complex system consisting of technical components that even incorporate intelligence. We firmly believe that we will have smart factories soon. The paradigm of "Internet of Things" is making inroads on all areas of daily life: Whether in the home, in cars, in production, embedded systems are rapidly becoming our daily companions. Coffee makers, toasters, and even plants can "have their own voice" and be responsive. This hidden computer systems, which are connected to the internet are working to make users´ lives easier. In future production systems the plants control themselves and work pieces are able to advice the production system how they have to be processed. This makes production much more flexible and allowing mass customization. As part of the German governments´ high tech strategy the trend of merging production technology with information technology has been termed "Industrie 4.0" – the fourth industrial revolution. The technological platform at the core of Industrie 4.0 is the Internet of Things (IoT), which largely eliminates the distinction between the virtual and the real world.

Since 2009 the Fraunhofer Application Center Industrial Automation in Lemgo has been working specifically on ICT-based automation technologies to realize the factory of the future.

In 2015, as we continue to pursue the same objectivity, the proven research and demonstration platform "Lemgoer Modellfabrik" is evolving into an intelligent factory of the future. **SmartFactoryOWL.**

With a consistently modular design concept in terms of mechatronics, automation, and software, the most characteristics of a research factory – such as adaptability, plug-and-play-capability and ease of use – are demonstrated with augmented reality methods.

Located near the campus of the Ostwestfalen-Lippe University of Applied Science, the SmartFactoryOWL is both demonstration facility and learning environment for students of industrial and electrical engineering as well as of computer sciences. Small and medium-sized production companies have the opportunity to benefit from a batch production and training their personnel.

On a floor area of 2.000 m², intelligent automation solutions are explored, developed and tested. The research factory for Industrie 4.0 technologies is **an initiative of the Fraunhofer IOSB-INA and the OWL University of Applied Sciences.**

Our research factory – Nestled in the CIIT Research Campus.

20 YEARS OF SUCCESS IN THURINGIA AND NEW INSTITUTE BUILDING BY 2018

20 years Fraunhofer AST

The first Fraunhofer Institute in Ilmenau, the Fraunhofer IOSB-AST began in 1995 as application center with three permanent employees. Today, 100 employees work on projects with a total volume of more than 5 million euros, every third euro of which comes from industry. Since 1995, the Fraunhofer IOSB-AST has worked on over 800 industry and research projects.

The institute division's achievements have been honored in two celebratory speeches on September 17, 2015, by Professor Georg Bretthauer of the Karlsruhe Institute of Technology and in a review by Professor Thomas Rauschenbach, head of the Fraunhofer IOSB-AST.

Prof. Jürgen Beyerer, institute head of the Fraunhofer IOSB: "Since its foundation twenty years ago, the Fraunhofer IOSB-AST has continuously, firmly and sustainably developed into a highly visible and internationally sought-after research body, including in the fields of energy and water management and in underwater and dry land robotics. A new, modern building is essential for the further successful development of the AST and will motivate our researchers to new major achievements."

1 *Nearly 100 guests were welcomed to the jubilee.*

2 *Prof. Dagmar Schipanski and Prof. Jürgen Wernstedt were honored for their contributions to the Institute.*

3 *Dr. rer. nat. Reinhard Ebert, deputy director of the Fraunhofer IOSB, keeps his greetings speech.*

Construction of joint institute building to start in 2016

Scheduled for completion in October 2018, the new institute building in the "Am Vogelherd" business park in Ilmenau will provide the employees of both the Fraunhofer IOSB-AST and the DVT project group of the Fraunhofer IIS with joint research and conference facilities. As of summer 2016, office, laboratory and training rooms for up to 212 employees will be created here on four floors with a total area of 3400 square meters (36,600 sq.ft.). The property has a total area of 18,000 square meters (about 190,000 sq.ft.) and therefore offers plenty of space for an extension, should the need arise. Prof. Albert Heuberger, head of the Fraunhofer IIS, and Dr. Reinhard Ebert, Deputy Head of Fraunhofer IOSB, presented the plans for this building to the public on September 17, 2015. The estimated construction cost is € 25 million.
Prof. Reimund Neugebauer, President of the Fraunhofer-Gesellschaft: "The performance and number of employees of the Applied System Technology branch of the Fraunhofer IOSB have witnessed positive growth in the past 20 years. The new building, in which the Wireless Distribution Systems project group of the Fraunhofer Institute for Integrated Circuits and Fraunhofer IOSB-AST will be housed, will further strengthen the cooperation potential between the researchers."

4 *Thuringian Minister of Economy, Science and the Digital Society, Wolfgang Tiefensee, Prof. Reimund Neugebauer, President of the Fraunhofer-Gesellschaft, Corporate Policy and Research Management, Technology Marketing and Business Models, and Prof. Thomas Rauschenbach, head of the Fraunhofer IOSB-AST and Prof. Giovanni Del Galdo, head of the project group DVT / Fraunhofer IIS (From left to right), at the launch of the new institute building in Ilmenau.*

Photos: Christoph Gorke

IT SECURITY LAB FOR INDUSTRIAL CONTROL SYSTEMS AT HANNOVER MESSE 2015

IOSB established an IT security lab for industrial control systems in 2014, which specializes in networking and the application of Internet technologies in the factory of the future (Industrie 4.0). This IT security lab was demonstrated at Hannover Messe 2015 and attracted great attention from representatives from politics and industry. Federal Minister of Education and Research Prof. Dr. Johanna Wanka as well as European Commissioners Elżbieta Bieńkowska and Günther Oettinger were informed about potential IT security problems in production systems.

IOSB experts showed vulnerabilities in networked industrial control systems which arise from misconfiguration of security means in PLCs of widespread use. Live hacking of these inadequately secured systems which operated a simulated production line gave detailed insight in potential damage.

Combining IOSB's expertise in automation, control and IT security the multidisciplinary team provides its customers with tailored solutions from a single source. Current work concentrates on new security technologies for networked industrial control systems and solutions that allow the operator to observe the security state of its assets (security monitoring) as well as extraction of knowledge about processes from process execution logs (Process Mining). Particular aspects are security measures of OPC Unified Architecture (OPC-UA) and anomaly detection using machine learning based network analysis.

1

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1 *EU Commissioner Elżbieta Bieńkowska.*
2 *Federal Minister Prof. Dr. Johanna Wanka and President of the Fraunhofer-Gesellschaft Prof. Dr. Reimund Neugebauer.*
3 *EU Commissioner Günther Oettinger.*

Security research and the testing of new security technologies and products are carried out in an integrated environment comprising physical components like PLCs and network equipment from different manufacturers as well as virtualized components especially used for MES systems and analyzing functions. Using cloud technologies IOSB experts are able to reconfigure network topologies at the click of a mouse.

Cloud based networking functions also drive the connectivity of further labs residing at other locations of IOSB (Lemgo, Ilmenau). Active vulnerability analysis and passive network packet analysis can be performed remotely over highly secured internet links. This network integration enables multi-site supply chain settings, combined software functions comprising different locations and deeper analysis of cloud based functions. Future activities will handle security aspects of public and private cloud based services for the Industrial Internet and the Internet of Things.

Being a member of the Industrial Internet Consortium IIC and the OPC Foundation IOSB is directly involved in standards and reference architectures.

CONTACT OFFICE CHINA, BEIJING

1 *An underwater vehicle for water quality monitoring at the Nanjing Hydraulic Research Institute.*

Many German companies have discovered China as an attractive market for itself. However, these companies often need local partners also in applied research. Due to a long-term cooperation with several research institutes and industrial partners in China, Fraunhofer IOSB established a representative office in Beijing as early as in 1996.

The focus of the representative office is the initiation of research activities focused in the areas of environment and energy. Especially in the field of water supply and water resource management Fraunhofer IOSB is involved in many R&D projects in China.

2014 and 2015 were very successful years for the cooperation with China. We could acquire several projects with partners in China. Some examples are shown following:

- solutions for the automation of harness production,
- condition monitoring for wind turbines,
- Development of four remotely operated underwater vehicles (ROVs) for water quality monitoring and observations of aquacultures.

As part of the funding program „International Partnerships for Sustainable Technologies and Services for Climate Protection and the Environment" (CLIENT), the research project „HAPPI" (Small Hydropower Plants: Assessment of Climate Protection Potential and Improvement by Smart Technologies) could be successfully continued. A region in Yunnan province was chosen for the application of the research results. In October 2015 a conference of this project was organized in order to present the research results. The Fraunhofer president, the president of the China Institute of Water Resources and Hydropower Research, delegates from the Ministry of Water Resources and the Economic Department of the Embassy of the Federal Republic of Germany and all project partners took part.

Another major water project, the EU project INAPRO (Innovative model and demonstration based water management for resource efficiency in integrated multitrophic agriculture and aquaculture system) could be continued.

The competence of Fraunhofer IOSB in the field of Industry 4.0 is highly estimated from Chinese researchers and companies. That's why several training courses were organized in Germany.

Furthermore, the exchange of scientists between China and Germany could be strengthened: Visiting professors of the China Agriculture University, delegations from the China Institute of Water Resources and Hydropower Research and from the Beijing Research Institute of Telemetry could be welcomed to Germany. Prof. Rauschenbach was appointed as adjunct professor of the Hohai University in Nanjing.

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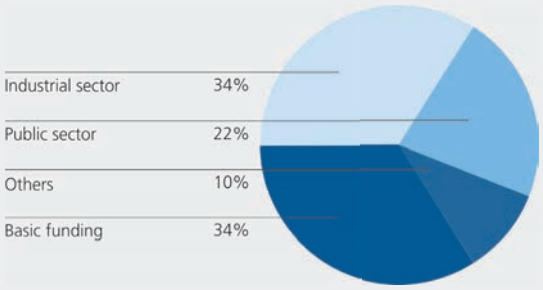
The development of IOSB continues to be positive and we are expanding organically furthermore.

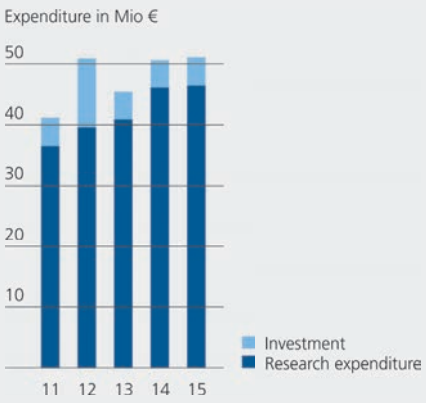
In addition to our permanent staff we also engaged 180 student assistants and interns.

* The diagram does not include research and business activities concerning defense.

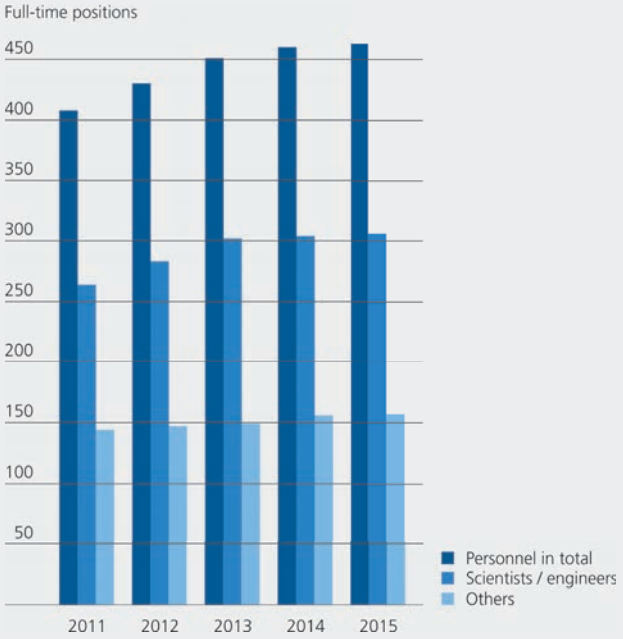
*Funding**



Business expenses



Staff



FRAUNHOFER-GESELLSCHAFT

Research of practical utility lies at the heart of all activities pursued by the Fraunhofer-Gesellschaft. Founded in 1949, the research organization undertakes applied research that drives economic development and serves the wider benefit of society. Its services are solicited by customers and contractual partners in industry, the service sector and public administration.

At present, the Fraunhofer-Gesellschaft maintains 66 institutes and research units. The majority of the nearly 24,000 staff are qualified scientists and engineers, who work with an annual research budget of more than 2 billion euros. Of this sum, around 1.7 billion euros is generated through contract research. More than 70 percent of the Fraunhofer-Gesellschaft's contract research revenue is derived from contracts with industry and from publicly financed research projects. Almost 30 percent is contributed by the German federal and Länder governments in the form of base funding, enabling the institutes to work ahead on solutions to problems that will not become acutely relevant to industry and society until five or ten years from now.

International collaborations with excellent research partners and innovative companies around the world ensure direct access to regions of the greatest importance to present and future scientific progress and economic development.

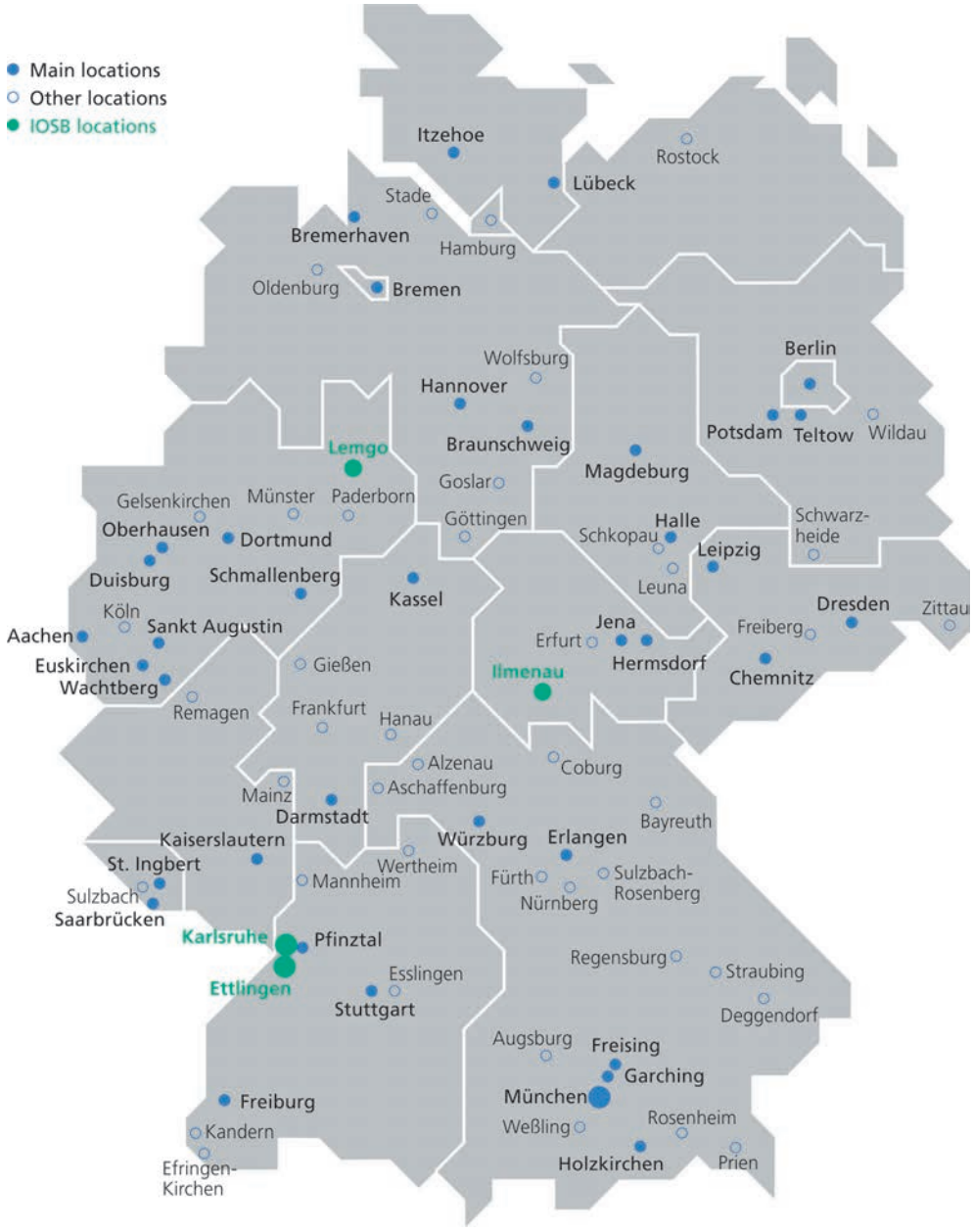
With its clearly defined mission of application-oriented research and its focus on key technologies of relevance to the future, the Fraunhofer-Gesellschaft plays a prominent role in the German and European innovation process. Applied research has a knock-on effect that extends beyond the direct benefits perceived by the customer: Through their research and development work, the Fraunhofer Institutes help to reinforce the competitive strength of the economy in their local region, and throughout Germany and Europe. They do so by promoting innovation, strengthening the technological base, improving the acceptance of new technologies, and helping to train the urgently needed future generation of scientists and engineers.

As an employer, the Fraunhofer-Gesellschaft offers its staff the opportunity to develop the professional and personal skills that will allow them to take up positions of responsibility within their institute, at universities, in industry and in society. Students who choose to work on projects at the Fraunhofer Institutes have excellent prospects of starting and developing a career in industry by virtue of the practical training and experience they have acquired.

The Fraunhofer-Gesellschaft is a recognized non-profit organization that takes its name from Joseph von Fraunhofer (1787–1826), the illustrious Munich researcher, inventor and entrepreneur.

more at:
www.fraunhofer.de

Locations of the Fraunhofer Institutes in Germany



more at:

www.standortkarte.fraunhofer.de

THE FRAUNHOFER GROUP FOR DEFENSE AND SECURITY (VVS)

Besides the Federal Ministry of Education and Research (BMBF), the Fraunhofer-Gesellschaft has, ever since its formation, also been committed to the Federal Ministry of Defense (BMVg), its services accounting for the largest part of the Ministry's institutional research by far.

For their prosperity and growth, our developed industrial societies are already highly dependent on tightly intermeshed vital infrastructures, a large-scale disturbance or even destruction of which harbors the potential for incalculable damage to society and the economy. Ever fuzzier boundaries between internal and external security, and between public and private safety in view of current phenomena, such as international terrorism, transnational organized crime, and the sometimes global repercussions of local natural disasters and major incidents furthermore present the institutions responsible for national security with unprecedented challenges.

Especially the requirement profiles of modern defense systems have highly escalated over the past few years. Due to both the nature and extent of the German armed forces' new foreign deployments and the increased connectivity of sophisticated infrastructures, the factors of time and resource utilization are becoming ever more important. The response to today's often asymmetrical threats must be both quick and precise; at the same time, the required systems must become ever lighter, more flexible and, ideally, cheaper.

In the Fraunhofer Group for Defense and Security (Fraunhofer-Verbund für Verteidigungs- und Sicherheitsforschung VVS), seven institutes and three guest institutes have joined forces to unite their skills and to coordinate and implement their research activities in the field of "Defense and Security". In order to recognize the wide range of possible risks early, preempt them as far as possible and minimize consequential damage if they do arise, the Group develops comprehensive technological security solutions and associated methodical, procedural and tactical concepts.

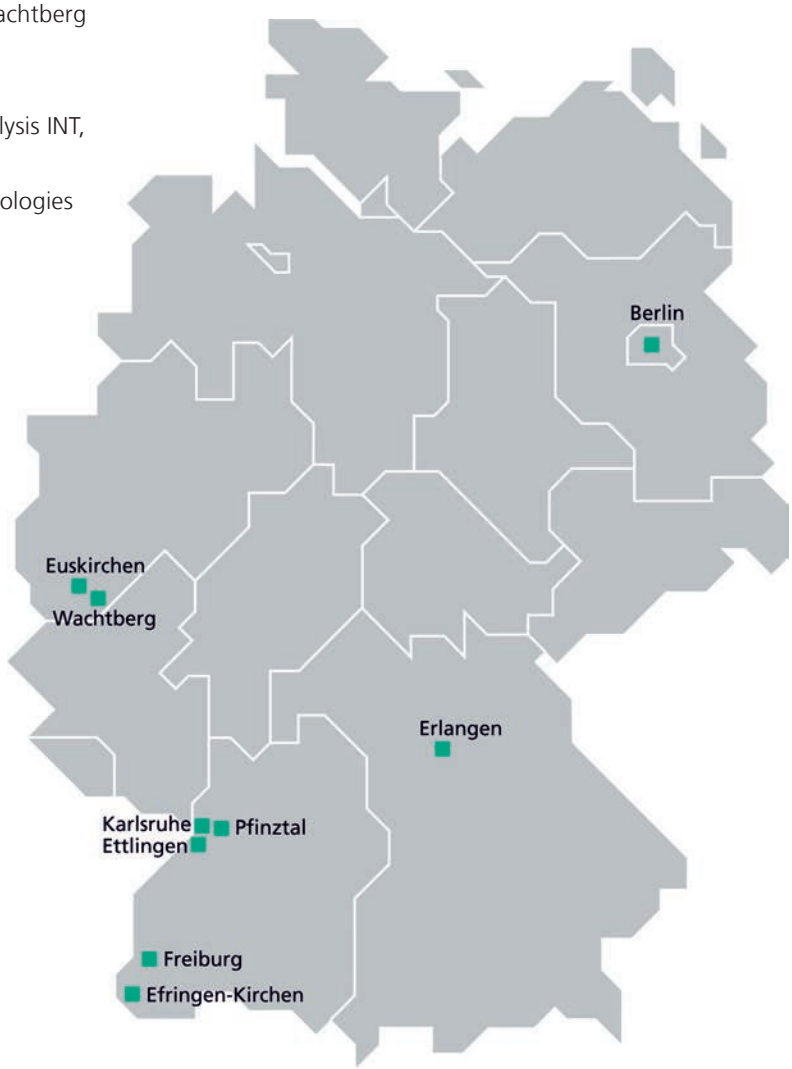
As of January 1, 2015, head of institute Prof. Dr.-Ing. habil. Jürgen Beyerer is the Group's chairman of the board of directors and therefore also a member of the presidential council of the Fraunhofer-Gesellschaft. Deputy chair of the Group is Prof. Dr. Peter Martini, director of the Fraunhofer Institute for Communication, Information Processing and Ergonomics (FKIE). New managing director of the VVS is Caroline Schweitzer.

Members

- Fraunhofer Institute for Applied Solid State Physics IAF, Freiburg
- Fraunhofer Institute for Chemical Technology ICT, Pfinztal
- Fraunhofer Institute for High Frequency Physics and Radar Techniques FHR, Wachtberg
- Fraunhofer Institute for Communication, Information Processing and Ergonomics FKIE, Wachtberg
- Fraunhofer Institute for High-Speed Dynamics, Ernst-Mach-Institut EMI, Freiburg
- Fraunhofer Institute for Technological Trend Analysis INT, Euskirchen
- Fraunhofer Institute for Optronics, System Technologies and Image Exploitation IOSB, Karlsruhe

Guest Institutes

- Fraunhofer Institute for Integrated Circuits IIS, Erlangen
- Fraunhofer Institute for Telecommunications, Heinrich-Hertz-Institut HHI, Berlin
- Fraunhofer Institute for Systems and Innovation Research ISI, Karlsruhe



IOSB IN FRAUNHOFER GROUPS

Fraunhofer Information and Communication Technology Group

Fraunhofer IUK-TECHNOLOGIE

As the largest ICT research group in Europe, the Fraunhofer Information and Communication Technology Group serves as a one-stop shop for industrial customers and media enterprises

The strengths of the member institutes are pooled strategically and marketed jointly. This network makes it possible to translate application-oriented research into customized, integrated solutions for a specific sector:

- tailored IT solutions
- competent consulting on technological issues
- pre-competitive research for new products and services

Regular economy summits unite the right partners from industry and research. The Fraunhofer Information and Communication Technology Group evolves strategies and visions for medium-term priority research areas, providing its member institutes with assistance in the transfer of technology and the marketing of their research activities. The ICT Group also publishes the economy magazine »InnoVisions«, which is available at the kiosk.

Business areas:

- *Digital media*
- *E-Business*
- *E-Government*
- *Communication systems*
- *Energy and Sustainability*
- *Medicine*
- *Production*
- *Security*
- *Financial service provider*
- *Automotive*

Contact at IOSB:

Prof. Dr.-Ing. habil. Jürgen Beyerer

Fraunhofer Group for Defense and Security

Fraunhofer VVS

This group has been formed by Fraunhofer institutes as a means of coordinating their research activities and defining common goals in the area of »Defense and Security«. The chief objective of the group is to agree on common strategies vis-à-vis government funding agencies and to promote collaboration with these institutions and with the defense industry. Furthermore, the members of the group intend to align their research strategies with the requirements of the projected unification of European defense and security policy.

The group aims to maintain its traditional combination of research fields with civil and military applications, because it represents a valuable source of innovation and technological progress, to the benefit of all parties. It will continue to exploit this factor as a competitive advantage in both markets. The member institutes of the group, which engage in both civil and defense research, thus have an important role to play in the transfer of knowledge. They ensure that any significant breakthrough in research funded by non-military sources will be used to benefit defense technology, and vice versa.

Business areas:

- *Security research*
- *Protection and deterrence*
- *Reconnaissance and surveillance*
- *Explosives and safety engineering*
- *Decision-making support for government and industry*
- *Localization and communication*
- *Image processing*

Chairman of the Board of Directors:

Prof. Dr.-Ing. habil. Jürgen Beyerer

Managing Director:

Dipl.-Ing. (FH) Caroline Schweitzer

Fraunhofer Group for Production

Fraunhofer PRODUKTION

The Fraunhofer Group for Production is a cooperative venture by a number of Fraunhofer Institutes, created with the aim of collaborating on production-oriented research and development in order to be able to offer customers in the manufacturing, commercial and service sectors comprehensive single-source solutions derived from the pooling of the wide-ranging expertise and experience of the individual institutes. The Fraunhofer Group for Production makes use of the latest findings in industrial engineering and information science to offer a range of services that covers the entire product life cycle or value chain.

Business areas:

- *Product development*
- *Manufacturing technologies*
- *Manufacturing systems*
- *Production processes*
- *Production organization*
- *Logistics*

Contact at IOSB:

Dr.-Ing. Olaf Sauer

IOSB IN FRAUNHOFER ALLIANCES

Fraunhofer AutoMOBILE Production Alliance

Fraunhofer AUTOMOBIL

Carmakers, their suppliers, and those equipping the automotive industry, represent a decisive economic factor in Germany. Significant changes to the entire concept of mobility are ultimately being driven by global trends, such as dwindling natural resources, an increasing need for mobility, urbanization and megacities. In addition, German carmakers and their suppliers are facing increasingly tough competition as the trend towards low-cost vehicles takes hold.

The Fraunhofer Alliance pools the expertise of 18 institutes, who collectively provide the German automotive industry with a competent single-source partner for its research and development needs. The complementary effect achieved by combining the individual institutes' key areas of research, makes it possible to generate rapid, integrated and sustainable innovations along the entire process chain of vehicle manufacturing – from the planning stage right through to the finished vehicle. The Alliance tackles the challenges posed by environmental policies (reducing fuel consumption and CO_2; electromobility; cutting material consumption) while taking full account of commercial imperatives (ongoing pressure to cut costs).

Business areas:

- *Production research for electromobility*
- *Methodological competence (logistics, planning, quality assurance)*
- *Vehicle body*
- *Powertrain*
- *Electrical/electronic systems*
- *Interior*
- *Assembly/vehicle final assembly*

Contact at IOSB:

Dr.-Ing. Olaf Sauer

Fraunhofer Embedded Systems Alliance

Fraunhofer EMBEDDED

Complex technological products generally contain embedded systems: computers that monitor, regulate and control various functions. Embedded systems are very much at the heart of high-tech devices in the automotive industry, in mechanical and plant engineering, in medical technology or in home electronics.

The complexity and capabilities of these systems have grown to such an extent in the course of their technological development that they are now beyond the competencies of any one field. In response, Fraunhofer has created the Embedded Systems Alliance, bringing together the expertise of those Fraunhofer Institutes whose combined competencies in the fields of information technology, electronics and engineering cover the entire spectrum of embedded systems.

Business areas:

- *Materials and components*
- *Numerical and experimental methods*
- *Electronics and control technology*
- *Systems*

Deputy Spokesperson of alliance:

Prof. Dr.-Ing. Jürgen Jasperneite

Contact at IOSB:

Prof. Dr.-Ing. Andreas Wenzel

Fraunhofer Energy Alliance

In the Fraunhofer Energy Alliance nineteen Fraunhofer Institutes join their expertise in energy technologies and energy research, with the aim to give research and development from one hand to industry and energy economy.

The alliance co-operates with the Fraunhofer networks Microenergy Technology, Wind Energy, Direct-Ethanol-Fuelcell and Smart Grids.

The Alliance's work is chiefly focused on: Renewable energy sources (solar energy, biomass, wind power); energy-efficient technologies (fuel cells, combined heat and power (CHP) systems and gas delivery, building-service technologies, power electronics); buildings and components (low-energy-houses, building energy technology); smart grids (p.e. systemtechnological net integration of distributed generators; electrical energy storage and micro-energy systems (lithium battery technology, fuel-cell systems).

Business areas:
- *Renewable energy sources*
- *Energy-efficiency technologies*
- *Buildings and components*
- *Intelligent energy nets*
- *Energy storage*

Deputy Spokesperson of alliance:
Dr.-Ing. Peter Bretschneider

Contact at IOSB:
Dr.-Ing. Peter Bretschneider

Fraunhofer Food Chain Management Alliance

Food Chain Management (FCM) focuses on the chain of food manufacturing as an integral process-extending from the primary production via processing and trade until it reaches the consumers.

The aim is to analyze and optimize these processes in order to finally supply consumers with qualitatively spotless food as efficiently and reliably as possible.

The Fraunhofer »Food Chain Management« Alliance aims at introducing latest scientific know-how in new products and solutions of this field by means of mutual projects. For this purpose, the platform Food Chain Management of the Fraunhofer Gesellschaft shall merge the expertise of all partners, i.e. a total of 10 institutes.

Thematic areas:
- *Food chemistry*
- *Food packaging technology*
- *Logistics*
- *Microsystem technology*

Contact at IOSB:
Dipl.-Ing., Dipl.-Wirt. Ing. Henning Schulte
Prof. Dr.-Ing. Thomas Längle

Fraunhofer Vision Alliance

The Fraunhofer Vision Alliance combines the expertise of institutes in the field of image processing.

The main office in Fürth serves as the initial point of contact for customers. This office is also responsible for the coordination of joint projects. The allianced institutes offer services relating to applications of innovative sensors, from infrared to x-ray, plus the associated handling apparatus. Their work focuses particularly on optical sensing and automated inspection processes for quality assurance.

Business areas:
- *Industrial image processing*
- *3D surveying*
- *Thermography*
- *X-ray technology*
- *Surface inspection*
- *Medical engineering*
- *Safety engineering*
- *Traffic engineering*
- *Terahertz imaging*
- *Computer tomography*

Contact at IOSB:
Prof. Dr.-Ing. Michael Heizmann
Prof. Dr.-Ing. Thomas Längle

Fraunhofer Water Systems Alliance

In the Fraunhofer Water Systems Alliance (SysWasser) eleven Fraunhofer Institutes have been pooling their expertise in the research and development of effective water infrastructure systems and technology.

The alliance's objective is to take sustainable solutions for water catchment, infrastructure, and wastewater treatment and adapt them for use in practical applications on a national and international level, taking into consideration the relevant social, economic and environmental implications.

The use of an integrated, systemic approach linking the energy, waste management and agricultural sectors will contribute towards a more efficient and environmentally compatible usage of water as a life-essential resource.

Business areas:

- *Urban/periurban water management systems*
- *Processes and systems for the supply with drinking and service water*
- *Wastewater treatment processes and systems*
- *Integrated water resource management (IWRM)*
- *Analysis and evalutation of water-economic systems*

Contact at IOSB:

Prof. Dr.-Ing. habil.
Thomas Rauschenbach

Fraunhofer Space Alliance

Bringing together 15 institutes, the Fraunhofer Space Alliance conducts applied research in the field of industrial space technology. Weather forecasts, navigation, real-time transmission for satellite TV or global Internet access – space industry applications and services have become an indispensable part of daily life, underpinning the importance of space technology for a modern industrialized society. In the Fraunhofer Space Alliance, the institutes pool their technological expertise in order to provide the industry and funding agencies such as the European Space Agency (ESA) and the European Commission with a central contact.

Fraunhofer acts as systems provider, developing a wide range of top-quality components, integrating them into an overall system and delivering that system to the customer. The sheer technological variety of the participating institutes enables the Fraunhofer Space Alliance to offer its customers a unique range of services. Its business units are Communication and Navigation, Materials and Processes, Energy and Electronics, Surfaces and Optical Systems, Protection Technology and Reliability and Sensor Systems and Analysis.

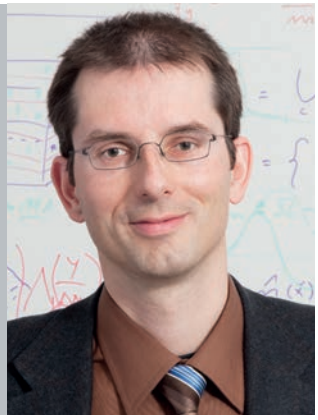
Business areas:

- *Communication and Navigation*
- *Materials and Processes*
- *Energy and Electronics*
- *Surfaces and Optical Systems*
- *Protection Technology and Reliabilty*
- *Sensor systems and Analysis*

Contact at IOSB:

Dr. rer. nat. Dipl.-Phys. Karin Stein
Dipl.-Ing.(FH) Caroline Schweitzer

AUTOMATION



Spokesperson
Prof. Dr.-Ing. Michael Heizmann
Phone +49 721 6091-329

Business Unit Development
Dr.-Ing. Olaf Sauer
Phone +49 721 6091-477

Real-time ICT for complex manufacturing processes

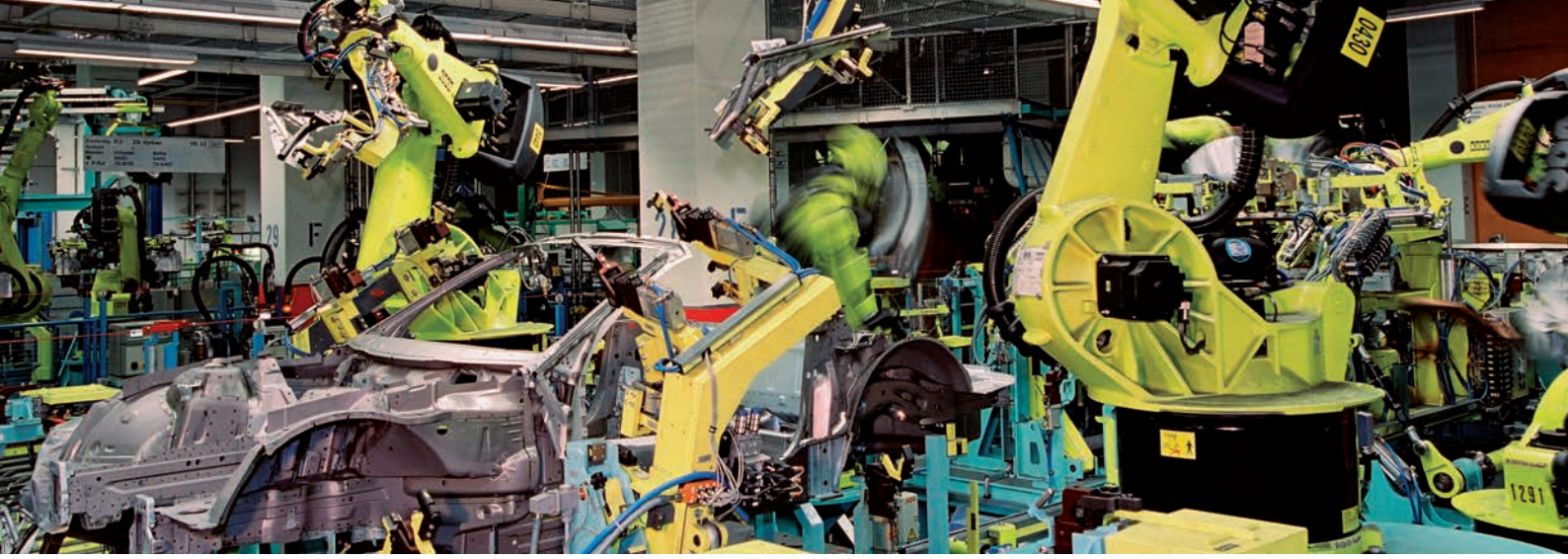
Automation technology is a key factor for the competitiveness of the German manufacturing industry. Automation – and particularly industrial information technology – also plays a major role in the current debate about cyber-physical systems and the Internet of Things: Information and communication technology (ICT) penetrates all devices, machinery and equipment in production, on all hierarchical levels, ranging from sensors and machine components, machines and their controls to interlinked plants and their visualization across operations by means of monitoring and control technology. Industrial ICT has to fulfill high standards, which result from competitive production costs, high equipment availability, required product quality and guaranteed delivery times. Mechanical engineers, computer scientists and automation experts must therefore cooperate more closely than ever to meet future requirements. That is what the team of the Automation Business Unit stands for.

To date, ICT in production technology has been based on the architectural model of the automation pyramid. Owing to increasing ICT support on all hierarchical levels of the factory, however, there seems to be a new trend according to which the information flow in factories follows a new "reference model of industrial information technology". This model takes account of three dimensions of information flow, namely vertical and horizontal integration, and integration spanning the entire life cycle of production equipment.

When it comes to enabling shop-floor-related ICT systems to communicate consistently within the three aforementioned dimensions, for example, it is necessary to connect them systematically with the systems of the digital factory (life cycle dimension) and with automation technology on the control and field levels (vertical integration). To this end, it is indispensable to use unified, general syntax and semantics.

Specifically, the activities of the Automation Business Unit focus on the following areas:

1) Production monitoring and control technology and MES: Monitoring and control systems become increasingly important for transparent and safe production. We consider control technology to be a fundamental part of today's manufacturing execution systems.
2) Adaptive information technology: Adaptivity is one of the key requirements for the factory of the future – not just in physical terms, but increasingly in terms of software, too. Our current activities in the field of Secure Plug&Work are ground-breaking in this respect.



3) Industrial Smart Grids: We deal with the challenge of energy management in manufacturing operations. To this end, our specialists make use of the principles of smart grids, including the integration with the smart grids of energy providers. We combine our expertise in energy management and suppliers' energy data management with long-term experience in monitoring production plants on behalf of energy consumers.
4) Process intelligence and quality improvement: We use state-of-the-art monitoring and control technology as well as condition monitoring to improve plant performance and availability in the process and manufacturing industry.
5) Industrial communication: It is our vision to create an internet for machines and "things" in general in manufacturing, making real-time information available on all levels of a distributed automation system in the required quality and allowing devices to be integrated on the basis of standardized Plug&Work principles.
6) Robot systems: This area focuses on activities relating to the control of autonomous and partly autonomous robots and vehicles, acting as individuals, in groups and in cooperation with human beings.

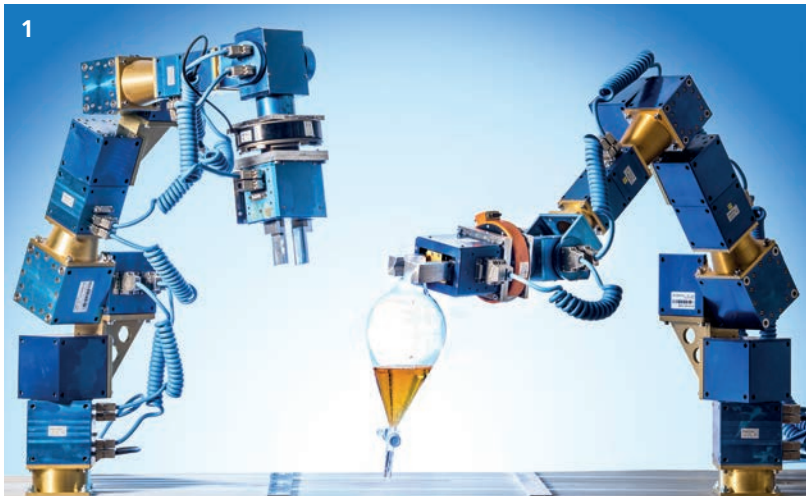
Equipment / laboratory facilities

- Model factories at IOSB Karlsruhe and at the Fraunhofer Application Center Industrial Automation (INA) in Lemgo
- IT security lab for industrial production
- ProVis test bed
- Automation test bed including PLCs, communication, and monitoring and control systems
- Tools for online fine planning and scheduling for discrete manufacturing (ProVis.APS)
- OPC and OPC UA simulation
- AutomationML™ test center
- Virtual commissioning laboratory including PLCs, WinMOD, and Delmia Automation
- Test installation to demonstrate interoperability and adaptivity
- Design and simulation tools for engineering and testing micro-electronic IPs in the field of real-time communication
- Network-based data loggers for process and system diagnosis
- Autonomous robot platforms
- Intelligent Energy Systems research platform at the sub-institute of Advanced System Technology (IOSB-AST)
- ICT energy laboratory at the sub-institute of Advanced System Technology (IOSB-AST)

References / product highlights

- ProVis.Agent® integrated monitoring, control and reporting system for car body, paint and assembly shops of the Bremen and Wörth plants of Daimler AG
- Integration platform in the press shop of the Bremen plant of Daimler AG
- ProVis.Agent® monitoring and control system for Thyssen Krupp Steel AG, Duisburg
- Various interoperability tools based on CAEX and OPC UA
- ProDaMi: suite containing data mining tools for decision support in manufacturing
- Condition monitoring for Bayer Technology Services GmbH, Leverkusen
- PROFINET single-chip solution for Phoenix Contact, Blomberg and Siemens AG, Nürnberg
- Various projects relating to Industry 4.0

1 *Cooperative handling of sensitive objects.*



PLUG AND WORK – CURRENT STATUS

Solution components for interfaces in industrial automation

In Industrie 4.0, intelligent plant components, machinery and equipment, and IT systems are connected with each other. Every component of the factory is aware of the relevant 'partners' and their characteristics. As a matter of fact, there are various heterogeneous software systems on every level of the factory today Most of these have proprietary interfaces that must be adjusted or re-programmed manually to account for every change. They are thus cost-intensive and error-prone.

Basic idea for interoperability in manufacturing IT:

Changes in software may

- result from embedded software in field devices connected via the field bus, e.g. in sensors, actuators, drives, or valves.
- affect the controlling software of machinery and equipment, e.g. programmable logic controllers (PLCs)
- be associated with the information technology above the level of the immediate equipment controls (manufacturing execution systems – MES).

Our efforts are aimed at ensuring PLUG and WORK compliance in the shopfloor-related software components consistently across the various levels of the manufacturing hierarchy. To achieve this, we use open standards currently used in industry. We are already able to export configuration data from devices and equipment, convert it to a standardized format, and thus provide all the relevant information for the automated configuration of monitoring and control systems and their visualization. The automated engineering of control systems even includes the generation of process control images with all relevant connectivity information. To this end, we use CAEX (Computer Aided Engineering Exchange) and/or AutomationML and OPC UA. A 'companion standard' of the two organizations (OPC Foundation and AutomationML e.V.) describes how an AutomationML model can be converted into the information model of an OPC UA server. Currently, these technologies are being enhanced in cooperation with industrial partners. The SecurePLUGandWORK (www.secureplugandwork.de) project focuses on ensuring that only authorized participants (components, machines, and IT systems) can connect with the production system and that the communication of the capabilities is encrypted to prevent spying.

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Semantic solution components

Originally designed as an exchange format for engineering data, AutomationML™ was enhanced by the partners of the AutomationML Association from science and industry. It is now a powerful description format and has been standardized internationally (IEC 62714). AutomationML is an open standard, which means that it is immediately available to any organization free of charge. We use AutomationML for the self-description of devices, machinery and equipment and of controls and network components, broken down into products, processes and resources. This includes the geometry and kinematics of the objects in a factory, their logic and behavior as well as logical and physical interfaces. A higher-level AutomationML model integrates the individual models. It visualizes the interaction between factory, lines, equipment, topology and the integration in the plant network.

Communication solution components

OPC Unified Architecture (OPC UA) presents a modern and powerful communication standard, which is becoming more and more widespread in the manufacturing industry around the globe. Standardized as IEC 62541, it provides interconnected information models end enables event-driven communication between servers and clients of industrial information technology. OPC UA includes future-oriented IT security mechanisms, ensuring that data can be shared between multiple sites. Models created for planning purposes, e.g. AutomationML, can be converted into an OPC UA information model on the basis of the joint "companion specification" of the AutomationML Association and the OPC Foundation. The fact that OPC UA is scalable down to the chip level and thus applicable in embedded system has been proved at our Centrum Industrial IT (CIIT), where the TPS-1 tiger chip has been developed. The Internet of Things thus appears to be within reach.

more at:
www.plugandwork.fraunhofer.de

Project execution

Dr.-Ing. Miriam Schleipen,

Robert Henßen,

Dr. rer. nat. Michael Okon,

Dr.-Ing. Olaf Sauer

Literature

[1] Schleipen, M.; Hensen, R.; Damm, M.; Lüder, A.; Schmidt, N.; Sauer, O.; Hoppe, S.: OPC UA and AutomationML – collaboration partners for one common goal: Industry 4.0. AutomationML User Conference, Blomberg, 2014

[2] Schleipen, M.; Sauer, O.; Wang, J.: Semantic integration by means of a graphical OPC Unified Architecture (OPC UA) information model designer for Manufacturing Execution Systems. In: Sihn/Kuhlang (Ed.), Sustainable Production and Logistics in Global Networks. 43rd CIRP International Conference on Manufacturing Systems, 26-28 May 2010, Vienna: Neuer Wissenschaftlicher Verlag, pp. 633-640

1

SAFE PHYSICAL HUMAN-ROBOT INTERACTION

To enable physical human-robot interaction in which humans and robots share a workspace and interact, robots must be equipped with capabilities for guaranteeing human safety: they must recognize potential collisions with human co-workers and react pre-emptively by adapting their motion to avert dangerous situations. They should furthermore be capable of directly interacting with humans, for example to hand over objects. Such capabilities are being developed and applied to a mobile manipulator in an industrial scenario at the Fraunhofer IOSB.

Task

In current production lines, human and robot workspaces are strictly separated and safety is guaranteed, for example, by fences or light curtains. If a human nevertheless enters the robot's workspace, the robot stops moving immediately. Many future applications, conversely, can benefit from shared workspaces and close physical human-robot interaction. To meet this challenging task, a demonstrator for safe physical human-robot interaction has been installed at the Fraunhofer IOSB laboratory. In this demonstration setting, a mobile platform equipped with a robot manipulator can supply various human workplaces with parts or tools and perform standard assembly tasks (see Fig. 1), while human workers perform complex assembly tasks in the same workspace as the robot. Both situations of unintended interaction, e.g. a human crossing the robot's path, and situations with intended interaction, e.g. the robot handing parts to a human can occur in this setting.

To allow such a human-robot interaction, robots must be capable of avoiding undesired collisions with humans while executing their task. The robot workspace must therefore be monitored by multiple sensors to gather information about the robot's environment. Based on this information, collision-free robot motions must be planned, with the robot continually reacting to unforeseen dangerous situations by adapting its planned motion, slowing down or stopping.

Workspace Monitoring

In order to detect obstacles in the robot's surroundings and to prevent collisions of the robot, the workspace is monitored by multiple depth sensors mounted on the robot, which deliver distance information about the measured objects, such as laser scanners or depth cameras.

By fusing the information from multiple depth sensors, dynamic obstacles, such as humans are tracked using a 2½D grid map, so that the obstacles' position and velocity can be estimated (see Fig. 2). Based on this estimation, possible collisions with dynamic objects can be detected.

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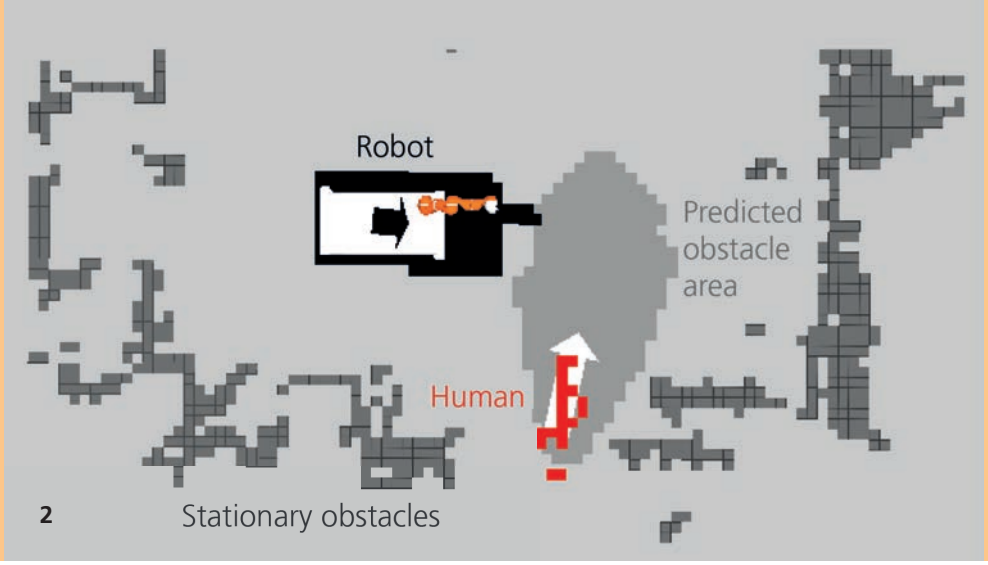

2 Stationary obstacles

3

Additionally, in the robot's immediate vicinity, a 3D obstacle representation is computed that contains not only the space that is currently occupied by the obstacles but also the space that is occluded by the obstacles and cannot be seen by the sensors. With this representation, a conservative estimation of the distance between robot and obstacles is possible. This is particularly important when an obstacle is located between the robot and the sensor, so that the sensor cannot see how close the obstacle comes to the robot.

Path planning and adaptation

In order to accomplish its planned tasks, the robot must move to the required goal positions without colliding with any stationary or moving obstacles or humans in its workspace. The goal positions are typically specified as Cartesian workspace positions, whereas the robot motion must be described by a path in the high-dimensional joint space. The path planning algorithms handle platform and manipulator joints in a uniform way so that an overall optimization of the path is possible. To obtain collision-free paths, the planners consider both a map of the stationary obstacles and the dynamic obstacles observed by the monitoring modules. During robot motion, the distance to obstacles is monitored continuously. If the path is obstructed by an unexpected obstacle, the robot prevents a collision by either slowing down or adapting its path to perform evasive motions. Path adaptation is performed by the elastic band method, which ensures a smooth avoidance path.

Physical Interaction

Physical interaction encompasses both interaction with objects (tools, parts, etc.) and interaction with human co-workers. When grasping an object, the position and shape of the object is normally not exactly known. The robot is therefore equipped with a depth camera mounted near the gripper to estimate the object's position and shape. Interaction with humans occurs, for example, when the robots hands over an object to a human (see Fig. 3). This interaction is controlled by measuring the force in the robot joints resulting from the human grasping the object. In this context, it is important to distinguish between intended and unintended interactions. For example, objects to be grasped by the robot may no longer be considered as obstacles to be avoided by the monitoring algorithms.

Conclusions

The described research has largely been conducted within the project SAPHARI (Safe and Autonomous Physical Human-Aware Robot Interaction) funded by the European Commission's 7th Framework Programme (grant agreement ICT-287513).

By integrating the monitoring, planning, and interaction control components, the task of grasping, placing and delivering objects to humans in a shared workspace could be demonstrated.

1 *Sensor-based grasping.*
2 *Obstacle tracking in a 2½D grid map: estimated velocities (arrows) and predicted motion of a walking person.*
3 *Force triggered handing over of an object to a human co-worker.*

Customer

EU

Project execution

Dr.-Ing. Christian Frese,
Dipl.-Ing. Angelika Zube,
Dipl.-Ing. Christian Frey

Literature

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1

ACTIVITY RECOGNITION IN THE CAR INTERIOR

Driver and Passenger Assistance Systems of Tomorrow

Modern cars are becoming more and more independent of the driver. However, as long as cars are not fully autonomous a degree of responsibility remains with the driver. With current systems this is handled by restricting the driver, for example by requiring that the hands remain on the steering wheel. This is not comfortable because it gets boring with time. For this reason a car driving autonomously needs to assess the situation in its interior. Current research therefore focusses on observing the passengers with cameras to deduce their actions and activities to remove current restrictions.

Introduction

Intuitive human-machine interaction solutions allow for safe and comfortable mobility. Minimizing usage barriers motivates active participation in everyday activities. In light of enhanced driving automation systems, demographic changes demand appropriate age-, user- and situation-based designs and compositions of human-machine interfaces within the car's interior. In ambiguous situations, in which both car and driver may intervene, or in which a gradual handover between the two has to take place, sensors currently installed in series cars (as for example touch-sensitive grips on the steering wheel) reach their limits for deducing the driver's overall focus of attention unambiguously and accompanying prepared-ness to take over driving responsibility. In order to predict the possibility of sideline activities, along with their individual durations, and account for this eventuality in a corresponding handover adjustment control, comprehensive observations about the activities within the car's constraints have to be achieved. These observations must not solely take the driver into account, but also factor in interactions between all car occupants, objects of interest, and overall individual activities that define the predominant situation within the car.

Approach

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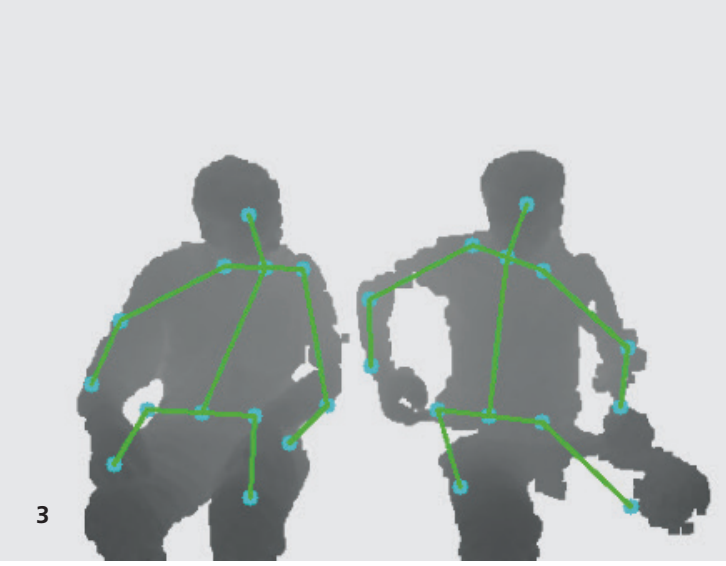
A camera- and video-based observation of the car's interior and its occupants allows a passive recognition of these events. Without the need for the observed people to explicitly interact with the measuring sensors (as for example by keeping their hands on the steering wheel at all times), their freedom of movement is not restricted in any way and natural and uninhibited interactions and behaviors can be taken into account from the very beginning. With increasingly reliable sensor measurements that cover all possible challenging conditions whilst driving – such as drastic changes in lighting, unpredictably occurring shadows and



1 *Body pose estimation in the car interior.*
2 *Body part labels estimated by machine learning algorithms.*
3 *Joint Positions determined from the body part labels.*

darkening of the interior, occlusions due to the restricted constraints within the car, and limited sensor placement possibilities – a growing tendency, at least for a partial equipment of the interior with camera-based sensors can already be observed today. The accompanying consumer and user acceptance emerging from the beneficial and innovative interfaces, such as gesture-based interaction or fatigue recognition systems, furthers an understanding of a complete observational sensor setup spanning the car's entire interior. Several research projects and framework programs aiming for intelligent mobility and driver assistance developments are furthering this understanding also from different perspectives.

The role of the Fraunhofer IOSB

For many years, the Interactive Analysis and Diagnosis department at Fraunhofer IOSB has been working closely together with the cv:hci-lab at Karlsruhe Institute of Technology, to implement and enhance the camera-based perception of humans in smart environments. With a recently acquired driving simulator, the already ongoing work of transferring the recognition of humans and their activities into the car's interior will play a key role in the strategic orientation of future research activities. Well-developed perceptual components, such as person detection, face identification, age and gender classification, articulated body posture recognition along with accompanying hand and pointing gestures, and attention tracking by means of eye gaze analysis and head pose estimation are therefore to be evaluated further and deployed in a homogenous sensor and recognition system architecture for use in smart driving assistance systems. In part, these technologies are already in use in the BMBF-funded research project InCarIn – Intelligent Car Interior, in order to provide the necessary recognition base for incorporating context knowledge into personalized and situation-aware human-machine interfaces and proactive assistance services.

Conclusion

The camera-based analysis of human intentions, interactions, sideline activities, and physiological handicaps promises exciting possibilities for both innovative and intuitive user interfaces, adapted to individual users' needs. With the relevance of comprehending the activities and preoccupations of all car occupants and within the entire interior's environment, safety and comfort benefits will be achieved and deployed for all.

ENERGY, WATER AND ENVIRONMENT

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Mission and vision

The nexus of sustainable and affordable energy, secure access to clean drinking water and effective environmental protection must be better understood and managed through the provision of tools, models and methodologies to exchange and process data. This is fundamental for the development of solutions meeting the needs of future markets. Fraunhofer IOSB offers integrated ICT systems, consulting services, and development of prototypes to industrial clients and public authorities that approach the problem from a holistic point of view. They cover the whole spectrum from sensor systems, systems modeling, and systems analysis to knowledge-based process optimization with a wide range of methods and sophisticated algorithms. An example for this is the energy market solution EMS-EDM PROPHET® that supports utility companies and system operators with varied and complex tasks in a liberalized market environment. In the fields of water management as well as environmental information and early-warning systems our business unit offers customized ICT applications for the private and public sectors. The objective is to provide integrated solutions that are flexible and can also adapt to individual constraints, such as those of service oriented architectures (SOA) and standard interfaces of the "Internet of Things and Services". Beside the close collaboration with industry, the business unit sees itself as a technology driver for future topics of intelligent energy systems, the Water-Energy-Food Nexus, Smart Cities (Smart Buildings and Water Infrastructures) and Integrated Water Resources Management (IWRM) in numerous national and international research projects.

Markets

The target groups of the business unit Energy, Water and Environment range from utility companies through communal water suppliers to governmental institutions, with a current focus on the German and European market. This business unit draws on projects with industrial and public partners in China, Colombia, Israel, Mongolia and Turkey, as well as on European research projects in the fields of environmental risk management, early warning systems and environmental monitoring. In the medium term the importance of international markets for this business unit will grow. Impulses are expected not only from Asia and the Middle East, but also from the USA, where a contract for the optimization of the hydropower plants at the Columbia River was acquired from Bonneville Power Administration (BPA) in 2014.

The market of innovative environmental information systems is served by the product suite WaterFrame®, which is installed in many German federal states (Länder) for communal and

governmental use. WaterFrame® is being extended according to customer needs to support standards of the Open Geospatial Consortium (OGC) compliant with the requirements of the Group on Earth Observations (GEO) and Infrastructure for Spatial Information in the European Community (INSPIRE). It is complemented by WebGenesis® for knowledge- and Web-based information systems.

The business unit's portfolio is complemented by its know-how in the field of maritime system technology, which is specialized in the guidance of underwater vehicles for automated inspection of underwater infrastructures and for water quality monitoring.

Laboratory and test facilities

ICT Energy Lab: energy and energy data management, virtual power plants, operational management of island and area networks

Intelligent energy systems research platform: micro grids, operational management strategies, storage management, automated metering, intelligent distribution networks, electric mobility

Maritime systems research platform: 250 m³ water volume, lorry access capability, energy and data interface, rail system for object placement

Smart City / Smart Building living lab: Internet of Things (IoT) technology, wireless sensor/actuator networks, smart control algorithms, data analytics

Environmental sensor network INSENSUM: based upon OGC Sensor Web Enablement standards

Product highlights

- EMS-EDM PROPHET® – energy and energy data management
- HydroDyn – network simulation solution for water and gas
- WaterDemand – water supply forecasting
- WebGenesis® / WaterFrame® – environmental information system for government agencies (environmental portal, specialized information offers, information systems for ground water, surface water and drinking water)
- Thematic information system for the Integrated Rhine Program

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- natGAS AG
- Nanjing Hydraulic Research Institute
- Spacebel, Belgium
- Stadtwerke Bielefeld GmbH
- Stadtwerke Marburg GmbH
- SWE Energy GmbH & SWE grid GmbH
- TenneT TSO GmbH
- The German Federal Institute of Hydrology (BfG)

1 *The topics of the Business Unit Energy, Water and Environment.*

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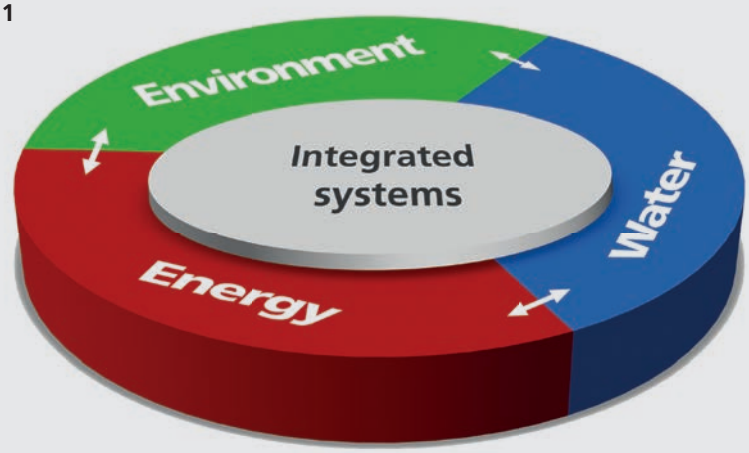

BAES 2 – ANALYSIS OF NEEDS FOR ENERGY STORAGE – EFFECTS OF SPATIAL DISTRIBUTION OF POWER GENERATION APPARATUS AND ASSESSMENT OF ENERGY BALANCING TECHNOLOGY

With nearly 40,000 MW of installed wind power capacity as well as 38,000 MWp of installed PV capacity, Germany already has a considerable power plant complex of fluctuating renewable energies. In 2014, every fourth generated kilowatt hour in Germany – in total around 157 TWh – came from renewable sources, turning renewable energy from a niche product into a dominant force on the energy market. The political targets go a lot further: By 2050, renewable energy is to cover at least 80 percent of the total energy produced in Germany. This has the effect of increasingly pushing system integration by means of grid expansion and flexibility options into the focus of research.

Supported by:
Federal Ministry for Economic Affairs and Energy
on the basis of a decision by the German Bundestag

Task

Predecessor research project BAES 1 already saw the development of models capable of determining the energy balance requirements for 146 regions in Germany, taking into account the restrictions imposed by the transmission grid. In BAES 2 the aim is to focus on the downstream medium- and low-voltage grid structures, i.e. to regard not only the horizontal balance over the transmission grid but also the vertical energy balance demand across multiple grid levels. Furthermore, it will be investigated to what extent the installation location of renewable energy generators and energy compensation options will impact the overall energy balancing requirement.

Project description

Within the framework of BAES 2, selected power generators (wind, photovoltaics and biomass) that can be used to assess the influence of the location will be defined. In the next step, Fraunhofer UMSICHT will determine the influencing factors and characteristics of energy balance options (different storage types and load displacement) and their locations. The 146 regions defined in BAES 1 are then grouped into categories with similar compensation requirements and a representative region is selected for the two most important categories.

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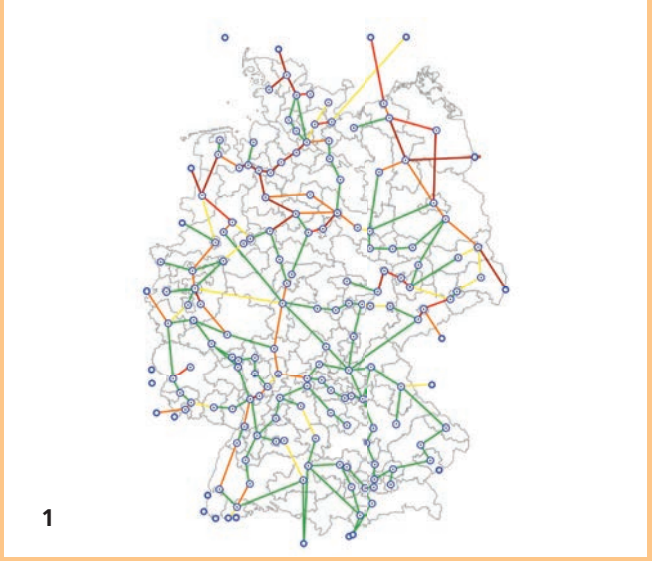

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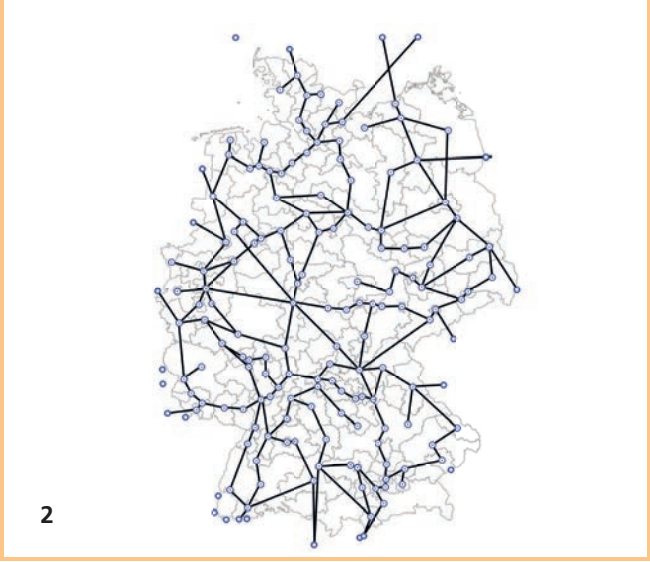

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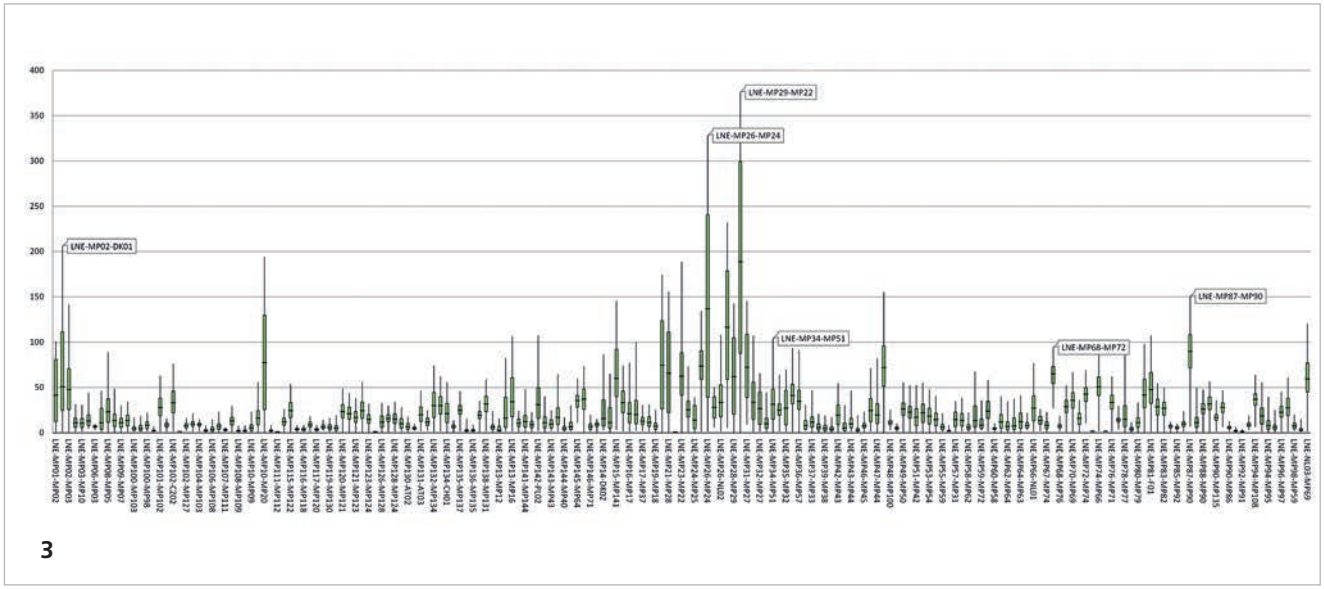

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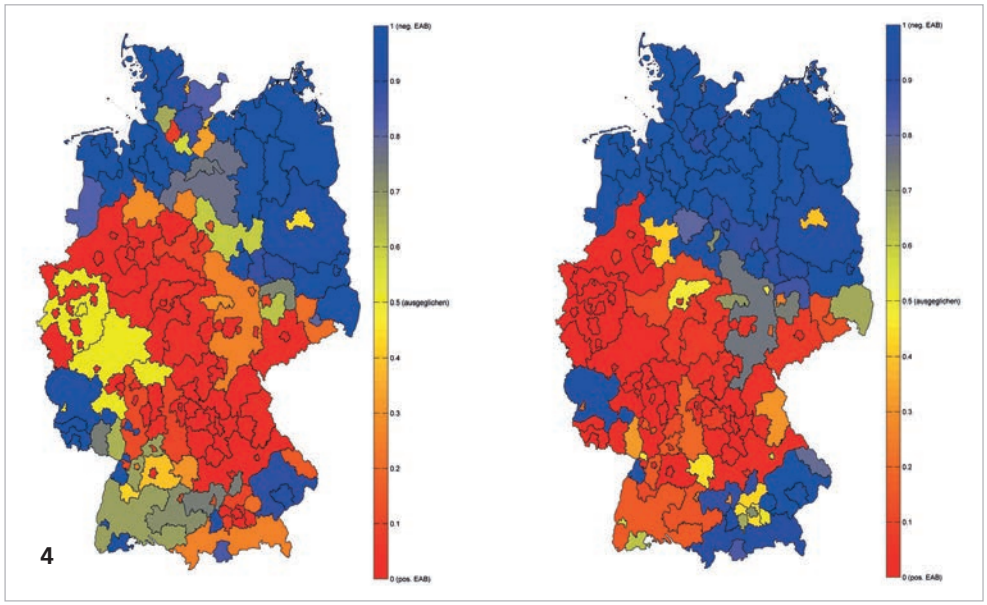
Finally, the impact of the locations of power generators and the implementation of energy compensation options on the overall energy balance requirement can be estimated based on the simulation results.



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1 *Shows the thermal loading of the cables in the transmission grid at any given time.*

2 *Illustrates the structure of the abstract transmission grid model based on the 146 individual regions.*

3 *Wire loading values for the reference year 2030.*

4 *Forecasted energy balancing requirements in 2030 and 2050.*

Partners

Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT

Fraunhofer UMSICHT

General project management

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1

KLARA – SMALL AUTONOMOUS MOVING AND HANDLING AID

In many companies, manufacturing and assembly processes require lifting and carrying of loads. These areas are therefore particularly relevant for occupational health and safety. Currently, many people cannot be employed in manufacturing and assembly processes since they belong to the group of people who cannot be expected to handle heavy loads. To provide these employees with the ability to participate in this area of activity and to minimize the risk of chronic skeletal health problems, it is necessary to reduce the strain of lifting and handling heavy objects. Many aids already exist for moving heavy loads. Not so, however, for small loads up to 50 kg: existing tools are used mainly in areas with relatively rigid work-flows, which largely excludes flexible usage of these aids.

Sponsored by:

Federal Ministry of Education and Research

Objective

In project KLARA, a personal, versatile lifting and moving aid for loads of up to 50 kg is being developed. Rather than replacing employees in production, the aim is to provide employees with an intelligent "sidekick". To be able to perform this task, the KLARA platform must have the following capabilities:

- Free navigation and automated driving
- 3D environment detection
- Recognition, picking up and lifting of small loads
- Simple, intuitive and personalized operation for specific tasks

Concept

The main task of Fraunhofer AST consists of the development of tasks related to navigation, which are implemented as a system of "embedded hardware modules". A task is therefore the development of an automatic navigation system with scalable assistance and sensor-based environment detection for reliable mission guidance based on lidar scanners and 3D sensor technology. The navigational aspects encompass sensor data preprocessing and fusion as well as automatic mapping. With the Gesture Move & Drive system, approaches to gesture-based control of the KLARA platform will be incorporated in the project.

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2

1 *Assembly area for manual wheelchairs of Otto Bock Manufacturing GmbH.*
2 *Storage space of Otto Bock Manufacturing GmbH.*

Technology

Positioning is being developed on the basis of the Simultaneous Localization and Mapping (SLAM) technique, which, in a learning phase, generates a sensor-based map of the environment, with which the KLARA platform can identify its location at any time in operation. The process for industry-capable use is being further developed in the KLARA project. In particular, in contrast to the state of the art, "learning" of the map is to take place largely automatically. Inexpensive 3D sensors will be used for positioning. The entire data processing chain is implemented with a distributed architecture of embedded, heterogeneous computer components. These modules are based on ARM or DSP processors and form a flexible modular network that can be easily adapted to various industrial requirements and enables a high reusability. Unlike standard PC hardware, the computer units are exceptionally small and energy-saving, so the solution has a high usability potential from both a technology and an economic perspective. Data processing is specifically optimized for this purpose and utilizes the Robot Operating System (ROS) to achieve an open architecture that is capable of further development.

Partners

- Götting KG (project coordinator)
- Otto Bock Manufacturing GmbH
- TU Ilmenau

General project management

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Prof. Dr.-Ing. Andreas Wenzel

Literature

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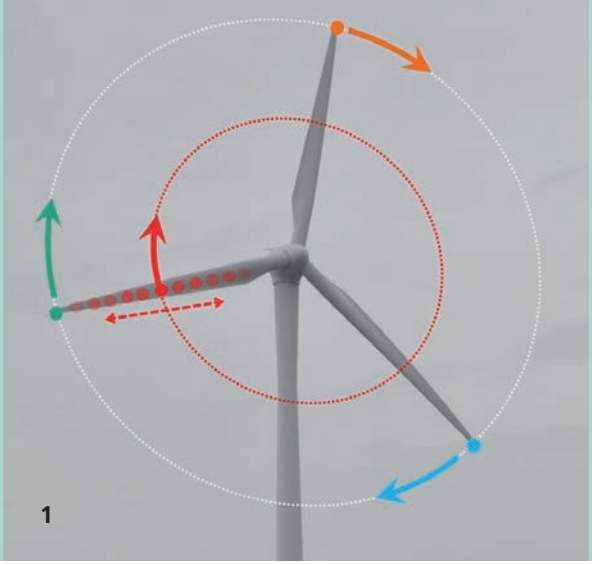

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LASER DOPPLER VIBROMETRY ON ROTATING WIND TURBINE BLADES

Sponsored by:

Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety

on the basis of a decision by the German Bundestag

Developing a System Demonstrator

The analysis of the vibrations of wind turbines is of great interest for maintenance and development purposes. Fraunhofer IOSB is developing a measuring system with which the vibrations of a wind turbine can be measured at a distance of 200 to 300 meters. The special focus of the project is on surveying the vibration of the spinning rotor blades during operation. The challenges consist in the development of a laser Doppler vibrometer suitable for measuring a moving object, and a tracking method capable of detecting the rotor's motion and controlling the pan-tilt head the vibrometer is mounted on.

Task

In operating wind turbines, maintenance and repair represent a significant cost factor. Downtimes resulting from the need for this work must be minimized and failures caused by unnoticed faults prevented. A key contributor to the load on the installation and to material fatigue is the plant's unavoidable vibration. Changes in the vibration characteristics can provide evidence of possible hidden damage. In productive operation, condition monitoring systems with sensors on the powertrain and, increasingly, also in tower and rotor blades are therefore used to collect vibration data. Especially in the blades, sensors can be installed only in selected, fixed positions during the blades' production. If these fail in operation, they cannot normally be replaced.

To overcome these limitations the present project aims to develop a method for measuring the vibrations of a wind turbine at a distance with high spatial resolution and completely independently of the power plant itself. The main effort that is addressed in the project is to examine the vibrations of the rotor blades while the wind turbine is under operation.

Result

We have developed a system that meets these demands. It consists of a laser Doppler vibrometer (LDV) mounted on a pan-tilt unit (PTU) that is controlled by a camera-based tracking system. The PTU is actuated to drive the laser spot of the LDV along with the rotor movement and stabilizes it on a user-set position on the blade. This will facilitate non-contact vibration measurement during regular operation from a distance of up to 300 m. Thus, the vibration

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pattern of the blade for a broad spectral range (~0.1 Hz to ~10 kHz) can be acquired point by point within a few rotor turns.

A scale model of a wind turbine that meets the real-life requirements regarding angles and dynamics was built in the laboratory. It was used in particular as test arrangement for implementing the tracking and pan-tilt unit control algorithms. Beside that it was used to demonstrate the resulting concept demonstrator at CeBIT in 2014.

Project description

The first task was to isolate the rotor from the background in the camera image. Different optical bands were discussed for this purpose, from the visual spectrum up to the thermal infra-red. Based on different tests it was decided to use a short wave infra-red camera that is also able to register the spot of the LDV to observe the wind turbine. Dedicated real-time software was developed that identifies the rotor and the laser spot of the LDV within the camera image. Due to the latency inherent in data processing and in the pan-tilt head's control system, the blade position had to be predicted for a brief period in the future. To this end, a dynamic 3D parameter model of the rotor is generated and continually updated from the detected blade tip positions. The actual position of the laser spot is compared to the desired target position. The deviation is fed back to the pan-tilt head controller as correction factor to compensate the slight distortions caused by the camera optics, parallax error, hard-to-compensate inertia and torque effects of the substructure, and other factors.

An LDV was developed that works at a laser wave-length of 1.5 µm. Thus a considerably higher output power is still eye-safe and allows a measurement distance of several hundred meters. The heterodyne concept of the LDV is adapted to compensate the motions of the PTU and optimized for measuring vibrations of objects that exhibit macroscopic movements relative to the LDV.

The system is still under development. In the next step it will be adjusted for recording vibration data of a real wind turbine, since laser and camera had to be modified for the much shorter distances in the laboratory to develop the methodology. The control system will be extended to allow automatic scanning of spatial vibration patterns of the spinning rotor blades.

In the long term, an extension of the tracking system for offshore applications is also conceivable. By further developing the active laser alignment tracking, the inevitable relative movements between sensor platform (such as a ship) and the measured installation could conceivably be compensated.

1 *Detection of the blade tips; positioning and tracking of the laser vibrometry beam.*
2 *Concept of the measuring system.*
3 *System demonstration at CeBIT 2014.*

Project execution

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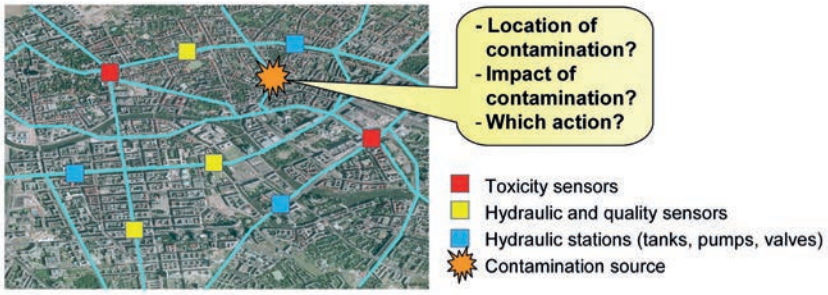

SMaRT-OnlineWDN: ONLINE SECURITY MANAGEMENT AND RELIABILITY TOOLKIT FOR WATER DISTRIBUTION NETWORKS

Water distribution Networks (WDNs) are critical infrastructures that are exposed to deliberate or accidental contamination. Until now, no monitoring system is capable of protecting a WDN in real time. The main objective of project SMaRT-OnlineWDN is the development of an online security management toolkit for water distribution networks that is based on sensor measurements of water quality as well as water quantity and online simulation.

Task

Water Distribution Networks (WDNs) are critical infrastructures that are exposed to deliberate or accidental contamination. In particular, the drinking water supply is potentially at risk of being a terrorist target and any contamination needs to be detected in good time. The resource, the treatment plant or the distribution network may be contaminated through a deliberate injection of chemical, biological or radioactive contaminants. To date, no monitoring system is capable of protecting a WDN in real time. Powerful online sensor systems are currently being developed and the prototypes are able to detect small changes in water quality. For taking appropriate decisions and countermeasures, WDN operators will need to have at their disposal (1) a fast and reliable detection of abnormal events in the WDNs, (2) reliable online models both for the hydraulics and water quality predictions, and (3) methods for contaminant source identification backtracking from the data history. In the project, Fraunhofer IOSB contributed with (a) an enhanced event detection module and (b) enhanced water quality simulation tools.

Result

(a) Event Detection Module: This is the contaminant detection system of the WDN. Based on measured historical sensor data, machine-learning algorithms are applied to generate a data-driven model that defines the non-contaminated state of the WDN. This model checks whether new measurements contain contaminants in real time. If contamination is detected, the module raises an alarm and communicates the concerned sensors, including their contribution to the alarm value to the hydraulic online models. It then also uses this information to predict the future flow of contamination. The module has been successfully tested on a laboratory plant and is currently running in the network of a European water supplier.

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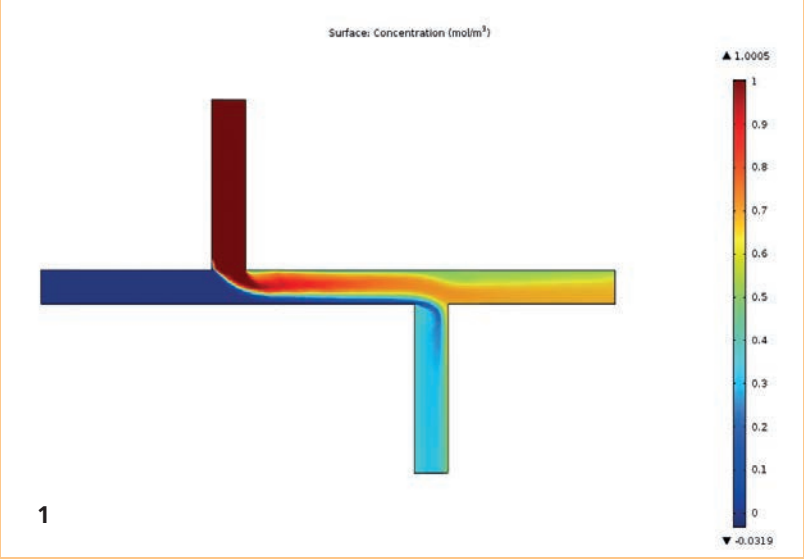

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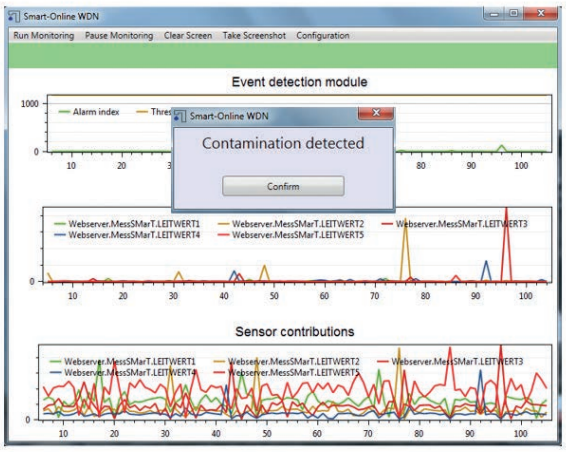

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1 *Reliable detection of contamination in drinking water networks.*

2 *Simulation of a contamination in a water distribution networks at a 4-way junction.*

(b) Enhanced Water Quality Simulations: Existing transport models in software packages (e.g. EPANET) possess some limitations regarding solute propagation in the network. In the context of hazardous waterborne products it is important to improve the models in order to take appropriate countermeasures. In many cases the three-dimensional geometry inside the network has an impact on the spread of substances and the one-dimensional (1D) transport simplified model may not be accurate enough (e.g., hydrodynamic dispersion in pipes for laminar flow and mixing at junctions). In the course of the project an enhanced 1D model for the mixing of transient contamination pulses in water distribution networks at 3- and 4-way junctions was developed. It is based on two-dimensional (2D) and 3D computational fluid dynamics (CFD) simulations in laminar, transitional and turbulent flow regimes. From the CFD simulation results, an enhanced 1D mixing model has been derived by a special interpolation method (interpolation on an irregular grid). The new 1D mixing model has been integrated in simulation platform Porteau. The junction configurations and hydraulic conditions have been derived from a real-world large network (water utility CUS, Strasbourg).

Project description

The project was a cooperation in civil security research between Germany and France. The project has been funded by BMBF and ANR. German project partners: Berliner Wasserbetriebe, 3S Consult GmbH, DVGW-Technologiezentrum Wasser. French project partners: IRSTEA, Communauté Urbaine de Strasbourg, Veolia Environnement, Veolia Eau d'Ile de France, ENGEES. Project duration: 4/2012 – 3/2015

Project execution

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Dr.-Ing. Thomas Bernard

Literature

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VISUAL INSPECTION

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Mission and vision

Replacing the five human senses with a wide range of technical sensors is something we do on a daily basis. This is especially true when it comes to acquiring more accurate information or doing so faster than humanly possible; or if we want to use a technical device to replace or assist a person performing a given task.

In the Visual Inspection business unit, Fraunhofer IOSB gathers all activities in the field of sensor technology, image analysis and signal processing for the purpose of quality assurance and / or increasing productivity in real time that come into play when "seeing" is the solution of choice. "Seeing" in this context refers not only to what the human eye is capable of, but also includes the entire electromagnetic spectrum from UV to IR as encountered in the natural and technical world. The technical solutions offered cover a broad service portfolio, ranging from feasibility studies to process developments, practical validation up to and including demonstrators and productive systems that can be used at the customer's site.

Markets

"Seeing" relevant information forms the basis for our solutions. In a technical respect, this generally comprises image acquisition using line scan or area cameras and image analysis in real time. Whether the task is to rapidly monitor a large number of moving parts while sorting bulk goods (in order to separate desirable parts from undesirable ones), detect changes in the reflective properties or the texture of a surface (which are indicative of product defects or process defects) or classify objects or object groups (to detect divergences from specifications), we are able to offer tailored solutions to our partners and customers.

Whenever the task is to "sort" large quantities of parts (e.g. bulk goods) in the material flow and in real time or to verify the compliance of complex individual parts with specifications – whether in terms of color, shape or other "visible" properties – our solutions are put into practice. The solutions we develop are used in recycling glass or enriching minerals to the same extent that they are used in sorting tea, coffee and other foods.

In the field of surface inspection, we not only detect changes in the structure, but also convert sensor data using photometric stereo or deflectometry into 3D data in order to reach conclusions relating to part topography. These methods are used to evaluate both glossy and mat surfaces. Sometimes "taking a look inside parts" or simply "seeing through them" is helpful when it comes to recognizing constituents or divergences. If light can be used to make them visible or the materials being searched for have specific reflective properties, we find them. We also offer solutions for special problems such as "seeing" vibrations from far away, "seeing" in an adverse environment (e.g. in deep-sea environments) or recognizing objects for identification purposes.

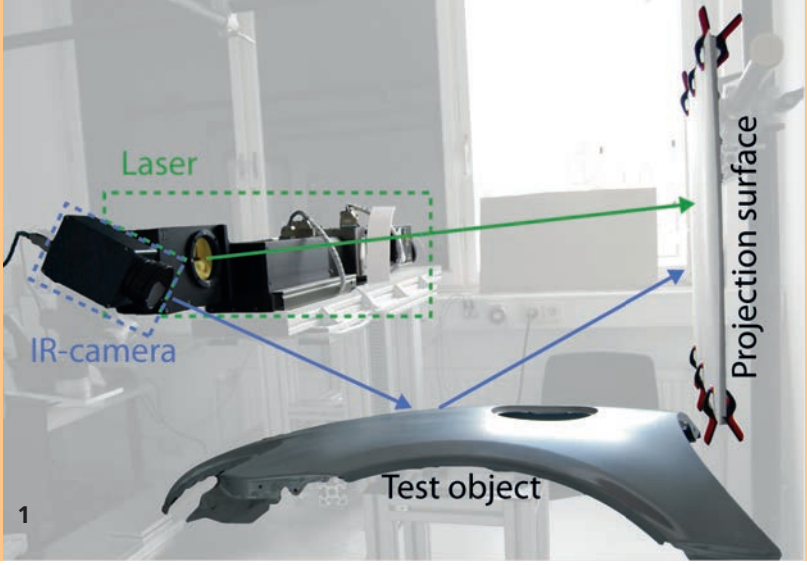
Equipment, lab and test facilities

- Sliding tables with a variety of lighting facilities for image acquisition
- Experimental systems for sorting bulk goods (each equipped with a camera and blow-out unit) in various configurations as a belt sorter, channel sorter, sorter with chute and free-fall sorting
- Measurement stations for inspecting surfaces, e.g.photometric stereo or deflectometry
- Measuring devices for 3D inspection
- Test systems for transparent materials
- Multispectral workbench
- Lab equipment for characterizing materials
- Microscopic image acquisition stations
- Test lab with lighting technology
- Fully-automatic BRDF measuring station
- Experimental systems for underwater inspection
- Cleanroom for inspecting sensible parts

References / product highlights

- Binder+Co AG: Systems for sorting recycling glass; recognizes heat-resistant glass containing lead
- SALUS Haus GmbH & Co. KG: Systems for sorting tea and herbs; color, size and debris sorting
- PETKUS Technologie GmbH: Sorting of seed
- Uhlmann GmbH: Blister inspection
- GREIWING logistics for you GmbH: Sorting system for plastic granulates
- Zwiesel Kristallglas AG: Inspection of glass lenses for occlusions and air bubbles
- Eti Maden General Directorate: System for sorting materials (colemanite)
- De Beers UK Limited: Systems for finding diamonds

1 *Experimental system for sorting bulk goods.*



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THERMAL DEFLECTOMETRY

Inspection of non-glossy surfaces

Deflectometry is an established approach for the inspection of specular and glossy surfaces. However, when rough surfaces like unpainted metal sheets are to be inspected, deflectometry usually meets its limits. In a research project at Fraunhofer IOSB in cooperation with KIT, this problem has been tackled using thermal infrared. Since the specularity of surfaces depends on their roughness together with the wavelength of the light used, a higher roughness can be compensated with a higher wavelength of the light used for inspection. The project results obtained so far show that the inspection using thermal infrared is feasible and offers the inspection sensitivity that is necessary for high-quality surfaces.

Task

Deflectometry is a highly sensitive inspection principle for measuring and evaluating the geometry of surfaces. It uses the specular reflection of a series of stripe patterns, which are displayed on a screen. After a camera has registered the specular reflections, automated image processing calculates the surface geometry from the images. Deviations from the desired shape in the inspected surface can be identified and assessed in the reconstruction of the surface. The main advantage of deflectometry is that its measurement resolution is very high, making it suitable for the control of high-quality products.

For the surface inspection of industrially produced surfaces like car bodies, it is desirable to use the same inspection principle throughout the entire production process, i.e. from the unfinished to the finished surface. Since deflectometry has proven to be the preferred inspection principle for glossy surfaces, it should therefore also be used for the surfaces prior to applying the paint finish. However, with the usual inspection setup using light in the visible range of the electromagnetic spectrum, unfinished surfaces do not provide a sufficiently high specular reflection, as the surfaces are just not glossy enough.

Result

Physics states that the observed amount of specular reflection of a surface depends mainly on the surface roughness and the wavelength of the light used for image acquisition. The higher the wavelength of the used light, the rougher the surface can be before a specular reflection is no longer obtained. For a surface with a given roughness, an inspection of specular reflection using deflectometry is therefore possible if light with a wavelength that is high enough for that roughness is used. For unfinished metal sheets, electromagnetic waves in the sensitivity range of thermal infrared cameras (about 8 to 14 µm) have been shown to yield usable specular reflections. This enables a consistent surface inspection using the same inspection principle from the unfinished component to the finished surface of industrially produced parts.

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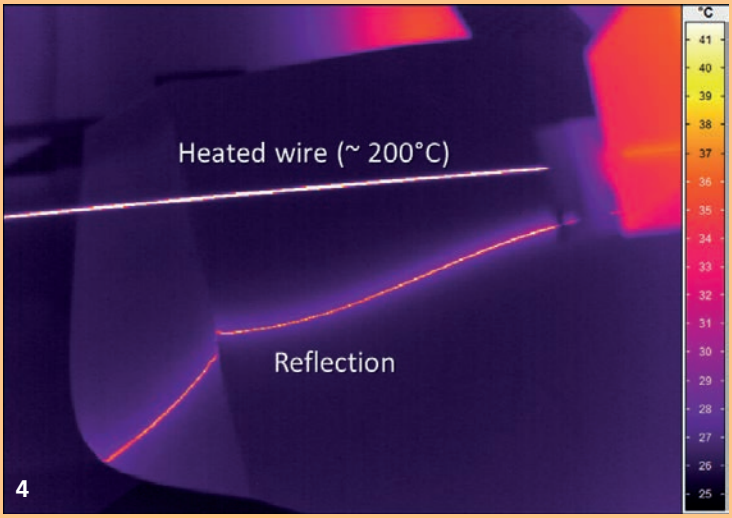

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In addition to applying thermal deflectometry to unfinished metal surfaces, this approach can also be used with visually transparent materials, such as glass and many types of plastics. Whereas visual light travels through the material, which prevents a surface inspection at that wavelength, these materials are opaque in thermal infrared, which can therefore also be used for surface inspection of transparent materials.

Project description

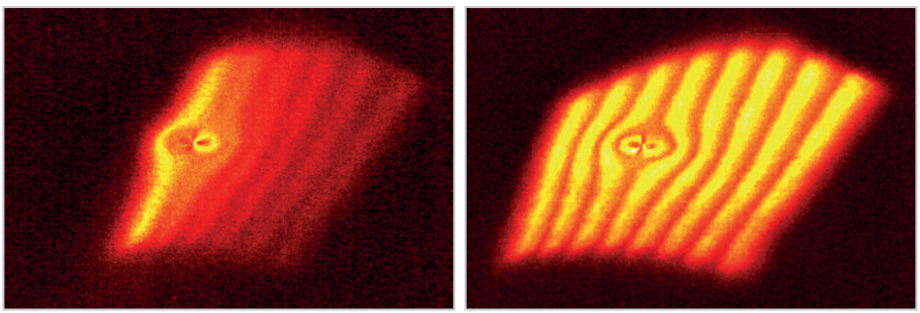
Imaging in the thermal infrared range requires an infrared camera with the suitable spectral range and a device that produces the dynamic stripe patterns needed for the deflectometric measurement setup.

While thermal infrared cameras with the required characteristics are commercially available, a major challenge for thermal deflectometry is the generation of the patterns for observation in the specular reflection. In contrast to the visual light spectrum, where standard computer monitors or TV screens are a low-cost solution to obtaining suitable pattern generators, there are no such devices for thermal infrared. Innovative approaches for generating dynamic patterns in the thermal infrared range were therefore needed.

One approach implemented in the project uses a laser beam to heat up a projection screen (Fig. 1). The laser beam is aimed at the screen with a beam deflection unit, such as usually used for laser inscription. By widening the laser beam, it is just strong enough to heat the screen surface without causing local burning. In principle, stripe patterns with sinusoidal or binary intensity characteristics, which are usually used for deflectometry, can be written. Since the generated surface heat dissipates quickly after the writing process, combining several images taken from different stages of the pattern generation process (Fig. 2 left) to one compound image (Fig. 2 right) proved advantageous. In the example in Fig. 2, a dent is clearly visible in the reflection image.

A second approach was implemented using an electrically heated wire (Fig. 3), which, combined with the infrared camera to form a sensor head, is moved over the entire surface to scan it. Although this inspection setup is mechanically very simple, it was proved capable of detecting defects such as dents or waves with high sensitivity (Fig. 4).

In summary, thermal deflectometry has proven suitable for inspecting unfinished surfaces, such as unpainted metal sheets for car bodies. Consequently, it is the missing link in the consistent inspection of high-quality surfaces from unfinished component to finished product.



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1 *Thermal deflectometry setup using a laser for pattern generation.*

2 *Specular reflection of a thermal pattern (left); combined pattern from several image takes (right).*

3 *Thermal deflectometry setup using a heated wire as pattern generator.*

4 *Thermal imaging setup using a heated wire.*

Project execution

Prof. Dr.-Ing. Michael Heizmann,
Dipl.-Inform. Sebastian Höfer,
Prof. Dr.-Ing. Stefan Werling

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XSORT-400, OR HOW TO FIND A WEDDING PRESENT IN KIMBERLITE ROCK

When looking for a wedding gift, kimberlite rock does not seem an obvious choice unless the groom is a geologist or a gemstone trader. Yet the igneous rocks kimberlite and lamproite are the ultimate bedrock sources of diamonds [1]. Kimberlite containing **diamonds** is formed in plumes or pipes (magma reservoir) that penetrated very old rock near the surface.

Although diamonds are increasingly produced artificially, their quality is often not good enough for use in jewelry or in industrial applications. Traditional quarrying of diamonds therefore continues to be of interest, and the mining industry requires modern technology to detect diamond-containing bedrock.

Task

At the end of the 20th century the IOSB, together with a partner, already developed and produced machines for detecting and sorting diamonds. Those machines were based on optical sensors in the visible wavelength range. This type of optical sorter as well as X-ray fluorescence (XRF) based sorters, which are also used to detect and sort diamonds, require the diamonds to be at the rock's surface, as neither method can look inside rock. Consequently, the rocks must be broken into small parts to increase the likelihood of discovering any diamond they may contain, which unfortunately also increases the risk of destroying the diamonds due to the high-energy quarrying process. A technology was needed to look inside kimberlite rock and to detect diamonds within it. Of course, the required method should work for rocks and diamonds of different sizes and ratios. In addition, the false positive rate, i.e. kimberlite rocks not containing a diamond, should be low. And last but not least, the valuable kimberlite rocks have to be detected and sorted at high speed and at high throughput to be applicable for industrial purposes.

Results

Initially Fraunhofer IIS-EZRT performed a feasibility study with dual-energy X-ray technology to evaluate the detectability of diamonds within kimberlite rock at the mine. The sizes of the tested diamonds were in the range of a few millimeters up to about 10 millimeters in diameter within kimberlite rock of a few millimeters up to about 40 millimeters in diameter. As the results were promising, a prototype was developed to run tests under industrial sorting conditions. To date, these tests are continuing at the mine's site, with first results confirming the feasibility.

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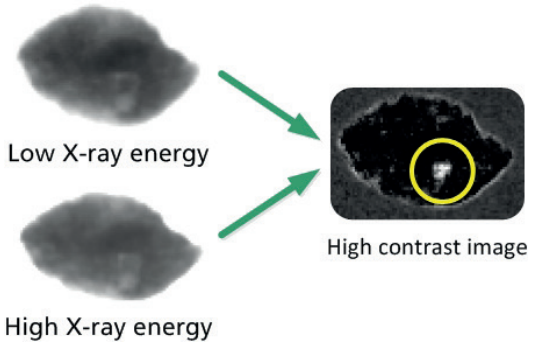

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1 *A special algorithm yields a high contrast image which can make the diamond visible within the rock.*

2 *Beautiful cut diamonds which originate from kimberlite rock.*

Project description

The Fraunhofer prototype components were a dual-energy X-ray detector, a powerful X-ray source, appropriate X-ray shielding and safety equipment, an image processing PC, and some electronics. All of these components were integrated into a sorting system that uses a conveyor belt for transporting the bulk material. As the rocks move along the conveyor, they pass through a perpendicular X-ray curtain that intersects the belt. A detector, below the belt receives the remaining X-ray intensity that has not been absorbed by the bulk material. The dual-energy sensor converts two X-ray spectra into two signals, which form the input to a special algorithm developed by the Fraunhofer IIS-EZRT. The output is a high-contrast image, which reflects the atomic number of the material, i.e. is material-sensitive (Fig. 1). The image, which is independent of the object thickness, then enters the image processing chain of the Fraunhofer IOSB, where it is further evaluated and classified. When the software identifies a diamond within kimberlite rock, the respective coordinates for its ejection are sent to the valve cluster, which blows the rock out of the material stream.

The two Fraunhofer institutes – IIS-EZRT and IOSB – complement each other very well. The IIS-EZRT in Fürth specializes in X-ray transmission technology, which it had not previously applied to bulk goods sorting. The IOSB has about 20 years' experience in bulk goods sorting but had not applied X-ray technology in this field to date. The software of the IIS-EZRT and the IOSB was comprehensively adapted and integrated into the real-time TeachNSort sorting software of IOSB.

Because the most powerful X-ray source available on the market was required for producing high-quality images and due to design restrictions, the X-ray shielding had a quite special and complex design to make the prototype sorter safe for users.

The project is the basis for future applications in X-ray bulk goods sorting. It is an ideal supplement to the established surface-sensitive sensor technologies of the IOSB. Companies in other fields of activity, such as foods and recycling, are showing an interest in applying the technology not only to finding wedding presents, but also to more everyday future uses, such as detecting unwanted foreign objects.

Partners

Fraunhofer Institute for Integrated Circuits, Development Center for X-ray Technology IIS-EZRT.

Customer

Aliud GmbH

Project team

Overall project management:
Dr. rer. nat. Kai-Uwe Vieth
IOSB team:
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Dipl.-Inform. Bettina Otten,
Dipl.-Ing. Matthias Burkhard,
Dipl.-Ing. Michael Palmer

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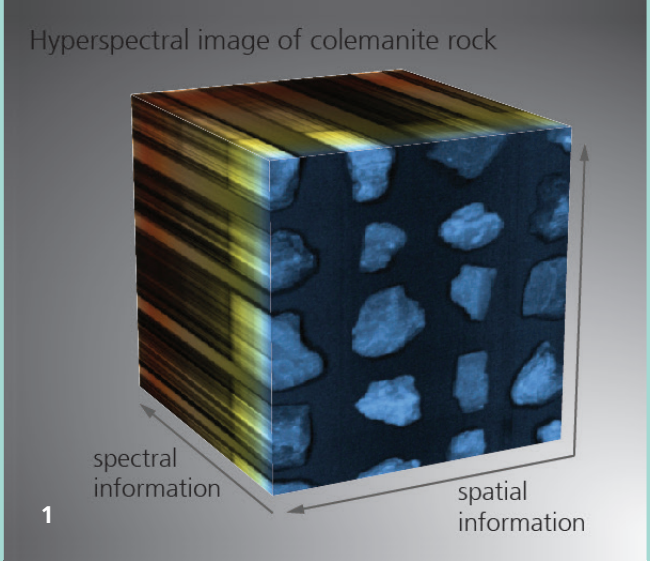

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HYPERSPECTRAL-IMAGING LABORATORY

About 20 years ago mobile phones were few and far between. Nowadays it is quite normal even for primary school kids to have their own smartphone and more and more people don't have a landline telephone at home. A similar trend is taking place with "old-fashioned" RGB cameras in industrial inspection and even on the consumer market – the three-color images are being replaced by multispectral and even hyperspectral imaging. A hyperspectral image represents a spectrum for each imaged pixel and thus offers more information about the imaged material than the corresponding RGB pixel. In most cases a hyperspectral image is more valuable for quality checks of foods, recycling, or mining for example.

Task

More and more visual inspection tasks require the use of the non-visible wavelength range, such as the ultraviolet (UV) or near-infrared (NIR) range. There is increasing demand, for example, for quick chemical-related quality checks in the food industry. The use of additional wavelengths allows us to see other material characteristics than those revealed using only visible light and thus offer the ability to distinguish materials or to detect defects that are invisible to a standard RGB camera. This nondestructive testing can be part of industrial sorting machines and consumer devices alike. To acquire high-quality hyperspectral images, to extract the relevant information and to apply this data for the inquired system is an essential task, both now and in the future. An example is the current Fraunhofer internal research project QUABA (Qualitätssicherung an Äpfeln durch innovative Bildverarbeitungstechniken – Quality assurance of apples using innovative image processing techniques), which aims to identify defects such as dents, internal browning or water core and to determine the apples' starch and sugar content.

Results

The first sorting system which was designed on the basis of hyperspectral imaging analysis was built in 2010. The sorter was able to distinguish between white colemanite rock (Fig. 1) – a borate mineral – and the equally white host rock, which had a different appearance in the NIR. One of the latest sorting systems is a grape sorter, the purpose of which is not only to detect foreign materials such as stems, beetles, and wood but to sort grapes with respect both to grape and wine composition, such as sweetness. A correlation between the sweetness level and the VIS/NIR spectrum could already be established by analyzing the corresponding chemical and hyperspectral data [1-3].

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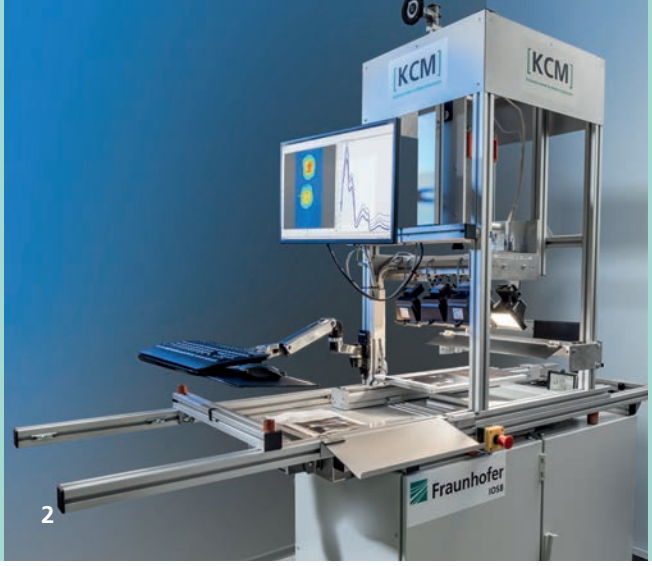

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Description of project

Establishment of the hyperspectral imaging (HSI) laboratory started in 2009 with the first HSI camera being sensitive in the wavelength range from 1 to 2.5 µm. An HSI camera for precision color measurement of granulates already existed for the visible range. That device was modified and enhanced to be sensitive up to 1.1 µm. The setup was completed with an HSI UV-range camera (0.24 – 0.4 µm). All of the devices are driven by the same IOSB-developed software, which controls the motor-driven table that moves below the fixed camera, acquires the images, and corrects them using images of white and black reference samples. The objects are then segregated from the background and registered to match pixels acquired with different devices. Afterwards the data are uploaded to a database. All data associated with the material and the acquisition are also uploaded in order to be able to reproduce the data processing procedure later on. The steps up to this point would seem to be trivial, but are, in fact, vital to establish a basis for good and reproducible results.

The next step is the data analysis, the goal of which is unrelated to the final sorting or inspection task: The relevant features needed to distinguish the different materials must be extracted. Every wavelength of the several hundred acquired wavelengths represents a feature, and an efficient analysis requires this huge amount of data to be reduced, especially since many of the features represent redundant information. This goal is achieved with so-called multispectral data analysis [4]. This can describe the center wavelength and wavelength width of a bandpass filter, which is then applied in addition to or instead of an RGB image to separate, for example, good corn from toxic aflatoxin-contaminated corn. Alternatively, a partial least square regression (PLRS) analysis can be applied to identify the features – i.e. wavelengths – that have to be used to sort grapes with a certain sugar content. This data forms the input for designing a special optical filter coating for an interference filter that, as it were, makes the sweetness of fruit visible.

The hyperspectral imaging laboratory, complete with its customized hardware and software is the basis for future developments that will be applied in industry and in the consumer industry to meet the increasing the demand for quality control.

Project team

Overall project management:
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IOSB team:
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Dipl.-Inform. Christian Negara,
Dipl.-Inform. Jürgen Hock,
Dipl.-Ing. Henning Schulte

1 ***The spatial and spectral information of colemanite rock is displayed in a so-called 3-D hyperspectral data cube.***

2 ***Hyperspectral imaging system in the shortwave infrared (SWIR) spectral range.***

3 ***Hyperspectral imaging system in the visual (VIS) spectral range.***

Partners

Karlsruhe Institute of Technology - Institut für Industrielle Informationstechnik (IIIT)

Literature

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Mission

For the benefit of Germany's defence as part of Europe and NATO the Fraunhofer IOSB supports the German ministry of defence and its subordinate authorities as well as the defence industry with applied research and technology on the areas of imaging with optronic systems, image and signal analysis, and architectures for simulation and information systems. Rapid transfer of our research results in order to enhance the ability of the armed forces and to protect our soldiers is our prime objective.

Content

The IOSB's core competency lies in research into optronic systems for human and computer vision, real-time processing and analysis of imagery, and full-motion video as well as the necessary information and communication technology for the use of images in network-enabled operations.

Of special significance for the German armed forces is our research and technology work in the following areas:

- Design, evaluation and protection of existing and future optical and optronic sensor systems: daylight and night vision, hyperspectral sensing, laser-based sensors and protection against laser threats.
- Warning sensors, propagation of light through the atmosphere, signatorics for reconnaissance and protection, concepts for and evaluation of camouflage, concealment and deception.
- Network-enabled interoperable real-time processing and analysis of imagery for purposes ranging from wide-area imaging reconnaissance to target detection in weapon platforms, including human-system-integration.
- Computer assisted object and situation recognition and image-based methods for object tracking and target handoff.
- System architectures for networked simulation and generation of terrain and building models for simulator-based training.

The research and technology activity of business unit Defence is carried out in three tiers:

- To support the ability of the German ministry of defence (GMOD) and its subordinate authorities for analysis and evaluation of defence-related technologies the IOSB conducts basic research that is funded by the GMOD in the long term.
- Based on this research the institute conducts technology projects of the GMOD with a medium-term horizon and specific objectives.

- Finally projects with the defence industry lead to solutions for the forces. These projects are carried out in close coordination with the GMOD to ensure the independent role of the IOSB as consulting entity for the government.

International cooperations based either on bilateral agreements, with contracts from the European Defence Agency (EDA), or common research activities in the context of NATO's Science & Technology Organization (NATO STO) are continuously flanking our national defence research work.

To the extent that military security classification does not prevent this, the R&T in business unit Defence is incorporated into the IOSB's applied research for civil purposes performed by the other four units in order to achieve the highest benefit for all application areas.

Equipment, and lab and test facilities

- Environment simulation (e. g. for camouflage assessment)
- Adaptive optics
- Bidirectional reflectance analysis of materials
- Airborne platform for imaging radiometrics (AirSIG)
- Observer performance evaluation
- Assessment of visual and infrared imaging systems
- Optronic countermeasures
- Femtosecond laser lab
- Human-computer interaction for image analysis (eye gaze, gesture)
- Testbed for network-enabled imaging reconnaissance
- Federation of simulators
- Distributed Network Battlelab (DNBL)
- SAR simulation (CohRaS®: Coherent Ray-tracing based SAR-Simulator)
- Reconnaissance and surveillance with mobile sensor swarms
- Serious gaming for image analysis training
- Airborne multisensor platform (VIS, LWIR and hyperspectral)

Reference solutions

- ABUL – Full-motion video exploitation system for reconnaissance and surveillance (air, land, and sea)
- RecceMan®: Interactive recognition assistance for aerial and satellite imagery reconnaissance
- i2exrep for reporting in image-based reconnaissance
- SAR-Tutor for image analysis training
- Computer-Aided Interactive Performance Evaluation Tool CARPET for camouflage assessment
- OMSIS: Onboard Infrared Ship signature Management system
- Digital Map Table
- CSD – Coalition Shared Data Server and clients for interoperable data and information distribution
- Predicition tool for thermal imaging based on a Thermal Range Model (TRM 4)
- Environment measurement system for characterization of atmospheric effects
- GERTICO: Infrastructure for federated simulators

1 *Laser-Based Helicopter Obstacle Warning.*

THE NEW ERA OF HETEROGENEOUS COMPUTING

Network-centric warfare gains it advantages by the fusion of different information sources in real time. Modern military concepts, such as „battlefield awareness", require that various sensors, such as image sensors, provide a rich set of information about a combat scene, which can be used to support strategic decisions. At the tactical level, the real-time fusion of images from different cameras, e.g. infrared and visual-light cameras with fast growing image sizes and frame rates demand a high processing power. The efficiency of processing is critical for reliable and fast decisions. The conventional single or multi-core processors are in many cases not suitable for the complex image processing applications used in the military context. However, in the last years we have witnessed the dawn of heterogeneous computing, which refers to systems that combine different commercial-off-the-shelf (COTS) hardware architectures. Depending on the application, there are two typical categories of heterogeneous systems. One of these are desktop systems with multi-core CPUs and at least one co-processor card. Typical co-processors are graphic cards (GPUs) or Intel® Xeon-Phi™ accelerators. Another group of heterogeneous devices are mobile System-on-Chip (SoC) devices, which combine ARM® multi-core CPUs with an embedded GPU on the same chip or ARM® big.LITTLE™ architectures. The main benefit of heterogeneous systems over the conventional multi-core CPUs is faster and more energy-efficient processing for many computationally demanding applications.

Heterogeneous computing, with all its advantages also presents new challenges for application programmers: The high computational power comes with a much more complex programming model. The mapping of the single tasks of an application to the different hardware architectures, scheduling and load-balancing of tasks, task synchronization, and task communication are now critical design decisions, which determine the success or failure of an implementation of real-time applications. An efficient use of heterogeneous hardware demands in-depth knowledge of the capabilities of the underlying architectures. To successfully use heterogeneous computing in future, different mapping and scheduling methods are being developed at IOSB, which make the use of heterogeneous systems transparent for application developers, who can then concentrate on the actual application development.

In order to develop and test various scheduling methods for heterogeneous devices, the OpenCL (Open Computing language) programming framework is a suitable choice. OpenCL offers a C-based programming language and a run-time system and supports a variety of heterogeneous hardware. With internal OpenCL constructs, such as command queues or

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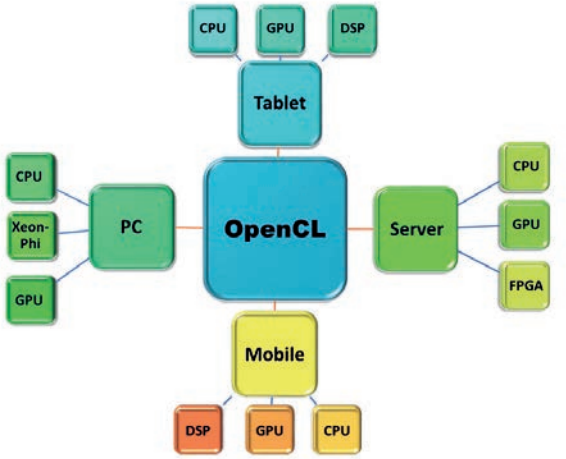

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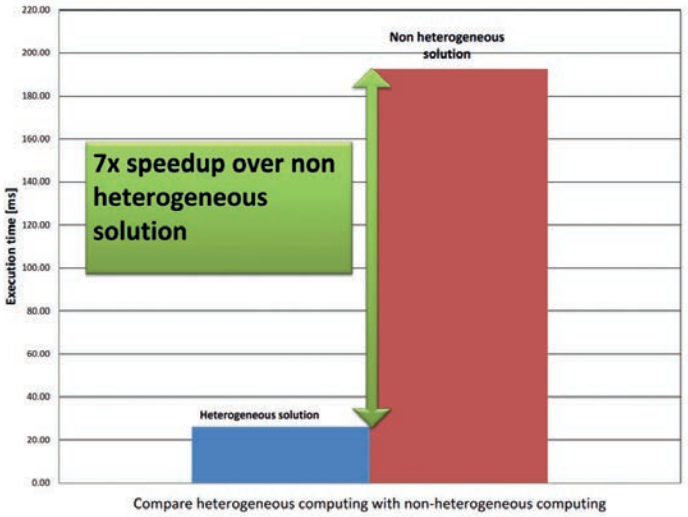

2

1 *OpenCL (Open Computing Language) is a suitable choice to program heterogeneous systems.*

2 *Comparison between heterogeneous computing solutions and homogeneous computing solutions.*

event systems, the computation on heterogeneous platforms can be easily and efficiently controlled. Based on theoretical characteristics of a computational device, different workload partitioning and distribution strategies are being developed. Additionally, various task optimization methods are being evaluated in order to identify the most efficient one. Figure 2 shows the speedup for an image feature matching algorithm, which forms the basis for many complex applications, such as person detection or real-time target recognition and tracking. The combination of multi-core processors and GPUs significantly increase the data throughput. In addition it has been shown that one of the most important factors for correct scheduling is the amount of data associated with a task. High-level tasks with a low or medium memory bandwidth can be efficiently processed by multi-core CPUs, while tasks with high data rates and high computational load are more efficiently processed by GPUs. Unlike conventional single-processor solutions, the heterogeneous computing solution enables real-time processing even for full-HD image sequences.

Future research will focus on two important aspects relating to automatic and efficient task scheduling in heterogeneous computing. The first research area will be a task analysis and description method. The other aims to develop device modeling methods to provide analytical models for the heterogeneous compute devices in a system . With the help of analytical models, it will be possible to automatically predict the ideal mapping and scheduling to the most efficient available hardware architecture.

Project execution

Dipl.-Ing. Konrad Moren

Literature

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Coalition Shared
Data Server
by Fraunhofer IOSB

THE COALITION SHARED DATA CONCEPT FOR INTEROPERABLE INFORMATION SHARING

The Need for Interoperability in Joint ISR

In the light of the increasing complexity and diversity of today's threats, making the right decisions and initiating the right reactions is more and more becoming a question of maximizing the benefit of ISR (Intelligence, Surveillance and Reconnaissance) systems. Also, budget restrictions combined with the fact that attacks today are aimed not so much on individual nations as on whole areas demand cooperation between civil and military organizations and force nations to collaborate and share ISR data and information. To this end, interoperability is required in both technical and operational respects.

Task

In Joint ISR, various sources deliver heterogeneous data and information: real-time and non-real-time, static and dynamic, in different formats, and for different purposes. Tasking data needs to be disseminated to the respective collection and exploitation systems. Data and information produced by these systems (e.g., images, video clips, tracking data, exploitation reports) need to be disseminated to the respective command and control level for further processing and distribution. Mostly, data and information are restricted in terms of sharing. When sharing them, it is essential to take the relevant operational processes and rules into account.

Coalition Shared Data (CSD) pursues the aim of facilitating data and information sharing within a coalition, i.e. within a collaborative environment. This is conceptually independent of any technical solution. However, interoperability in both technical and operational respects is a prerequisite for reaching this goal within the coalition. In essence, the right data and information must be delivered to the right person at the right time in the right format. A key to making this possible is storing and disseminating data and information by making use of existing standards.

Result

Taking into account technical and operational requirements, the CSD concept was developed and has led to the development of an ISR architecture in which relevant NATO Standardization Agreements (STANAGs) are used where possible. Within this architecture, data and information are shared through standardized interfaces and in standardized formats. In essence, the output of the involved - usually national - systems requesting, producing, processing and/or exploiting data and information is translated into a standardized format that any other

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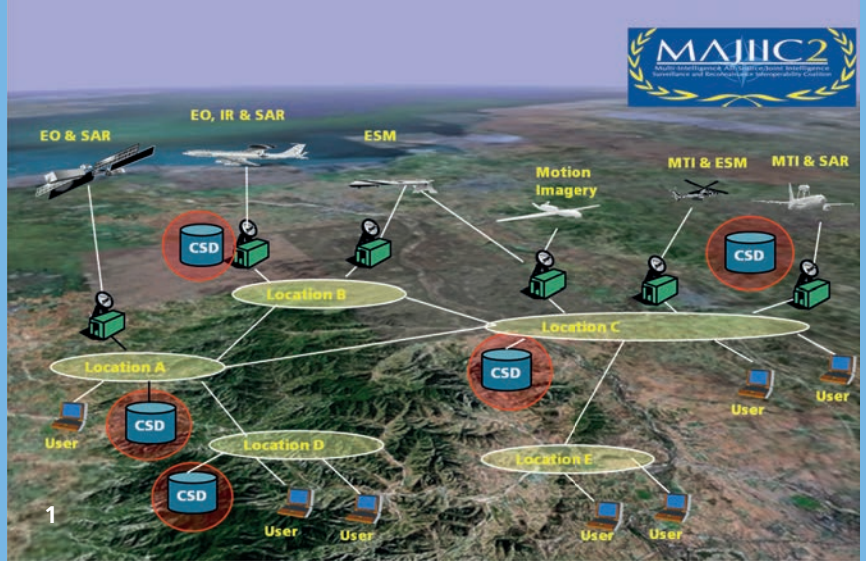

1 *Infomation distribution within a coalition.*

system knowing that standard can ingest, retrieve and process. Within the resulting format, data and information are enriched by metadata which formally defines them on a higher level and makes them searchable. Appropriate synchronization mechanisms between storage capabilities based on the metadata are the basis for providing network-friendly data access within the coalition.

Project description

In the context of Joint ISR, the CSD concept and a technical approach for it were developed in the projects CAESAR (Coalition Aerial Surveillance and Reconnaissance), MAJIIC (Multi-sensor Aerospace-ground Joint ISR Interoperability Coalition) and MAJIIC 2 (Multi-intelligence All-source Joint ISR Interoperability Coalition) funded by the BMVg (Federal Ministry of Defence). Within these projects, a close collaboration between military and technical experts was established to develop a technical architecture that depends appropriately on a corresponding operational architecture.

The CSD concept itself and the corresponding technological approach evolved over time. In the above-mentioned projects, a multi-national, exercise-driven approach was applied. Solutions were tested regularly in coalition exercises and trials allowing also the involvement of military operators at an early stage. Taking the lessons learned into account, the architecture as well as the underlying technical solution and the processes it supports were improved iteratively. The initial CSD concept was merged with a more sophisticated service-based approach. Initially, the CSD architecture in essence followed the principle of providing all kinds of data and information through a single system – the STANAG 4559 server. It employs a classical client-server architecture using the principles of ubiquitous metadata availability and access to the actual data on demand. While the project results proved that this solution is appropriate for static products, they indicated that data and information being subject to constant change (e.g., streaming data, tasking data) are not supported well. A separation of data and information into adequate dissemination capabilities was therefore implemented and specific dissemination capabilities for non-static products were established.

Currently, the major context of CSD is Joint ISR. Nevertheless, the concept and the corresponding technical solutions can also be transferred to contexts with similar requirements. Within the field of civil security, for example, the concept was successfully adapted and tested in the EU project SOBCAH (Surveillance of Borders Coastlines and Harbours).

Project execution

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Dipl.-Math. Jennifer Sander,
Christian Kerth, M. Sc.,
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Literature

[1] Essendorfer, B.; Kerth, C.; Zaschke, C.: Evolution of the Coalition Shared Data Concept in Joint ISR, Proceedings of the NATO IST/SET-126 Symposium on "Information Fusion (Hard and Soft) For Intelligence, Surveillance & Reconnaissance (ISR)'', Joint Symposium IST-106 and SET-189, 2015

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1

WORLDWIDE IN ACTION FOR DEFENSE AND SECURITY

If you want to meet members of the research group "warning sensor systems", the institute's premises are not your best bet. Since the group's Know-how, skills and technical resources are in high demand, most of the group members spend more time on field trials than in the institute. The group, which generally deals with the layout and assessment of warning sensor technology, works on several topics, including:

- missile approach warning systems (MAWS, from UV to LWIR wave band),
- electro-optical hostile fire indication (HFI),
- acquisition of threat signatures,
- simulation of detector performance in theater,
- influence of atmosphere on warning and countermeasure systems,
- integration of environmental effects (e.g. airglow) for improved night vision capabilities.

Working on these subjects, the group has participated in several large-scale field trials during the past months. The trials are often carried out in an international context, e.g. as part of NATO or EDA collaborations. In May 2014, at the Vidsel Test Range in the far north of Sweden, the group took part in a large signature acquisition trial organized by NATO SG 2 MWS-TT (NATO subgroup 2, missile warning systems, technical team). More than 100 researchers from 11 different nations collected data on emissions of different types of surface-to-air missiles (SAMs). The data complements the IOSB threat data base and will be used for the development and improvement of missile approach warning systems (MAWS). These sensors are part of the self-defensive aids suites of airborne platforms like the new military cargo airplane Airbus A400M. The signature data will be used as input for simulation software that we are currently developing. It will allow a performance evaluation of different warning sensor systems. Currently only intended for the assessment of systems on airborne platforms, the simulation package will be upgraded in future to also allow the assessment of naval (boats and ships) and ground-based platforms (tanks and other vehicles).

Only a few weeks later the group participated in another NATO trial: Near Karlovy Vary in the Czech Republic the SG 2 organized an experiment to acquire data necessary for the development of hostile fire indication (HFI) systems. These systems are intended to detect small arms fire, e.g. shots from assault rifles, machine guns or grenade launchers. The data we collected will be used in a prototype system currently in course of construction at IOSB. Furthermore, data on the tactical usage of air defense systems could be acquired during a training session of the Czech Army that participated in the trials.

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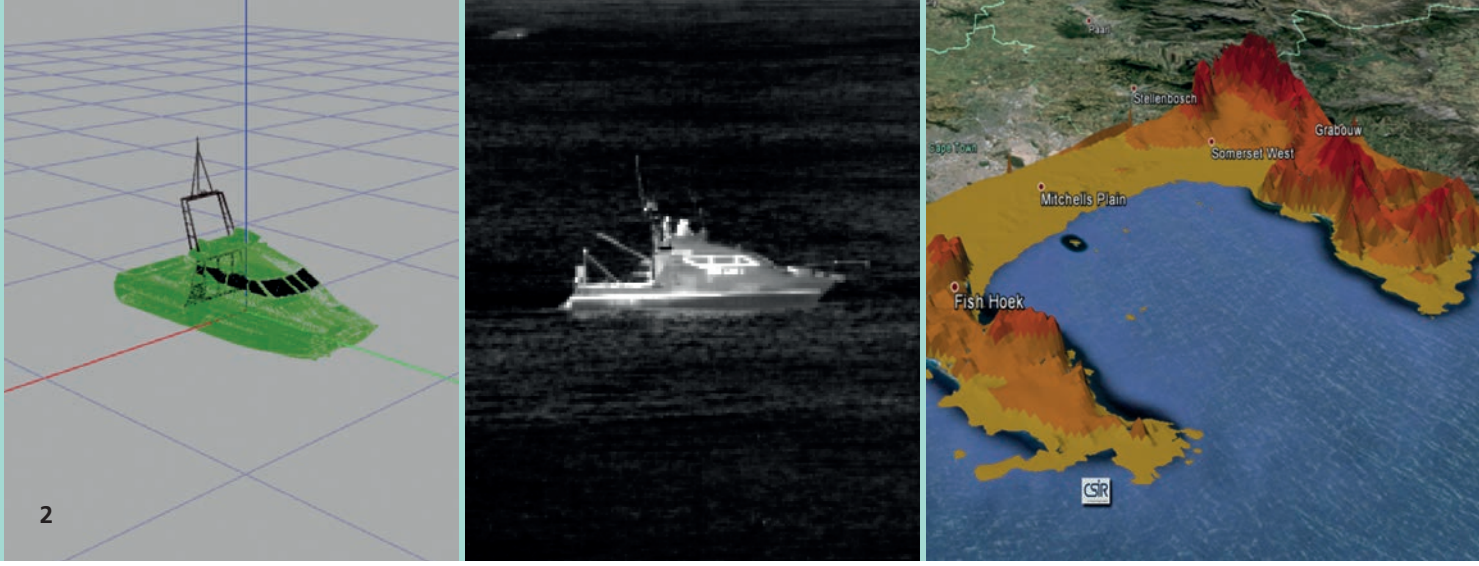


1 *Czech Republic: Tactical firing of a surface-to-air missile from a tank.*

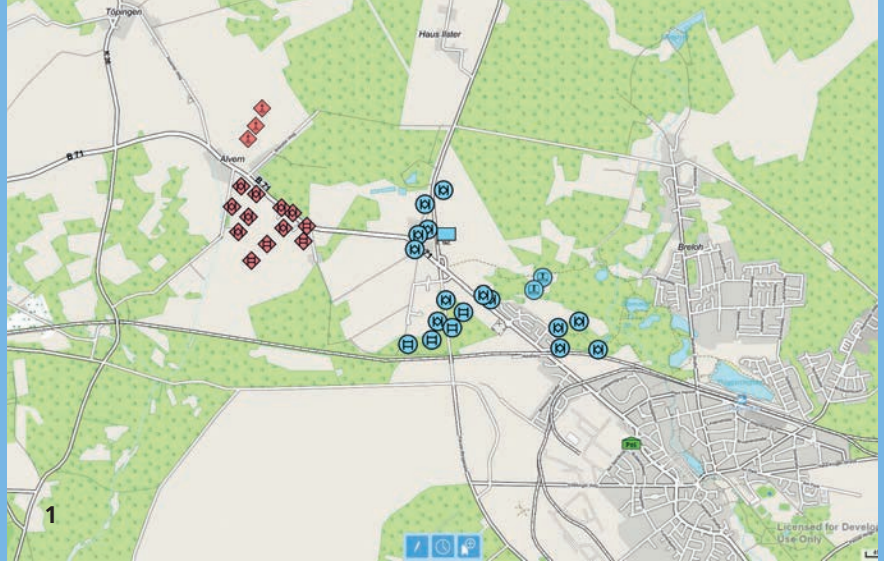
2 *"SeaLab" – Boat used for Propagation Experiments in South-Africa, left: CAD-Model, center: MWIR signature, right: trial location, False Bay. Source: Dr Christo Rautenbach, CSIR, Stellenbosch.*

However, electro-optical signatures are not the only important information needed for effective threat detection. Since all signals emitted by missiles, rifle shots and other sources have to propagate through the atmosphere before reaching the sensor, an in-depth knowledge of the environment is vital! But not only the detectability of a threat is affected by atmospheric conditions: counter measures such as DIRCM (directed infrared countermeasure) systems also suffer from atmospheric effects like turbulence and refraction. These effects lead to beam wander and intensity fluctuations in the transfer of laser energy. In collaboration with researchers from Italy, France and Sweden we are investigating potential negative effects on the self-defense systems of airborne platforms such as helicopters. The effectiveness of such systems can be reduced by the air flow caused by the rotor movement (downwash) and by the hot exhaust gases that induce extremely high turbulence and emit strong infrared radiation. To characterize these effects a joint field trial under the umbrella of EDA was carried out in autumn of 2014 on an air base of the Italian Air Force near Pomezia in Italy. A similar experiment to investigate the adverse influence of exhaust gases from turboprop engines used on transport aircraft is planned for 2016. Besides the optimization and development of future defensive aids suites, knowing the limitations of on-board self-defense systems will allow appropriate tactical usage of the platform to ensure maximum survivability of the crew.

For detailed investigations of eo-propagation in maritime environments, we are currently performing a long-term experiment in collaboration with the Institute for Maritime Technologies (IMT) of South Africa and the TNO from the Netherlands. The experimental set-up is located at False Bay, close to Cape Town in South Africa. The long-term characterization of electro-optical propagation effects like refraction and turbulence is one of the topics of interest. Others include the effects of solar loading of material and the temporal behavior of wakes generated by boats or ships, which both influence the perceptibility of naval vessels.

During all of these campaigns the cross-sectional knowledge and the group's technical equipment was much in demand from our national and international partners. The knowledge about sensor technology from UV to thermal IR in combination with the knowledge of environmental effects on propagation and the ability to gather and handle signature and atmospheric data helps us obtain optimal results. To support experimental activities the group can provide equipment ranging from calibrated cameras to weather stations including turbulence and particle measurement systems (aerosols, ozone). Ground-truth measurements are essential for the correct interpretation of experimental findings, especially if long optical paths are considered.

If you have any questions regarding warning sensor technology, optical countermeasures or atmospheric effects that limit equipment performance, do not hesitate to ask us. We will be glad to assist you.



1

INTERACTIVE MAPS FOR SUPPORTING SITUATION AWARENESS

The Digital Situation Table as a common working environment

Geographic information systems are essential tools for operational and tactical planning activities. In such planning tasks, a team of people usually works collaboratively to establish a common situational picture. This situational picture is an essential piece of information for supporting decision makers' situation awareness. The Digital Situation Table (DigLT) and its software IVIG (Interactive Visualization of Integrated Geodata) support the effective generation of a common situational picture, especially when several people in different locations must work together.

Task

Operational and tactical planning tasks are usually performed by a collaborative team. This team has a defined structure, in which each user has a designated role, i.e. has to conduct a specific task. When generating the situational picture, main tasks include mapping the own and adversarial forces, geographical circumstances, and logistical restrictions. Each role, which may include several persons, defines and maps its own georeferenced layer. For generating such layers, predefined tactical symbols exist, both for military and for civil application scenarios (see Figure 1 for an example). The final layer includes the complete planning for the specific role. However, there may also be more than one layer per role, because there are several solutions for the planning task. For making final decisions, all generated layers can be overlaid and the combined picture assessed. Usually at this point, different planning solutions are evaluated until one is chosen.

Description of the solution

For supporting the collaborative planning task, Fraunhofer IOSB has developed the Digital Situation Table (DigLT) as an item of hardware, and the IVIG (Interactive Visualization of Integrated Geodata) software that supports the interactive map generation in a distributed setup. The DigLT consists of a horizontal multi-touch display showing the situational picture and a vertical display showing metadata information, e.g. for specific points of interest (see Figure 2). The IVIG software has as a modular architecture, allowing custom configurations. The service-oriented architecture organizes all geodata and metadata in its back-end, which represents the core of IVIG. Additionally, further modules provide user-interaction, communication, and sensor management functions. The system supports Open Geospatial Consortium-based web services, OpenStreetMap data, as well as STANAG-compliant and

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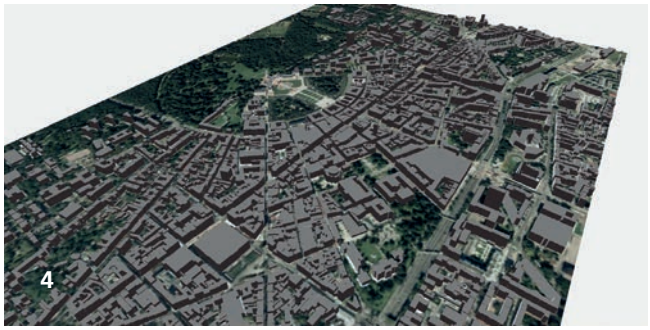
specific interfaces, thus allowing an automated fusion and visualization of geodata from different civilian and military sources. The geodata visualization itself is implemented with an ArcGIS runtime from esri. However, IVIG is not limited to use in combination with a DigLT: It can be installed on all Windows-based systems. A mobile version with two tablet pcs, which was designed for use inside an armored personnel carrier (APC) also exists (see Figure 3). Additionally, the software is able to display a 3D-view of a selected area in the metadata display, supporting digital elevations models and 3D models of buildings (see Figure 4).

Furthermore, IVIG allows role-dependent layer editing and can be started separately on various clients. Different roles are able to work in parallel on various devices such as PCs, notebooks, tablets or smartphones (see Figure 5). When starting the software, users must log in due to their designated role before being able to create and edit layers within their field of responsibility only. Once created, the new layer is initially not visible to users with other roles. In order to make the layer visible to other roles, the users must publish their layer. Furthermore, if a user changes his decision, he can also to retract the layer, i.e. make it invisible to other roles. This layer concept is managed in the server component so that all actions are synchronized with the server application. Thus, every user and every role is able to view created and published layers from other users and roles. Especially the decision-maker is able to create his own combined view of all published planning solutions and can easily copy and paste his favorite visualizations for further use in other tools, such as PowerPoint.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More information: product sheet DigLT and product sheet IVIG, both available from http://www.iosb.fraunhofer.de/servlet/is/7583/

1 *Situational picture of own and adversarial forces.*
2 *The DigLT with a horizontal multitouch display.*
3 *A mobile version of the DigLT with two tablets, located inside an armored personnel carrier (APC).*
4 *3D visualization of an urban environment (3D models courtesy of Stadt Karlsruhe).*
5 *DigLT with various mobile clients.*

Customer
Bundesamt für Ausrüstung, Informationstechnik und Nutzung der Bundeswehr (BAAINBw), Wehrtechnische Dienststelle für Informationstechnologie und Elektronik (WTD81), Flensburger Fahrzeugbau Gesellschaft mbH (FFG), Griffity GmbH, Führungsakademie der Bundeswehr – Fachbereich Führungslehre Heer

Project execution
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1

SAR SIMULATION FOR URBAN DAMAGE ASSESSMENT IN HIGH RESOLUTION SAR SCENES

When disasters such as earthquakes or tsunamis strike urban areas, one of the first and most important tasks is to give the rescue units an overview of the most inflicted areas, of the kinds of damage they will have to deal with and of the state of the infrastructure. This first overview of the situation is usually gained using satellite imagery. Since optical satellites are limited by daylight and adverse weather conditions, often the first available image of a disaster area is a SAR image. However, extraction of relevant information from SAR images is difficult, especially if no pre-event imagery is available and thus the information has to be extracted from the post-event image alone.

SAR simulation can be of vital interest in these situations, especially if a 3D model of the city is available, which already is the case for many of the bigger cities and is becoming more common for smaller cities as well. In these cases, the pre-event image could be a simulated one, generated from the 3D model with the exact sensor parameters of the post-event SAR image. Once the simulated image is available, comparisons between the real and the simulated image can be used to aid in the extraction of the required information.

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Task

The simulation of SAR images of urban scenes is challenging, especially if the simulated images are to be compared to real SAR imagery in an automated process, as is required for disaster situations since affected areas are large. For very detailed simulations of such large areas at high resolution, an efficient SAR simulator is needed. The CohRaS simulator developed at Fraunhofer IOSB is able to simulate scenes containing up to 1 billion triangles spread over an area of several square kilometers at a resolution of better than 50cm in a few hours. The main challenge in making the simulated images comparable to real SAR images is the creation and pre-processing of the 3D model passed to the simulator as input. For geometrical correctness, this model should not only contain the buildings of the city and the ground level but also larger vegetation, such as trees. For radiometric correctness, different materials, such as vegetation areas, streets, rivers and buildings need to be assigned to different parts of the model. For the huge 3D models necessary to simulate a realistic image of a large urban area, this is only possible in an automated process.

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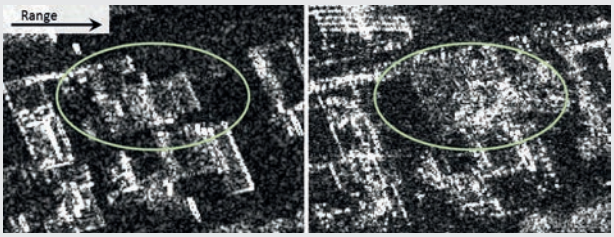

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1 *3D model.*

2 *Good agreement between*
a) simulation and
b) TSX image of undamaged area.

3 *Considerable differences in*
a) pre-event simulation and
b) post-event TSX image of area with a collapsed building.

Methods and procedures

Before a simulation that is sufficiently accurate to be compared to real SAR imagery can be performed, a 3D model which is geometrically realistic enough is required. Also, materials have to be assigned to the different parts of the model and have to be stored. For such simulations a high level of detail is of great importance, since corners, even small ones, induce a large part of the signature in urban SAR imagery. This is achieved in several processing steps. If the city model consists of just the buildings, a ground level has to be added, preferably a digital terrain model (DTM). Since high vegetation tends to significantly conceal building signatures, it has to be provided for in the 3D model. Using a detailed 3D model of a single tree and a semi-automatically generated positioning list, trees with random orientation and size are inserted in the correct positions in the scene automatically. This approach provides the buildings and trees as separate objects, so that it is easy to assign separate materials to them. For other areas, such as streets, low vegetation, and water, for which a radiometric differentiation is also of crucial importance, ancillary data must be employed. The raster GIS map we use for this purpose is nowadays universally available from open sources. After co-registration of the GIS map to the DTM and definition of the color values of the different classes, an automated process locates the corresponding areas in the DTM and stores them as separate objects. To this end, the DTM heights are interpolated to a finer grid, since the resolution of a DTM often is too low to effectively define the contours of the class areas. Resampling the GIS data to the same grid and triangulating this grid provides the 3D model including the class affiliations. Figure 1 shows a 3D model processed in this way, depicting a scene of the city center of Christchurch before the earthquake in 2011.

Result

Using real sensor properties and the imaging parameters of the real post-event SAR image, the simulation of the pre-processed 3D scene enables the extraction of information via change detection without a pre-event SAR image. As can be seen in the visual comparison in Figure 2, the pre-event simulation (a) and the post-event TerraSAR-X image (b) are in good agreement in areas where there is no damage. This allows areas in which there has been a change – as, for example, the collapsed building in Figure 3 – to be distinguished. This provides the prospect of an automated technique for the detection of damaged buildings.

Project funding

Bundeswehr Technical Center for Information Technology and Electronics (WTD 81) in Greding

Project execution

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Literature

[1] Kuny, S.; Hammer, H.; Schulz, K.: Preparing a new data set for earthquake damage detection in SAR imagery: the Christchurch example I. Proc. of SPIE, SAR Image Analysis, Modeling, and Techniques XIV, doi: 10.1117/12.2065833, Vol. 92430X, pp. 92430X-1 – 92430X-8, 2014

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1

REAL-TIME AERIAL VIDEO EXPLOITATION FOR SURVEILLANCE AND RECONNAISSANCE

Video exploitation is one of the major backbones of modern reconnaissance and surveillance systems. However, most existing video processing solutions only provide basic video visualization features. In this context, Fraunhofer IOSB has developed the video exploitation system ABUL, which integrates current research results in order to disburden operators by assisting them in the exploitation process.

Task

Recent developments in sensor, sensor platform, and communication technologies lead to an increasing amount of data that operators have to process and exploit in order to fulfill their task. The time needed for processing the data is, in many cases, critical for the success of the mission. This means that real-time processing of (video) data is essential. Current aerial video processing solutions support only basic video visualization features, e.g. contrast enhancement and simple object tracking. The goal is to develop together with end-users a video exploitation system that assists operators in fulfilling their tasks more efficiently by providing state-of-the-art algorithms in a user-friendly system. This includes on the one hand the development and integration of a variety of algorithms for, e.g., activity recognition, super resolution and mosaicking in real-time for different sensors (IR/VIS, SAR, SD/HD …) and scenarios, e.g. wide area aerial motion imagery and oblique zoom views; on the other hand, geospatial data processing, optimized human computer interfaces, and interoperability are essential features for such a system.

Result

In close collaboration with end users, Fraunhofer IOSB has developed the ABUL video exploitation system, which integrates state-of-the-art algorithms for real-time and offline processing in order to assist operators in their work. Standardized data formats and interfaces, e.g. to the Coalition Shared Data (CSD) Server, guarantee interoperability with other systems. A novel database for storing raw video and geo data allows efficient retrieval of video data content, for example for change detection. Originally developed for remotely piloted aircraft systems, the video processing algorithms of ABUL are not restricted to this application. Several projects have demonstrated that the algorithms are general enough to process data received from maritime and land-based reconnaissance systems or surveillance cameras. MABUL, a mobile version of ABUL, is the latest development and provides selected functionalities for notebooks or tablets.

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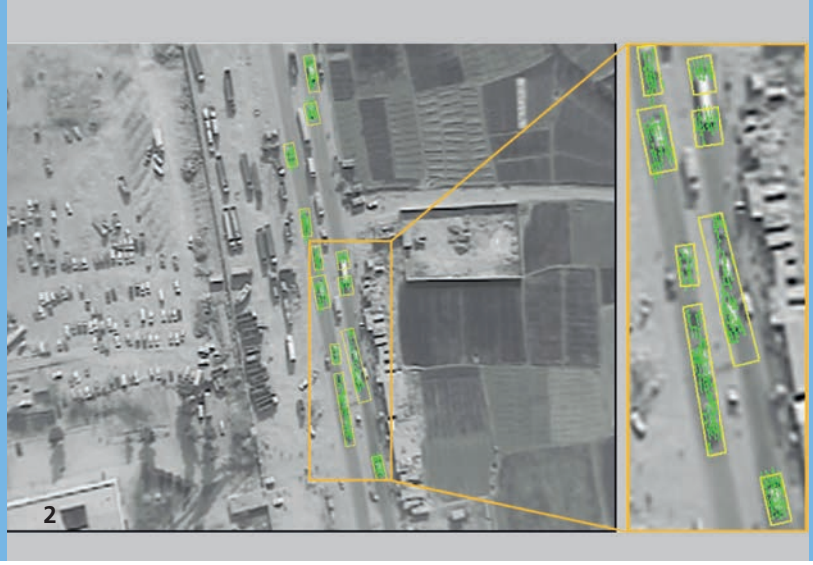

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Recently, the Air Force Imaging Reconnaissance Training Center (AZAALw) in Fürstenfeldbruck established a novel training room for aerial reconnaissance officers. One key element of the training is the use of ABUL, which closes the gap between algorithm research and application in operational systems.

Project description

The ABUL video exploitation software is the result of more than 10 years of development, integration and close collaboration between end users, industry partners and the Fraunhofer IOSB. ABUL provides real-time optimized features for online surveillance and tactical reconnaissance as well as functionalities valuable for offline reconnaissance tasks. These algorithms cover, for example, activity detection, tracking of objects, geo-registration, and image enhancement, such as stabilization and multi-frame super-resolution [3, 4, 5].

Furthermore, Fraunhofer IOSB works on novel image processing methods for change detection [6] and 3D reconstruction. In this context, a newly developed video database plays an important role [1], [2]. This database system allows the user to efficiently search for specific reference material in several hundreds of thousands of images. For this purpose, the user may look for geographical information as well as specific markers or image properties, such as ground sampling distance (GSD) or viewing angle.

In addition to efficient algorithms for image and video exploitation, interoperability with other systems is crucial for mission success. ABUL therefore supports processing and generation of STANAG 4609 video streams and other STANAG-compliant products for both images (STANAG 4545) and tracks/plots (STANAG 4607). Moreover, it is equipped with an interface to the CSD Server developed at Fraunhofer IOSB to provide NATO-wide distribution of products, such as mission reports, generated by other exploitation systems. An interface to the Fraunhofer IOSB tool i2exrep (STANAG 3377) is also implemented.

Funded by industrial contracts, Fraunhofer IOSB does not only develop computer vision algorithms but also a complex system that fulfils end-users needs such as reliability, user-friendly design and interoperability.

Project execution

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Dr.-Ing. Markus Müller,
Dipl.-Inform. Jochen Ring,
Dipl.-Inform. Arne Schumann,
Dipl.-Math. Günter Saur,
Dr.-Ing. Tobias Schuchert,
Raphael Senk,
Lars Sommer, M. Sc.,
Dipl.-Ing. Christian Teutsch,
Dr.-Ing. Michael Teutsch,
Patrick Trantelle, M. Sc.,
Sascha Voth, M. Sc.

1 *UAV LUNA in launch position. ABUL provides not only support for LUNA and Ranger, but also interoperability by meeting the STANAG 4609 video interface standard.*

2 *Vehicle detection and tracking algorithm from video data.*

3 *AutoTrack prototype user interface.*

Customers

Airbus, armasuisse, EMT, WTD 81

Literature

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SECURITY

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Mission

The business unit Security focuses on the security needs of people, companies and official bodies, which wish to protect against natural and intentionally planned hazards, and comprises a broad range of interlinked competencies that deal with sensor sphere optronic aspects as well as multimodal surveillance robotics (on land, at sea and in the air), the development of ultra-modern analytical methods, the support of interoperable standards for the real-time exchange of information for risk detection and management as well as assistance in the situational analysis and human machine interaction in situation centers.

Considering that new technologies are being discussed in controversial manner with respect to conflicting aspects of security needs and the need for freedom, particularly if they are associated with surveillance, IOSB pursues the notion of "Privacy by Design", which requires that privacy criteria are already accounted for during the design of the system. Furthermore the protection of industrial installations and production capabilities against cyber-attacks in the context of the "Industry 4.0" paradigm is an uprising task for which IOSB has already set up working groups and projects.

The range of services spans from studies (e.g. for evaluation) to the realization of experimental systems or prototypes and in individual cases up to and including system development. In typical projects the security researchers of Fraunhofer IOSB support customers in their efforts to improve their competitive position, addressing challenges previously thought too difficult with new product generations featuring innovations from the cutting edge of research.

Markets

The business unit Security serves customers from the private and public sector. The former includes, among others, security technology providers, security service providers and operators of properties with critical security profiles. IOSB serves official bodies at the federal, state and municipal level in the public sector, particularly official bodies and emergency services, which aim to identify and evaluate new technologies in order to fulfill their duties.

IOSB is available as a partner for specialized small and medium-sized companies for the development of product innovations and considers itself to be a research resource for companies, which would also like to benefit from new scientific results without maintaining their own research department. Scientists from the business unit Security often take on demanding subtasks in large projects on behalf of large companies. System integrators integrate IOSB developments in their systems, for example based on licenses.

Prior to or after acquisition of their contracts, security service providers and IOSB discuss the possibilities for further increase in the efficiency and/or effectiveness of their work by means of using new technologies; if necessary, IOSB involves industrial partners for commercial development and 24/7 support of the systems. Providers of novel high-tech products, which want to offer their own customers assurance with respect to their performance claims, commission IOSB with lab evaluation and benchmarking tests, on the basis of which absolute and/or relative conclusions relating to performance can be drawn. IOSB experts offer consultation to companies or official bodies, which are preparing large invitations to tender for security systems, particularly when it comes to the issue of relevant new technologies. This particularly includes the evaluation of technologies with respect to their suitability for certain objectives.

Companies that intend to resort to publicly funded research projects in order to enhance their portfolio receive assistance by IOSB when it comes to identifying suitable funding programs and preparing a proposal. During the course of a project, IOSB acts as a research partner. Furthermore IOSB finds funding programs and suitable partners from industry for users in search of new technologies for their fields of activity.

In a technological respect and according to the overall research proposition of Fraunhofer IOSB, methods and systems for image exploitation are a core area, which are for example developed for property surveillance in both indoor and outdoor areas. With its competencies, IOSB handles the entire chain from sensor-sphere data acquisition, sensor carriers and their automatic control for surveillance missions, analysis on an automatic or human-machine basis, multi sensor fusion, and situation analysis up to and including the use of information acquired in this manner for higher-level management support. System design in compliance with privacy protection is an explicit topic of research and part of the consulting portfolio of the business unit Security.

Equipment, laboratory and test facilities

- Comprehensive laboratory equipment for capturing the entire image processing chain, from sensors through analysis to interoperable information exchange
- Innovative, powerful sensors, such as eye-safe gated viewing lasers, two-color infrared sensors, multi- and hyperspectral sensors, and remotely-sited laser vibrometry systems
- Distributed test setups for multi-camera tracking and privacy-compliant video analysis in public spaces
- Multimodal sensor platforms: Experimental robotics on land, at sea and in the air, and associated ground control stations (stationary and in vehicles) for mission planning and control in heterogeneous deployment networks
- A "Smart Control Room" lab as a "perceptual room"
- Mobile Control Center – a truck-based experimental platform for on-site situation management support

References and product features

- Fraunhofer IOSB as strategic partner for security research and technology of the German federation of security services (BDSW)
- Armasuisse / Swiss Confederation: UAV-based systems for border surveillance
- Various event organizers: Providing security at major events with IOSB sensors and sensor carriers
- Federal Ministry of Education and Research (BMBF): Systems for water quality monitoring
- Federal Ministry of Education and Research (BMBF): Video assisted systems for detecting conspicuous movement patterns, attacks and assaults, and abandoned luggage
- European Union (EU): Systems for identifying victims of natural disasters and searching for missing persons
- European Union (EU): Systems for offshore monitoring (detection of illegal border crossings and, smuggling of people, weapons, and drugs)
- European Union (EU): Systems for the protection of critical infrastructures and utility networks


1

ADAPTIVE OPTICS FOR LASER COMMUNICATIONS

Free-space optical communications

Free-space optical communications is an excellent example of a technology with both military and civilian relevance and also with compelling scientific timeliness and good market prospects. Based on experience of the IOSB's employees in the area of laser beam propagation through turbulence, new laser-based telecommunications concepts are being designed, implemented and tested for resilience against strong atmospheric disturbances.

Task

Free-space (i.e. not cable- or fiber-dependent) communications is not a new concept. People have been communicating using radio waves and microwaves since the experiments of Heinrich Hertz in 1887. The high current interest in laser-based communications can be explained by the following facts:

- Laser light is directional, precluding the possibility of eavesdropping on a laser channel
- Smaller wavelength, in comparison to radio and mm-waves, translates into higher bandwidths and smaller antennas (smaller antennas, in turn, imply the opportunity of deployment of such devices on small, possibly moving platforms)
- No required license for spectrum usage for frequencies higher than 300 GHz (wavelengths smaller than 1 mm)

Naturally, the technology of free-space laser communications is, as the name implies, not dependent on cable availability between the terminals. As such, it is foreseen as a promising solution to the "last-mile" problem (the final leg of the telecommunications networks is typically the speed bottleneck), provision of bandwidth in rural regions, and emergency services in remote areas, especially in combination with satellite links. Military applications include transfer of intelligence, surveillance and reconnaissance (ISR) data between ships and from ship to shore, temporary battlefield networks, and long-range, secure data transfer.

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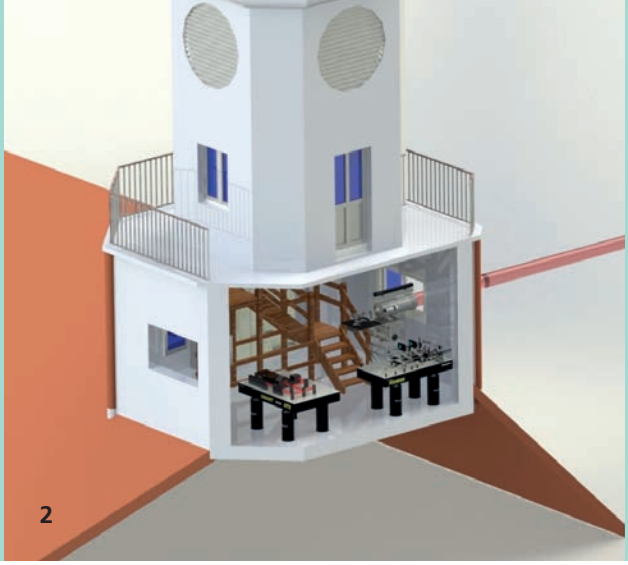
However, atmosphere can have a big impact on the performance of laser-communications systems. Putting aside completely disruptive phenomena, such as rain or fog, atmospheric turbulence influences the power delivered to the terminal and the number of errors in the transmission. Our simulations show that in a not-so-challenging scenario of propagation



over only 400 m one may find oneself four to five orders of magnitude away from the target bit-error-rate level of 10-10, which is considered an industry standard.

Result

Fraunhofer IOSB addresses the problem with advanced adaptive optics (AO). This technology aims to improve the performance of optical systems by reducing the effect of wavefront distortions (here induced by the atmosphere). The simplest AO system consists of a wavefront sensor measuring the aberrations of a laser beam which had travelled through the atmosphere, a computer which translates this measurement to correction commands, and the deformable mirror which accepts these commands and changes its shape at kHz speeds to correct the incoming wavefronts. In the AO laboratory in Ettlingen we are researching approaches to the most challenging problem of laser propagation through strong turbulence near the ground. A holographic wavefront sensor [1] is being put forward as one solution. This device has several major advantages over traditional wavefront sensors: for example it eliminates the need for one component of a standard AO system – the computer – because it senses the aberrations directly (optically) at the speed of light. It has proven very robust in the laboratory experiments [2]. Additionally, researchers at IOSB have discovered that the sensor is very resilient to the most challenging turbulent phenomenon – scintillation – which causes random obscurations or saturations of sections of the detector. Its robustness makes this sensor particularly suitable for scenarios in which laser light is propagating through strong turbulence, usually encountered in terrestrial links.

Project description

The holographic wavefront sensor will be tested alongside the classic Shack-Hartmann approach over an experimental path of 400 m between the Institute and the nearby church (Fig. 1). Next tests will be carried out in the new Laser Communications Laboratory over a very challenging path of 8 km between Ettlingen and Karlsruhe (Fig. 2). The new laboratory is funded by the "Strategischer Kleinbau" Programme of the Fraunhofer Society. At the same time, tests of various communications approaches can be carried out in the custom-built turbulence simulator. Work is also underway to verify the feasibility of laser communications underwater.

Acknowledgment

This research is part of the ATLIMIS project (Atmospheric Limitations of Military Systems, No. E/UR1M/9A265/AF170), commissioned and sponsored by the WTD91 (Technical Centre of Weapons and Ammunition) of the German Armed Forces. Funding for the Laser Communications Laboratory came from the "Strategischer Kleinbau" Programme of the Fraunhofer Society.

1 *First-generation laser propagation system for measurement and – in the future – correction of atmospheric turbulence over a distance of 400 m.*

2 *Design of the new Laser Communications Laboratory (superimposed over real background in the right picture). The laboratory will be ready to host experiments in 2016.*

Project execution

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Andreas Zepp, M. Sc.,
Rui Nuno Almeida de Sa Barros, M. Sc.

Literature

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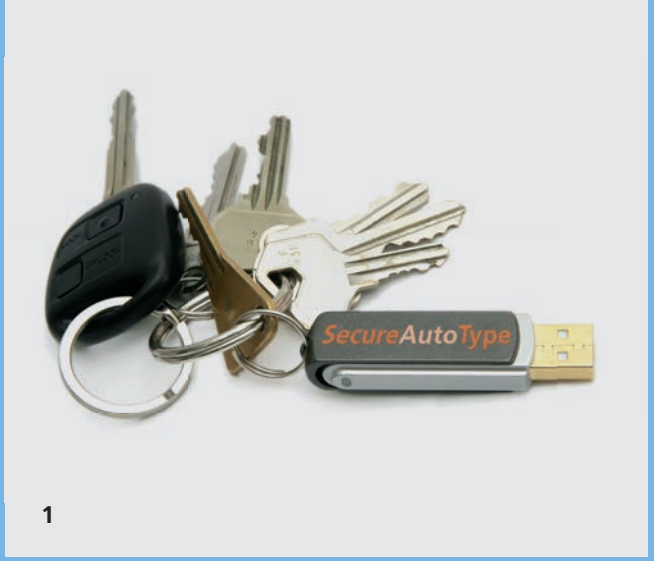

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SecureAutoType - SECURE AND USER-FRIENDLY PASSWORD MANAGEMENT

Almost all online services use password-based authentication schemes, many of them exclusively. Despite this, password management is still a largely unsolved problem for the individual user. In this project a hardware device has been developed that helps users conveniently manage large numbers of highly secure passwords.

https://www.youtube.com/watch?feature=player_embedded&v=D5uMkKtsXFg

Task

In order to protect the accounts from dictionary-based brute-force attacks – where the attacker tries out many different passwords in a short space of time – the German Federal Office for Information Security (BSI) recommends that every password should have at least 12 characters and that special characters should also be included.

Another attack vector that endangers the confidentiality of password-protected resources is the leakage of existing password databases. Due to programming errors and misconfigurations of servers, hackers have managed to copy entire password databases from existing online services in the past. Together with other personal information – e.g. e-mail addresses – the hacker can now try to gain access to other online services with the valid assumption that users have used the same set of e-mail and password for **multiple accounts**. Hence it is critical to use a unique password for every single account.

These two requirements, combined with the fact that the average German already uses about 50 different online accounts, create an enormous challenge. Most people are not able to memorize the required number of secure passwords.
There are several solutions on the market that address this problem, but all of them fall short in at least one of the following areas: security, usability or universal applicability. Therefore those approaches lack broad acceptance in the general population.

Result

The department of Secure Communication Architectures (SKA) of Fraunhofer IOSB has set out to find a solution that combines security and universal applicability with good usability. SecureAutoType is the result of intensive internal discussions and many improvement iterations of the original idea.

SecureAutoType operates by combining the features of a standard smartphone with the functionality of a special hardware device, which is so small that it can be carried on a key ring.

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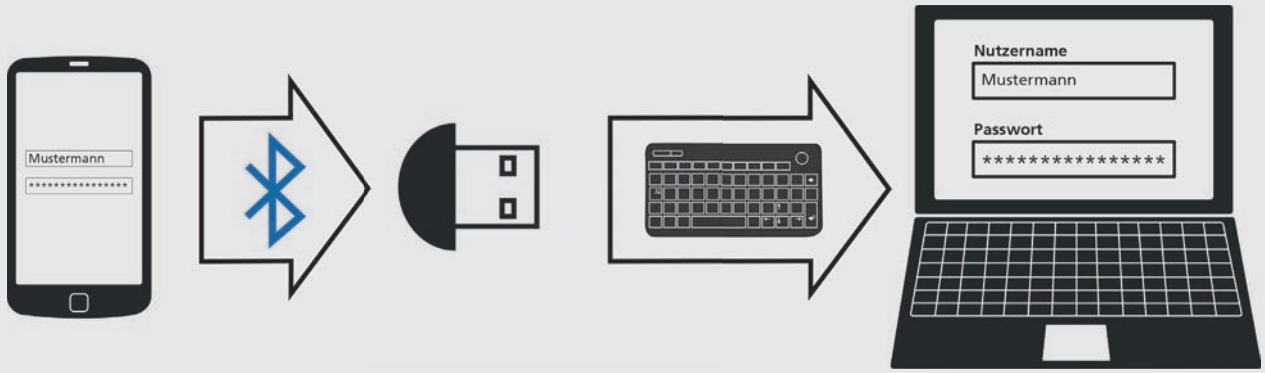

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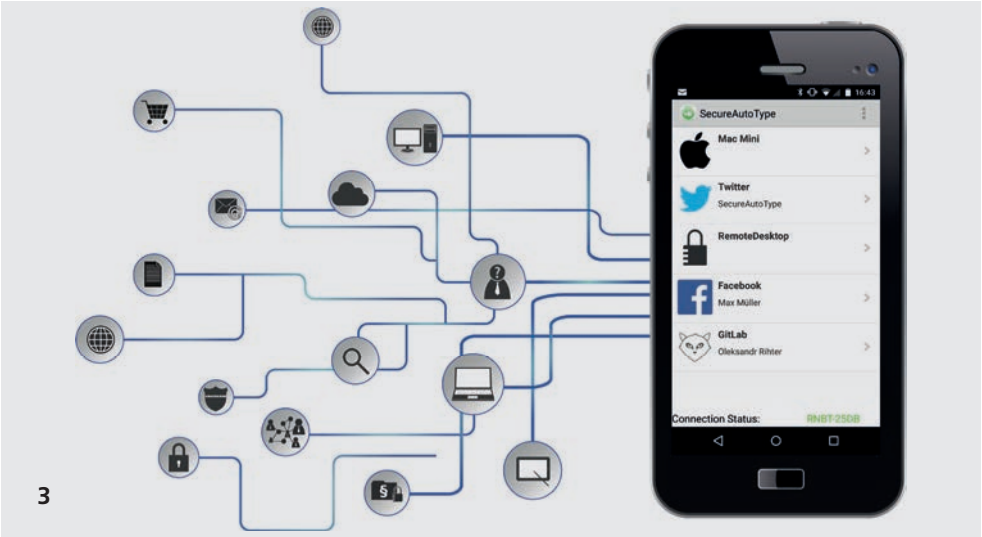
From the user perspective, the combination of a password database – located on the smartphone – and a special hardware device – located on the key ring – is easy to operate. If the user wants to retrieve a password he or she simply has to open the SecureAutoType app on the smartphone and select the appropriate account – e.g. a webmail account. The encrypted password is then send wirelessly to the SecureAutoType device where it is decrypted on the fly and automatically forwarded to the device where the authorization step is required. SecureAutoType offers a standard USB interface and is therefore able to emulate a standard keyboard when connected to a third-party computing device. This enables SecureAutoType to automatically type decrypted passwords into the required password fields, thereby relieving the user from cumbersome and error-prone typing of the password by hand.

While this method guarantees high usability for the end user, SecureAutoType also aims to provide strong security. First of all, the passwords stored on the user's smartphone are encrypted at all times. Even in the worst case – the smartphone is stolen or the password database is copied by malicious software on the device – the confidentiality of the passwords is maintained. The database is encrypted with state-of-the-art asymmetric encryption and the private key needed for decryption is only stored on the tamper-proof SecureAutoType hardware. Only the combination of the encrypted passwords on the smartphone and the SecureAutoType hardware device enables the decryption.
Another advantage enabled by the autotyping feature is the usage of longer and therefore more secure passwords.
By combining increased security with high usability, SecureAutoType tries to make an important contribution to solving the current password management problem.



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1 *SecureAutoType hardware on the keyring.*
2 *SecureAutoType in action – Entering login data.*
3 *SecureAutoType app on mobile device.*

Project execution

Dipl.-Inform. Erik Krempel, Mario Kaufmann, M. Sc.

Literature

[1] Krempel, E.: „SecureAutoType: Passwort-Manager neu gedacht" DsiN-Blog – Der IT-Sicherheitsblog für den Mittelstand. URL: https://www.dsin-blog.de/secureautotype-passwort-manager-neu-gedacht 2015

COMPANIES WITHIN SOCIAL MEDIA - WHO HAS THE CONTROL?

Nowadays, social media is a big part of our everyday life. Using Facebook, Twitter, Google+ and many other networks as a means of communicating quickly and sharing information with a lot of people is attractive to companies. A lot of employees therefore profit from these opportunities at their job. In Germany, 85% of companies have a profile in social media for recruiting, marketing and communication purposes. But is it worth the trouble?

Social media offers companies a chance to publish information rapidly and worldwide. They can update their ideas, offers and events to increase the rate of presence on the internet. Without any efforts or costs they are able to "share" whatever they want to publish. Posts, pictures and links help them to win additional recipients. As a result of reaching out to selected new customers, they share the information and yet others see the published content. Furthermore, this content can be redesigned and improved in a precise, well calculated and effective way without any delay.

However, using social media is also associated with risks. To question the negative aspects is important: In what way is the company at risk? What threat is given for the employees while using their social media account at work? Who is in control of your data and information?

Private users of social media are mostly aware of the potential danger of publishing private information. They know about the risk presented by their web presence. Many employees, however, are not aware of the difference between using social media in private and at work. Small mistakes can result in problems for employees themselves, the company they represent and their private life.

By abusing sensitive information, a data leak may be damaging good reputation, irrespective of the size of a company. Even small or mid-sized companies and their personnel can be a target of attacks within the internet. According to statistics, 90–95% of online attacks are targeted at individual persons. Hackers use various data, information, and methods stopping at nothing to harm a company in pursuing their goals. Their methods include sending scam emails, smuggling malware into the company or stealing highly confidential data and documents.

Once a hack or data leak is discovered, it is usually too late: Companies pay with their data. The fact that there is no contract or agreement between the operators of social media platforms

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and the companies increases the risk of such events. Ultimately, the platform operators are responsible for the connections between the information and its transmission. Despite this, companies continue to use social media. And issuing permissions and prohibitions to their employees does not eliminate this risk.

But which is the right behavior and policy? Who should be allowed to communicate on behalf of the company?

First of all, the company must formulate a guideline to protect involved parties. Secondly, employees must be informed about methods of using social media as well as being aware of the consequences of misapplying those rules.

To ensure safety when using a social media platform the company can also fall back local laws. Data privacy, copyright and trade mark laws, also apply to the internet covering updated texts, pictures, photos and videos as well as the rules of citation.
In addition to using the applicable laws, companies are also advised to create a Social Media Team within their departments or sectors to promote contact between the press and the marketing department. They must make sure that they are always informed about processes and changes on the company's website. They also have to keep record of official activities and, if necessary, establish alternative ways of exchanging data between the company and its customers beside the social media platform (e.g. using e-mail or web forms). To establish regulations for labor laws or internal agreements and declarations regarding the use of social media, they have to be party to every labor contract. Thus malpractice with social media and unwanted situations can be prevented.

It is recommended to raise awareness within the whole company, even if some departments might not come into contact with social media at work at all. These measures may in addition have a positive effect on colleagues and their private use of social media. It is necessary to point out that a person should never provide any information relating to identity, such as their date of birth, postal address, or telephone or cellphone number on social media platforms. Even browser information about the owner of the website and its security characteristics should be considered because a lot of social media platforms use their own specific regulations.

Controlling the propagation of your profile information and any shared content is no longer possible after joining a social media platform. From the moment of being part of social media, a person must be aware of the related risks. Data and information are shared out rapidly. Being careful and considered with public appearance is good advice for behavior both at work and in private; mixing the two, employees must be aware of the resulting risks for themselves and their company.

SMALL UNMANNED AERIAL VEHICLES: LOW AIRSPACE SURVEILLANCE AND COUNTER MEASURES

Controlled and safe urban airspace

Small Unmanned Aerial Vehicles are getting better, cheaper and more accessible. As a result, they are increasingly used in new areas of application. A noticeable side-effect of this development is an increasing number of more or less hazardous incidents with these systems. Not only illegal activities, such as spying and drug transportation, but also the disturbances or even simple mishaps that can happen with any technical system can lead to dangerous situations. To keep urban airspace controlled and safe, new Low Altitude Air Surveillance Control system (LASC) can be used.

Task

Unmanned Aerial Vehicles (UAVs) are an emerging technology with a great potential for disruptively changing our lives. Their capabilities have by far exceeded those of the niche product radio-controlled model aircraft in terms of payload, flight duration and range, self-stabilization and auto pilot capabilities, and automated collision protection and video transmission capabilities. Leveraged with new technologies, small UAVs have started to go beyond the toy and entertainment domain while entering more and more real business and scientific applications (e.g. surveillance, reconnaissance and rescue mission support, video production, logistics and delivery, archaeology, and biology). Furthermore, with the broad availability and low cost of UAVs, a common and unforeseeable use of this technology is expected in the private sector.

As always, each technology comes with drawbacks and the potential of abuse, and this is particularly true for UAVs. With their inherent risk of crashing and the resulting damage and harm to persons and goods, each application must be carefully assessed for security issues and constraints [1].

To enforce regulations and to react efficiently and on time to violations and emerging security risks, new technologies are required to detect and intervene in these systems.

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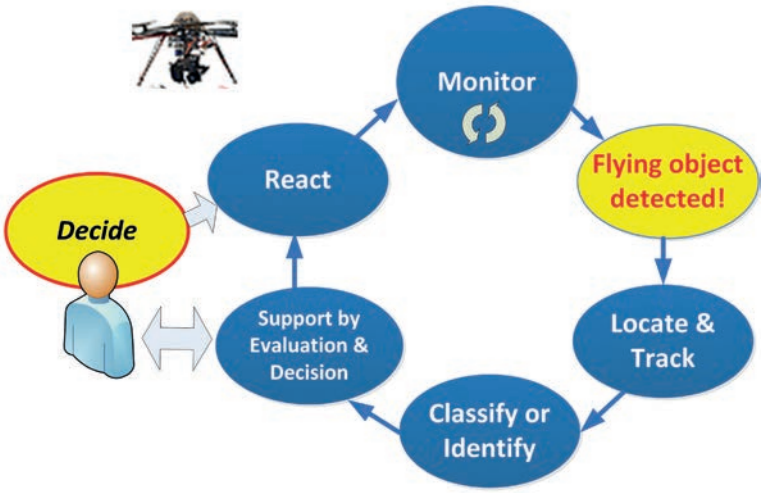
Result

The major functional objective of a LASC system is the surveillance of the currently uncontrolled airspace below about 500 m – primarily in urban areas. The LASC system concept includes



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multi-sensor detection, localization, tracking, and classification or identification of small UAVs integrated in a scalable distributed system.

The common workflow of LASC is depicted in Figure 1. The system starts with the continuous monitoring of airspace with multiple sensors. Once a sensor detects a flying object, the system will try to locate it and ensure tracking by orchestrating multiple sensors. Once location and tracking are established, the back-end IT system of LASC must perform a classification and, if applicable, identify the detected object. It then starts an evaluation of the UAV's authorization to fly through the current airspace corridor. If no authorization is given, the system prepares possible responses, considering the estimated threat classification and risk assessment as well as decision support to a human operator who is in charge of initiating the suitable countermeasures. All of these activities will be automated to a high degree in order to guarantee a real-time execution of the process and to enable high scalability for multiple events.

1 *Common workflow of the LASC system.*

Customer
Atos SE

Project execution
Dr.-Ing. Igor Tchouchenkov, Dipl.-Wirt.-Ing. FH Florian Segor, Dipl.-Ing. FH Matthias Kollmann

Project description

To find efficient solutions and provide a future-proof holistic system design, a joint project between AToS SE and Fraunhofer IOSB has been set up and the concept for a Low Altitude Air Surveillance Control (LASC) system for control of small UAVs has been developed. Its main features are the utilization of multi-sensorial data (video, infrared, RF, radar, laser scanner, and acoustic) and background knowledge to assess and evaluate risks and provide adequate situation-dependent countermeasures.

Besides their detection, the classification of threats and the safe identification and distinction of legal UAVs is a challenging task. But not only the current position and type of a suspicious UAV must be recognized to assess the risk: much more important in these cases is the payload.

Possible countermeasures include soft jamming of the remote control link and GPS spoofing. A more efficient but also much more challenging solution is a control takeover. If successful, the UAV in question can be landed in a suitable place. The selection of suitable countermeasures for different situations and threats is interactive and is based on a comprehensive predictive assessment of the threat the UAV poses and its payload.

The scalable architecture of the distributed LASC system has open interfaces wherever possible and includes data analysis and fusion modules, a coalition shared database as well as interactive visualization and decision-support components. The LASC system must be integrated into conventional air traffic control to prevent possible incidents due to intersecting airspaces.

The next task is to develop major components of LASC as well as a system framework and test these in different situations.

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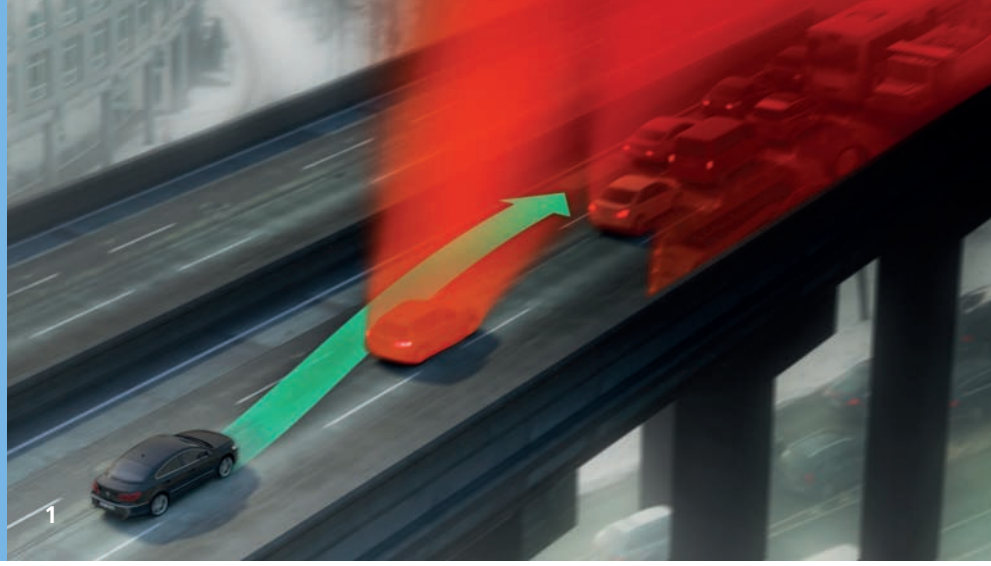

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AUTOMATED DRIVING AND VIRTUAL TEST DRIVING

Following the pioneering achievements of the IOSB in the field of automated driving during the 1990s, department VID joined forces with Valeo Schalter und Sensoren GmbH in 2012 to develop an artificial intelligence for fully-automated driving. The task was to use processed sensor data, stored in a dynamic map of the environment, to plan an optimal maneuver through complex inner-city traffic situations. The developed solution, named SPARC (Situation Prediction and Reaction Control), aims to revolutionize several fundamental aspects of how trajectory planning was performed thus far. As a by-product of the research towards automated driving, we developed OCTANE (Open Control Testbed for Automotive Numerical Evaluation), an open source-based platform for virtual test drives.

SPARC: A New Concept for Automated Driving

The motivating idea of the SPARC concept [1] is to fuse all tasks related to environment interpretation and maneuver planning into a single mechanism, capable of continuously handling all forward driving functions, capable of explicitly modeling uncertainty through a sound statistical framework, and capable of simultaneously considering all modeled goals (such as safety, traffic rule compliance, comfort, and ecology). The underlying statistical framework provides a verifiable and flexible interface to different perception, prediction and planning algorithms, which in turn can be tailored independently to account for various degrees of computational power.

The mechanism is divided into two eponymous stages: Situation Prediction (SP) and Reaction Control (RC). The SP stage receives input from the environment perception and mapping layers of the automated vehicle and interprets the information in order to predict the imminent development of the scene, in particular the possible motions of other traffic participants [2]. Occupancy probabilities are combined with further information about the object, such as its type and its expected speed. The situation prediction also infers applicable traffic rules, such as speed limits and no-passing lines. The information accumulated in this way about the vehicle's predicted environment (about five seconds ahead) is called the pre-penalty field, which is updated and passed on to the RC stage at a rate of approximately 10 Hz.
The RC stage takes the pre-penalty field and a list of next waypoints and plans a trajectory that runs close to these waypoints and considers the following goals:

- **Safety**: Avoiding collisions based on the expected detriment, which arises from the occupancy probabilities, the other objects' type (e.g. a twig, a guardrail or another traffic participant) and their relative and absolute expected speeds.
- **Legality**: Avoiding traffic rule violations based on the severity of the violation, e.g. passing a red light at an intersection, overtaking a vehicle on the right, exceeding the speed limit. Regular traffic rule violations are outweighed by the necessity to clear the way for emergency vehicles.

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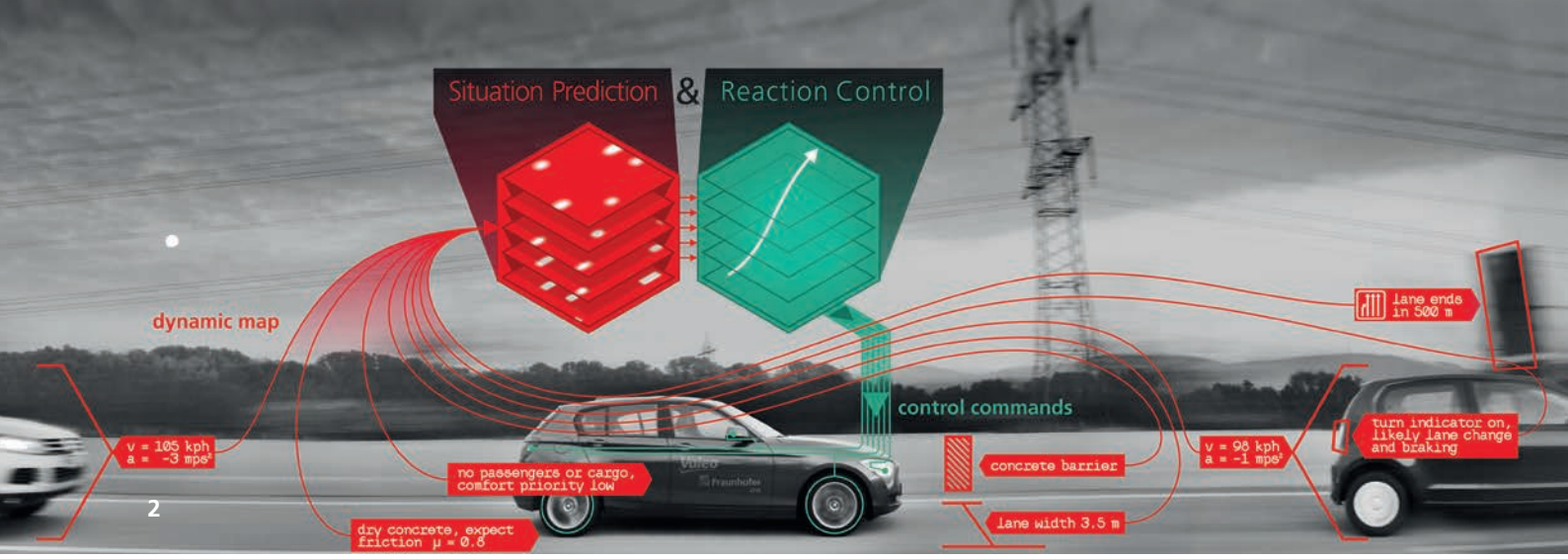

- **Comfort** and **Ecology**: Avoiding strong longitudinal and lateral accelerations, as well as speed bumps and potholes to reduce unpleasant forces on the passengers and minimize unnecessary emissions as well as wear and tear. The extent of avoidance can be varied to provide sporty or comfortable driving styles without affecting safety.
- **Effectiveness**: Minimizing the time to arrival at the final destination.

The optimal trajectory needs to satisfy all above goals according to their priority, similar to how a human driver would act, though in a way that is more reliable, more reproducible and less susceptible to human limitations in perceiving the environment, considering the physical limits of the vehicle and performing the necessary actions in fractions of a second. The RC stage not only obtains the optimal trajectory, but also a fail-safe emergency trajectory [5] and the corresponding control commands for the actuators. Since the planning horizon by far exceeds the planning rate, only the first few control commands are usually relevant; the long-term planning is used to assure anticipatory driving.

The combined system can constantly resolve all driving situations, from following another vehicle, through overtaking scenarios and complex inner-city traffic involving pedestrians, bicycles and cars, up to pre-crash situations. There is no need to switch responsibilities between dedicated planning algorithms during runtime, and instead of choosing parameters for each dedicated planner separately, SPARC solutions are governed by a single set of optimality criteria for safe, rule-compliant, comfortable and efficient driving. Additionally the sound statistical framework offers an integration of all stochastic models into the analysis, including sensor uncertainties, uncertain prediction models and even uncertain actuator results.

Recent results equip SPARC with the ability to employ global optimization of trajectories in real time [3, 4], based on the well-understood optimization criteria that are described above and that previously only lent to purely local optimization. This novel method enables an efficient hardware implementation of the trajectory planner while at the same time avoiding many pitfalls associated with local optimization.

OCTANE: An Open-Source Virtual Test Drive Platform

The development of SPARC shed light on an issue that is common in research on advanced driver assistance systems (ADAS) in general: Vast amounts of test drives are necessary to determine and continuously verify safety-critical parameters of systems – a challenge even for large automotive manufacturers. Simulation methods are widely used, yet their underlying model assumptions are rarely transparent to the companies employing them.

Aiming for a common and open standard on testing and evaluating models and algorithms in the field of automated driving – in particular in the case of safety-critical functions – we initiated OCTANE (Open Control Testbed for Automotive Numerical Evaluation), an open-source framework for simulating vehicle dynamics, traffic flows, sensor perception and weather conditions. The key motivation of OCTANE is to satisfy the principle of full disclosure, to provide the possibility for an exhaustive model and tool validation performed by a large community.

1 *SPARC can handle emergency situations as well as regular driving.*

2 *Overview of the SPARC concept for automated driving.*

Project execution

Dipl.-Ing. Miriam Ruf,

Jens Ziehn, M. Sc.,

Dr. Dieter Willersinn

Literature

[1] Ruf, M.; Ziehn, J.R.; Rosenhahn, B.; Beyerer, J.; Willersinn, D.; Gotzig, H.: Situation Prediction And Reaction Control (SPARC). In Färber et al. (eds.), 9. Workshop Fahrerassistenzsysteme (FAS), 2014

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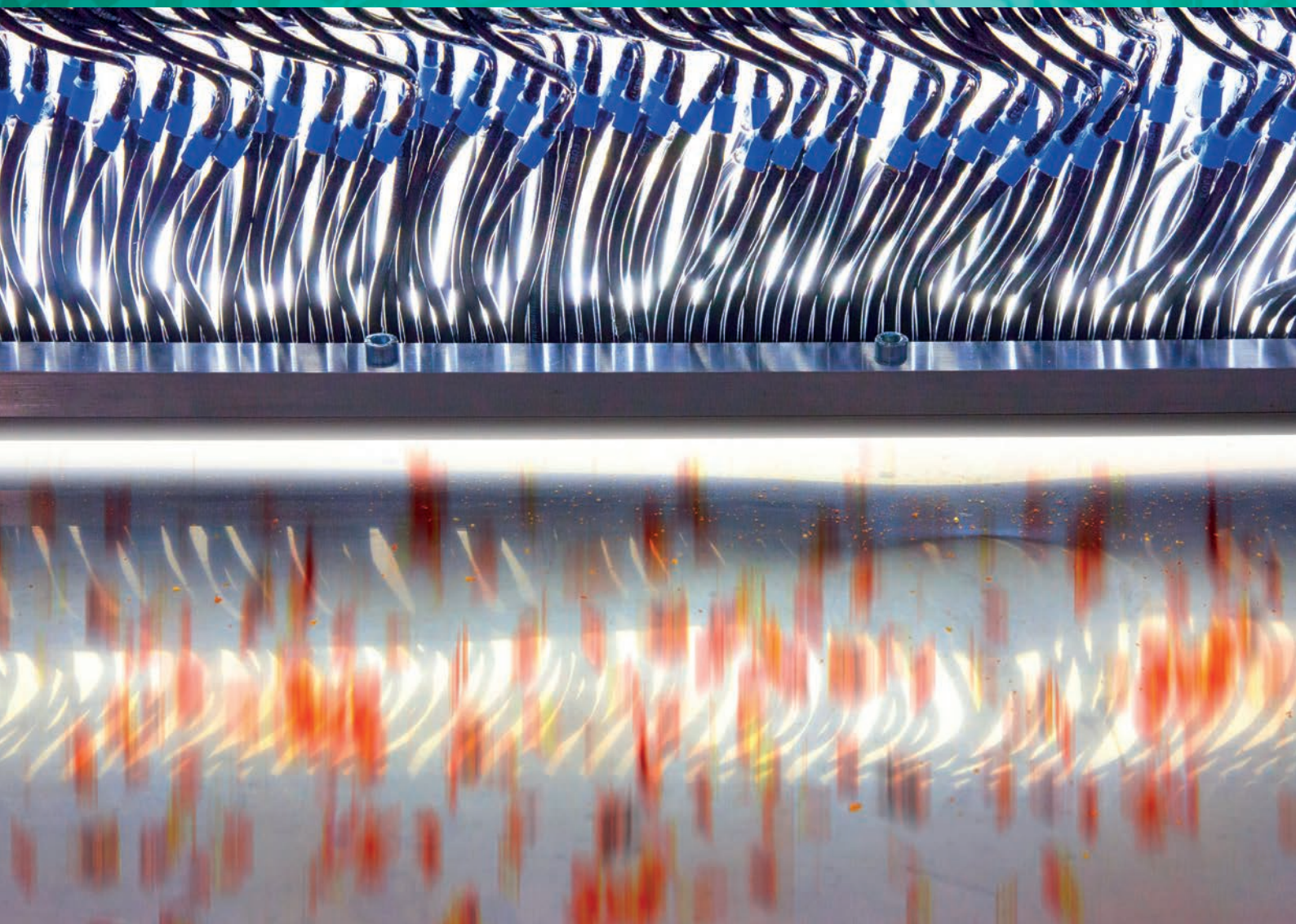
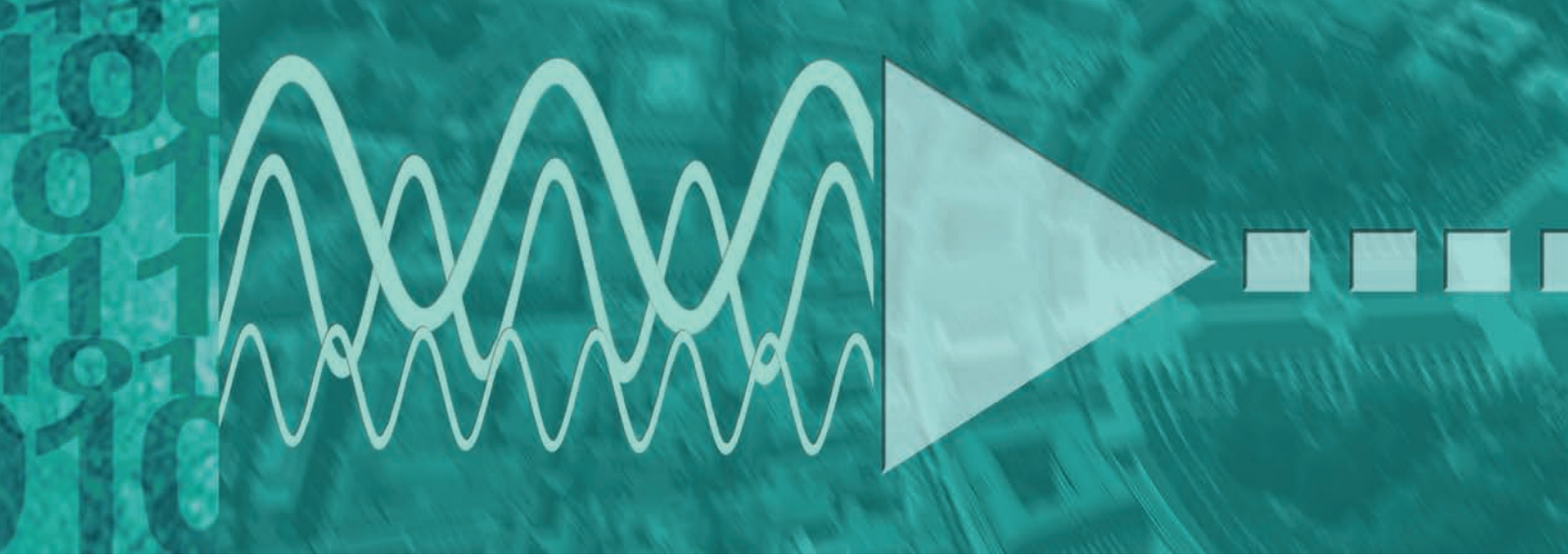
[3] Ziehn, J.R.; Ruf, M.; Rosenhahn, B.; Willersinn, D.; Beyerer, J.; Gotzig, H.: Correspondence between Variational Methods and Hidden Markov Models. In Proceedings of the IEEE Intelligent Vehicles Symposium (IV), 2015

[4] Ruf, M.; Ziehn, J.R.; Willersinn, D.; Rosenhahn, B.; Beyerer, J.; Gotzig, H.: Comparison of Local vs. Global Optimization for Trajectory Planning in Automated Driving. In Stiller et al. (eds.) 10. Workshop Fahrerassistenzsysteme (FAS), 2015

[5] Ruf, M.; Ziehn, J.R.; Willersinn, D.; Rosenhahn, B.; Beyerer, J.; Gotzig, H.: Global Trajectory Optimization on Multilane Roads. In Proceedings of the IEEE 18th International Conference on Intelligent Transportation Systems (ITSC), 2015

CORE COMPETENCE OPTRONICS





OPTRONICS (OPT)

Competencies and portfolio

The Department of Optronics (OPT) develops methods for experimental and model-based performance evaluation and for optimization of passive and active optronic systems. Laboratory evaluation systems are being developed for infrared detector mosaics, thermal imaging equipment, image intensifier tubes and laser sensors, taking into account perturbation and hardening. Theoretical work related to novel evaluation methods and variables have resulted, among other innovations, in new analytical range models and imaging simulation models.

Our thermal range model ***IOSB_TRM4*** allows a calculation of the performance of scanning and rigid thermal imaging devices, and cameras in the NIR and SWIR spectral range. ***IOSB_TRM4*** is being continually adapted to current requirements and equipped with new features: Currently it is being extended for thermal bolometer cameras.

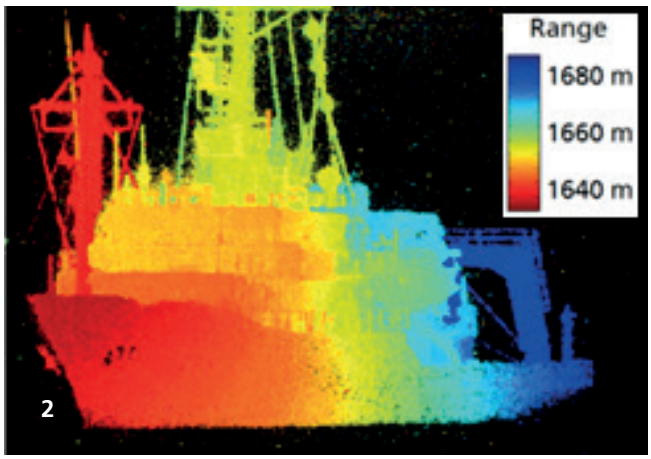
For image simulation of IR sensors in static applications, the simulation model SITOS(S) has been developed. This can be used to simulate real-life scenes from a thermal imaging device. The simulation uses high-quality IR image templates as a substitute for real-life scenes. Using a computer process the templates are degraded to the extent that the resulting image most closely resembles the image that the thermal imaging device being simulated would show of the scene.

New device concepts are being analyzed and assessed with ***IOSB_SITOS(S)***. For this purpose 3D scenes (simulation model ***IOSB_SITOS(D)*** for dynamic applications) are also generated, and visual simulations to evaluate the performance of imaging sensors conducted.

The use of laser sensors is often limited by the safety requirements associated with laser equipment. To estimate the hazard range of the laser sensor, the degree of reflection of the laser radiation from the investigated object must also be known. Both modeling and numerical calculation of the reflection behavior of laser radiation on surfaces that are subject to statistical fluctuations – such as water surfaces – present a particular challenge. For this purpose the dynamic water surface model ***IOSB_WOM*** has been developed.

Novel sensing methods and components are being developed and implemented in laboratory samples. They include gated viewing cameras and laser radars with heterodyne detection for determining 2D and 3D laser reflection signatures, and 2D vibration signatures for target classification over long distances.

1



2

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To obtain the 2D vibration signature, the laser beam scans the target in X and Y direction. For each measuring point a frequency analysis is performed. If the target vibrates (e.g. a running drive unit) a micro Doppler shift is imprinted onto the laser beam. This allows vibrating targets to be located through partial obstructions (vegetation, fog, camouflage nets, etc.) to analyze their vibration behavior. From the findings conclusions about the motorization of the objects can be drawn and their geometric shape partially reconstructed.

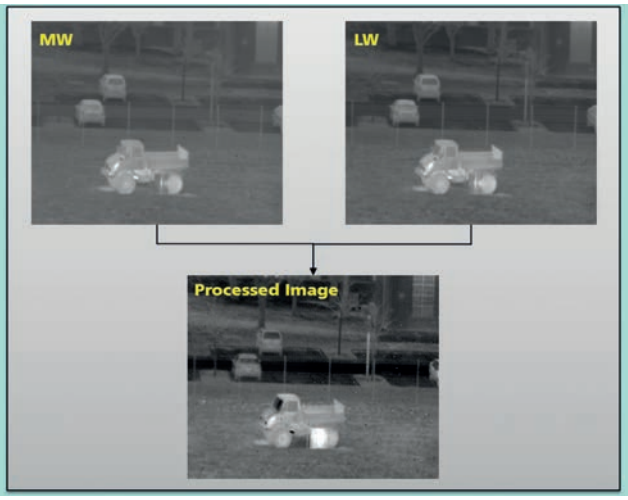
In addition, concepts for the protection from laser radiation are being developed for optronic sensors, with a particular focus on protection against laser dazzling.

Projects

- Laser radar demonstrators and methods for target classification
- Use of laser vibrometry for remote diagnosis of mechanical structures
- Analytical calculation, modeling (***IOSB_TRM4***), and experimental verification of the range performance of imaging sensor systems (passive and active) in the spectral range from UV to thermal infrared for military and civilian tasks
- Experimental performance evaluation of passive and active optronic sensors
- 3D scene generation and image simulation for performance evaluation of imaging sensors (***IOSB_SITOS(D)***)
- Eye protection against laser radiation (protection from dazzle and injury)
- Influence of and protection from laser radiation on optronic sensors
- Propagation phenomena of ultra-short laser pulses (femtoseconds) in atmosphere and in optical materials
- Investigations on the use of laser radiation in maritime environments using a water surface model ***IOSB_WOM***
- Development of laser safety concepts

1, 2 *Gated-viewing exposure of a ship with sliding gate technique in Figure 2.*
3 *Dual-color image processing (MW: mid-wave infrared; LW: long-wave infrared).*
4 *Laser vibrometry for wind turbine inspection using a tracking camera (in cooperation with OBJ).*

3



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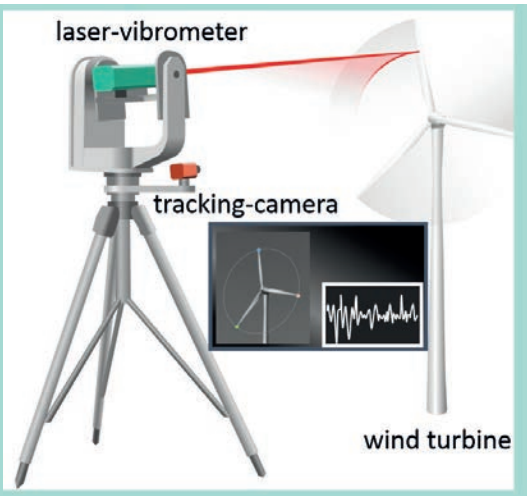


SIGNATORICS (SIG)

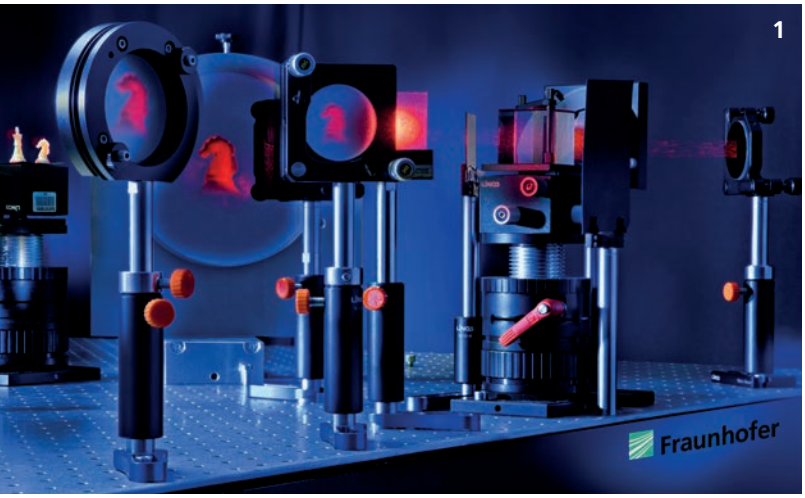
Competencies and portfolio

The competences of the department SIGNATORICS (SIGNATORIK – SIG) focus on the following areas:

- Warning sensor technology
- Signature management
- Environmental limitation

The activities comprise, amongst others, performance optimization of electro-optical technology in the atmospheric environment (from ultraviolet to the infrared spectrum), as well as development and improvement of signature management measures.

One of the core research themes within the field of warning sensor technology, beside the characterization of the environment and the backgrounds, is information gathering on the signatures of potential threats. Warning sensor systems are developed for diverse threat scenarios.



Within the department, research is also being carried out on the use of warning sensors in the civilian settings. On the one hand, research projects in the area of signature management conduce to change and/or reduction of the owned signature and thus to the reduction of discoverability. On the other hand, possible adverse camouflage and deception measures are also being evaluated. Both, ground- and air-based measurement methods are developed and deployed in aircrafts and helicopters within the scope of complex field trials over land and sea. Relevant material and system properties are identified with the help of innovative laboratory and field measurement systems and are used in numerical simulations for signature evaluation.

An essential subtopic within all research areas of the department is the analysis of atmospheric effects on electro-optical systems. As far as suppression of environmental effects is concerned, the department makes use of a comprehensive database on limiting factors, like atmospheric refraction and turbulence, acquired over the past years. These measurements are the basis for evaluation of atmospheric effects on sensors, with the objective of achieving optimum compensation for such effects.

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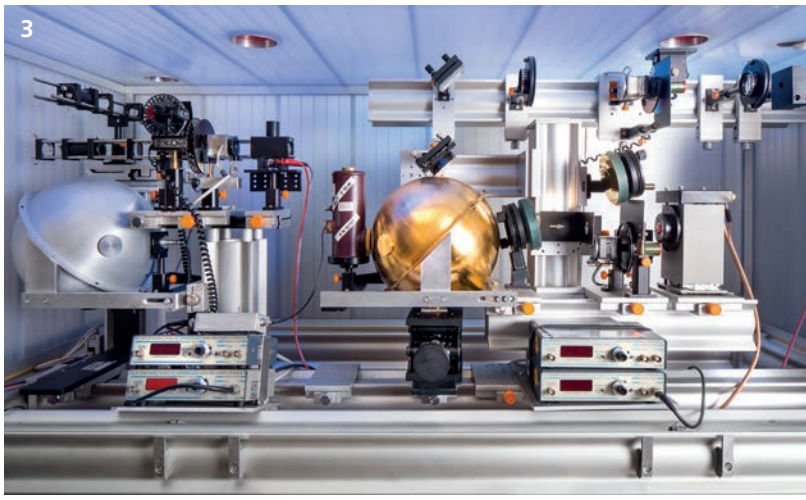
1 *Holographic wavefront sensor assembly.*
2 *MWIR radiance distribution (color-coded) of a research vessel.*
3 *High-performance spectrometer assembly.*

Work within the department focuses on the following topics:

- Innovative warning sensor technology for the military and civilian sectors
- Designing sensors for satellite-based monitoring systems
- Measurement of atmospheric parameters and development of corresponding compensation methods
- Application of adaptive optics and software-based methods for image correction
- Development, testing, and evaluation of multi-spectral signature management approaches and deception measures
- Laboratory experiments and field trials in maritime and terrestrial environments with passive and active sensors
- Identification of optical properties of materials within the full spectral range
- Design of analytical models and numerical simulations for radiation transport and propagation processes in maritime and terrestrial scenarios



VISUAL INSPECTION SYSTEMS (SPR)

Competencies and portfolio

The Visual Inspection Systems (SPR) department develops and delivers systems for automatic visual inspection tasks in industry. The main areas of application are currently the automatic sorting of bulk goods in recycling, mining and the food industry (e.g. waste glass, metals, gold, diamonds, tea, herbs, coffee, grains, and seed), the inspection of surfaces for defects (e.g. paint coat inspection), the inspection and characterization of transparent materials of all shapes (e.g. flat glass, headlight glass, and sunroofs), color measurement of granulates and inspection of blister packs.

All these applications are characterized by the fact that the inspection is performed at high throughput rates inline with the higher-level process, which thus calls for high-performance image exploitation systems. The imaging sensors are used for high-resolution line scan cameras of various types (color, grayscale, UV, and imaging NIR), 3D area array scanners or laser scanners. The image acquisition equipment is individually tailored to the specific task at hand, making particular use of folded beam paths and LED flash illumination.

The system platform for solving application tasks consists of standard PCs based on the PCIexpress bus under the Windows 7 and Windows embedded OS. The system's high processing power is achieved with specially developed plug-in cards for the PCIexpress bus. Together with a real-time system of algorithms for the capture and exploitation of images, this platform is at the core of the delivered application systems.

The department's products are used in industrial applications around the world. Partnered companies are responsible for marketing and service. In some cases, however, the department develops directly for end users and takes care of installation and service in the process.

The department operates an image exploitation center and a cross-application multi-sensor lab with experimental apparatus for process clarification as well as development systems for a variety of application areas. On the "multispectral workbench", materials can be inspected within the frequency range from ultraviolet (UV) up to and including near infrared (NIR) in order to obtain optimal decision-making criteria for the inspection task. Such "hyperspectral imaging" experience is directly linked to the work group for multispectral data analysis coordinated by SPR.

Projects and products

- VisioChromHR: Image exploitation system for automatic inspection of tablet blisters
- Clarity: Image exploitation system for automatic sorting of waste glass shards
- ClarityHR: Image exploitation system for automatic sorting of heat-resistant glass
- ClarityLead: Image exploitation system for automatic sorting of lead-containing glass
- Minexx: Image exploitation system for automatic sorting of minerals
- GemStar: Image exploitation system for automatic detection of diamonds in granulated rock
- FoodControlHR: High-resolution image exploitation system for automatic purification of tea, herbs and dried vegetables
- CoffeeControl: Double-sided image exploitation system for automatic sorting of coffee
- WheatControl: Image exploitation system for automatically cleaning grains
- GranuControl: Image exploitation system for automatic sorting of plastic granulates
- SpotInspect: Image exploitation system for automatically detecting contamination in a material flow

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- Purity: Image exploitation system for detecting defects as air bubbles or inclusions in arbitrarily-shaped transparent materials (e.g. flat glass, curved glass, lentils, or granulate)
- Purity tension: Image exploitation system for detecting defects and measuring tension in arbitrarily-shaped transparent materials
- MultiScan: Image exploitation system for automatic detection of defects and for evaluating texture, color and luster of industrial goods (e.g. tiles, base plates, coated steel belt, or copper laminates)
- ColorControl: Image exploitation system for automatically identifying the color of granular products (e.g. synthetic granules)
- WindShield Inspection: Inline image exploitation system for detecting defects in windshields

Infrastructure and equipment

Image exploitation systems for industrial visual inspection are application-specific or customer-specific. This is why almost all research projects start with the question of whether the respective task can be solved at all using an image exploitation system. After that, the limits of the recognition capacity are determined. Eventually, an estimation of the resource requirement for system realization is performed. Satisfactory answers to these questions can be obtained only through experiments, which tend to be costly and time-consuming.

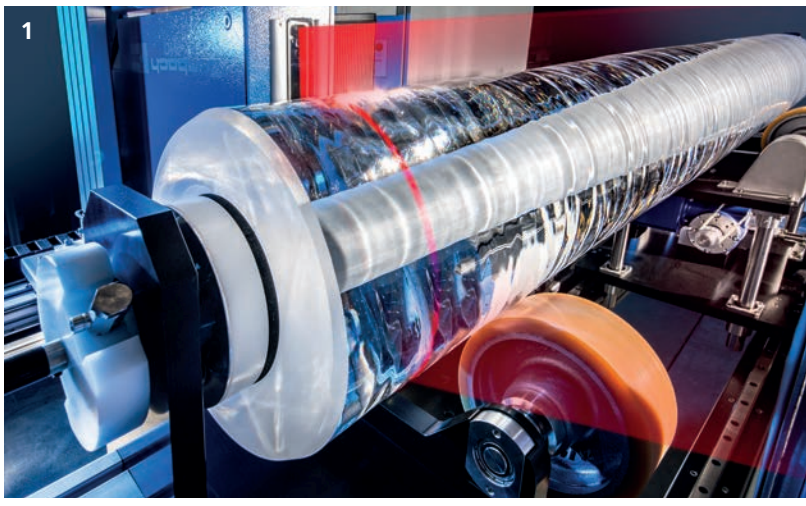
The image exploitation center and the cross-application multi-sensor lab of the IOSB were set up for the purpose of experimental procedure clarification with, if applicable, the involvement of other IOSB departments and the KIT research group. The image exploitation center and the multi-sensor lab offer numerous facilities for image acquisition and exploitation.

In addition to cameras and lighting equipment, they include:

- Sliding tables with a variety of different lighting fixtures for image acquisition
- Experimental systems for sorting bulk goods (each equipped with a camera and blow-off device) in various configurations as a belt sorter, sorter with chute and free-fall sorting
- Measurement stations for inspecting surfaces
- Measurement setup for 3D inspection
- Test system for transparent materials
- Multispectral workbench (240 – 2500 nm)
- Lab equipment for material characterization
- Sorting container for fast prototype production
- Cleanroom for inspecting sensible parts

The methods used for image exploitation permit evaluation of shape, texture, color, luster, material signature and 3D characteristics of the specimens.

1 *High-precision 3D-reconstruction of transparent tubes.*



CORE COMPETENCE SYSTEM TECHNOLOGIES


SIEMENS
SIMATIC HMI
IOSB
Startansicht
HMI
Pick&Place
Hand + Service
Systembilder
FESTO
HMI
Pressen
HMI
Trennen
HMI
Bearbeiten
TOUCH

ENERGY (NRG)

Expertise and portfolio

The German and European energy supply is facing major challenges: Renewable energy is only one aspect of the current structural changes to the energy system. Energy efficiency and cross-cutting issues such as electric mobility, power analyzes, forecasts, virtual power plants and energy storage are gaining importance through the interconnected european power system. Fraunhofer IOSB-AST, department energy, has in all these areas extensive knowledge which is applied in various projects over fifteen years.

In the industrial sector, the software solution EMS-EDM PROPHET® is successfully represented in the German and Turkish energy market by major partners such as Compello GmbH and BTC AG. Here topics such as energy and energy data management are at the forefront.

In energy research, more foreward-looking issues like demand response and demand side management, energy storages, wind power forecast technologies or the integration of renewable energy into the power grid are explored.

The department energy consists of five working groups:

EMS-EDM PROPHET® - Engineering
- Project management
- Demand and feed-in forecast
- Procurement optimization in liberalized markets
- Optimization of energy processes
- Accounting grid and network utilization management

EMS-EDM PROPHET® - Development
- Software solution EMS-EDM PROPHET®
- Implementation of forecast and optimization methods
- Support of market regulations (MaBiS, KoV IV)
- Open, cross-system IT architecture
- Scalable, high performance client/server development

Power systems
- Grid simulation and network planning
- Smart grids
- Optimal system management and adaptive grid protection
- Grid integration, energy storage and e-mobility
- Safe IT infrastructures for smart grids

Energy business and system analysis
- Liberalized energy markets and business models
- Market processes and communication
- Smart metering
- Energy economic analysis
- Development of forecast and optimization methods

Energy technology components and equipment
- System engineering and small producer
- Components for efficient energy usage
- Decentralized energy storages / grid protection components
- Automation device / safe IT components

Tasks and projects

- *ADELE ING* - Adiabatic compressed-air energy storage (CAES) for electricity supply (BMWi, Energy Storage Funding Initiative)
- *Gesteuertes Laden 3.0* managed by BMW AG (BMWi)
- *Smart Region Pellworm* managed by E.ON Hanse AG (BMU, Energy Storage Funding Initiative)
- *ICT energy lab* - research and development platform for analysis and development of IuK technologies for centralized

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1 *Vertical-axis wind turbine in Ilmenau. Photo: Martin Käßler.*
2 *Hybrid power plant on the North Sea island Pellworm. Photo: Steffen Nicolai.*

and decentralized intelligent energy supply systems and training center for EMS-EDM PROPHET®

- EMS-EDM PROPHET® - energy management with forecast and optimization as well as energy data management for liberalized energy markets
- *Demand analysis energy storage 2* - The impact of the distributed power generation for electricity generation and evaluation of energy balancing technology (BAES2, BMWi)
- *sMobiliTy* - development of a cloud-based system and service platform for electric mobility (BMWi)
- REM 2030 - Regional Eco Mobility 2030 (Baden-Württemberg, Fraunhofer Society)
- EBITA - Exploiting the Scientific and Business Potential when Integrating Smart Data Analytics into Internet of Things Applications
- REGEES: Renewable electrical energy system – Reg-EE-System – 100 % integration of renewable power in 2030 (BMWi)
- VEREDELE FACDS - Robust control and feedback control systems of distribution power grids with a high proportion of fluctuating power production and flexible loads with the approach of flexible AC distribution systems (BMWi)
- Study E-Bus City of Erfurt
- Photovoltaics with battery systems maximizing internal consumtion (JenaBatteries GmbH)
- Load forecast and operational management of distribution power grids with an incentive-based consumer influence and fluctuating power infeed (DFG)
- Addition to the concept study E-Bus: A power supply system for electric busses in multiple citites
- EIT ICT-Labs "User Friendly Scalable Smart Distribution Grid Management Solution"
- EnEff:Stadt / EnEff:Wärme - Concomitant research (BMWi)

WATER AND MOBILE SYSTEMS (WMS)

Expertise and portfolio

The department water and mobile systems is engaged in the field of holistic and integrated consideration of water supply systems, the development of embedded systems, assistance systems, and autonomously driven land and underwater vehicles. The department is split into three working groups:

Embedded systems

- Integration of embedded systems
- Embedded control and regulation systems
- System design and modules for autonomous vehicles
- Hardware integration
- Guiding systems for vehicles
- Maintenance and diagnostic systems
- Sensor data fusion and simulation

Water supply and wastewater treatment

- Drinking water abstraction
- Drinking water treatment
- Drinking water distribution
- Reservoir and dam systems
- Wastewater collection
- Wastewater treatment
- Sludge treatment
- Recycling of wastewater

Maritime systems and surface water

- Simulation and guiding software for underwater vehicles
- Design, engineering and construction of underwater vehicles and compression-proof modules
- Virtual test environment for simulation of mobile systems and evaluation of vehicle guidance strategies
- Control functions for the automated inspection of underwater infrastructure, sea cables and pipelines
- Modeling, simulation and optimization of surface water systems
- Flash flood warning systems
- Water demand forecast

Tasks and Projects

- OTHELLO: development of a mobile household assistant for people with limited mobility
- KLARA: development of a personal handling assistance to support tasks like grabbing, giving and depositing of low weights through semi-autonomous functions
- Sytech wiring loom fabrication: Flexible Cable Harness Production - Equipment; Software; Service
- Otto Bock Mobility Solutions GmbH: Bluetooth and HMC-module, range module, Demonstrator: Hillfighter
- DAIMLER AG: Bulb temperature calculation
- Stadtwerke Marburg: HydroDyn industry project water distribution
- ExAUV-BRIT: development of a remotely controlled underwater vehicle for water quality monitoring
- HAPPI: small hydro power plant – evaluation of the potential of climate protection and improvement by intelligent technology
- MoMo III: Integrated Water Resources Management for Central Asia: Model Region Mongolia Phase 3
- ABB Projects: Abu Dhabi, Mina Abdullah, Hafar al Batin, Taif Baha, Ras Alzaur Pipeline System
- EDIT: Hygiene online monitoring
- INAPRO - Innovative model & demonstration based water management for resource efficiency in integrated multi-trophic aquaculture and horticulture systems

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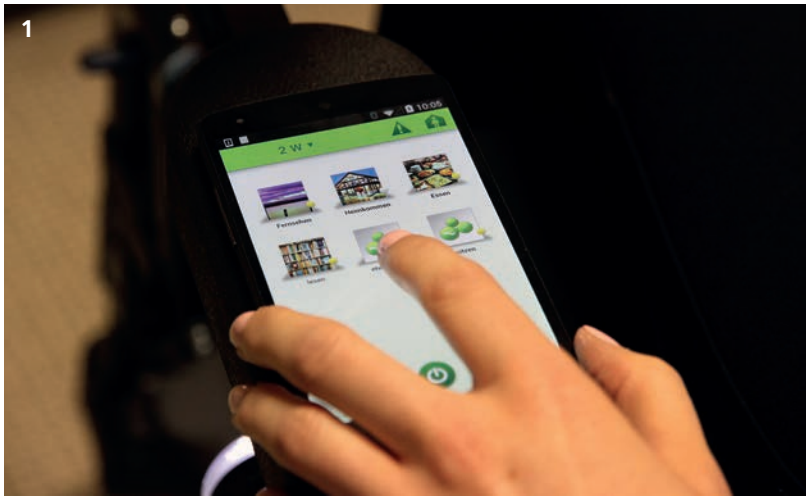
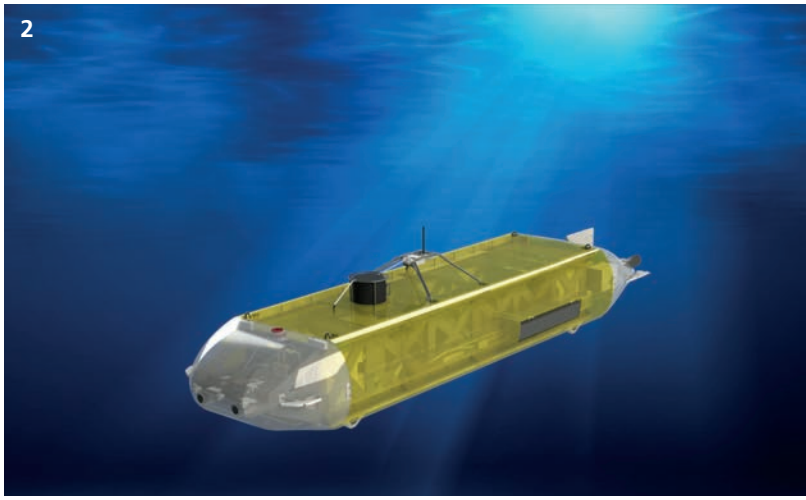
- MoSiOp - Model Based Simulation and optimization of a UV-LED based emitter module
- UV-LED AnPHOS - Monitoring and control concept and conversion into control electronics for high-performance UV-LEDs
- Fraunhofer 4D: DeDAvE: Deep Diving autonomous underwater vehicle for exploration

1 *Together with digitalSTROM AG and the Ottobock Group, the WMS department presented a home automation system for wheelchair users at the IFA.*
2 *Financed as part of a 4D board project, the autonomous subaquatic vehicle DeDAvE can dive to a depth of 6000 meters.*





INFORMATION MANAGEMENT AND PRODUCTION CONTROL (ILT)

The objective of the department Information Management and Production Control (ILT) is to develop components and complete solutions for the design, operation and maintenance of complex information, control and test systems. Security requirements are considered by design. Our focus lies on the application domains of environment, health, risk management, resource efficiency, production and security.

On the basis of agile methods in requirements analysis, system design and recognized architectural and communication standards, we implement open, innovative, and customized software solutions, encompassing and driving new paradigms of the "Internet of Things and Services" as well as "Industrie 4.0". In order to accompany and support our customers on this way, we offer dedicated consultancy services, e.g. enterprise-specific Industrie 4.0 roadmaps, or the transformation of Manufacturing Execution Systems (MES) to the requirements and technologies of the smart factory.

We analyze the suitability of modeling and communication methods and IT security technologies for:

- Complex manufacturing processes driven by Industrie 4.0 value chains (e.g. AutomationML and OPC UA)
- Environmental sensors and models (SensorML)
- Environmental observations (geospatial standards of the Open Geospatial Consortium OGC)

Our information management system "WebGenesis®" supports ontology-driven Web-based information systems, problem-specific information analysis and personalized user interaction. For the emerging Internet of Things (IoT) we draft and implement smart solutions for the efficient search in and processing of heterogeneous data sets ("big data"), the extraction of knowledge with data mining methods (incl. semantic annotation) and the fusion of heterogeneous sensor data to meaningful technical information for decision support ("Fusion4Decision").

We are responsible for the systematic and facilitated requirements and IT security analysis as well as for the specification and realization of service-oriented and event-driven architectures (SOA/EDA).

We develop thematic applications and connect them to integrated environmental information systems. Our software framework WaterFrame® renders data sources accessible and integrates geographical information system (GIS) components as well as innovative geostatistical methods. WaterFrame® provides support in generating thematic maps, diagrams and reports.

With the ProVis suite we realize production control system components and integrated solutions according to both the classical functional MES requirements, and the emerging IoT/Industrie 4.0 paradigms encompassing demanding IT security features such as intrusion detection services and secure communication. The functions offered by ProVis range from monitoring and managing production facilities up to engineering control rooms and the processes of manufacturing control. This allows us to deploy production control systems in automotive production sites and the steel industry, including Web-based analysis and reporting systems.

We run vulnerability tests for critical systems and develop test systems for selected de-facto standards such as Foundation Fieldbus, AutomationML, and HLA. Our technologies are integrated into the IT Security Lab for Industrial Production

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of IOSB. Our objective is to promote the adoption of standards in the market and to support interoperability in open systems. We therefore actively participate in the relevant standardization bodies in VDI/VDE, DKE, DIN, IEC, IIC, W3C and OGC.

Products

- WebGenesis® – Web-based information and knowledge management solutions for applications in the environment, traffic and automation sectors and for the documentation of research projects
- WaterFrame® – Java framework for the development of thematic applications and environmental information systems
- Fusion4Decision – service pattern and software platform for sensor data fusion and decision support based on OGC standards
- ProVis.Agent®/Visu® – agent-based production control and visualization system for managing and monitoring automated production facilities
- ProVis.Paula – production and plant data evaluation system with data mining components
- OPC UA/AutomazionML Toolset – User assistance ranging from graphical modelling, conversion support to plug-and-work- functionality
- AutomationML test system – Web-based conformance testing of AutomationML descriptions, available online at http://amltest.iosb.fraunhofer.de
- GERTICO – Modeling and service infrastructure for coupled simulators based on HLA
- SERVUS – Web-based use case documentation tool for service-oriented analysis and design
- Network Calculus – methodology for the performance evaluation of communication networks
- CyphWay – Secure communication solution with integrated key management for untrusted devices

Infrastructure

- ProVis – integration and test facility
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- WaterFrame®– integration and test facility
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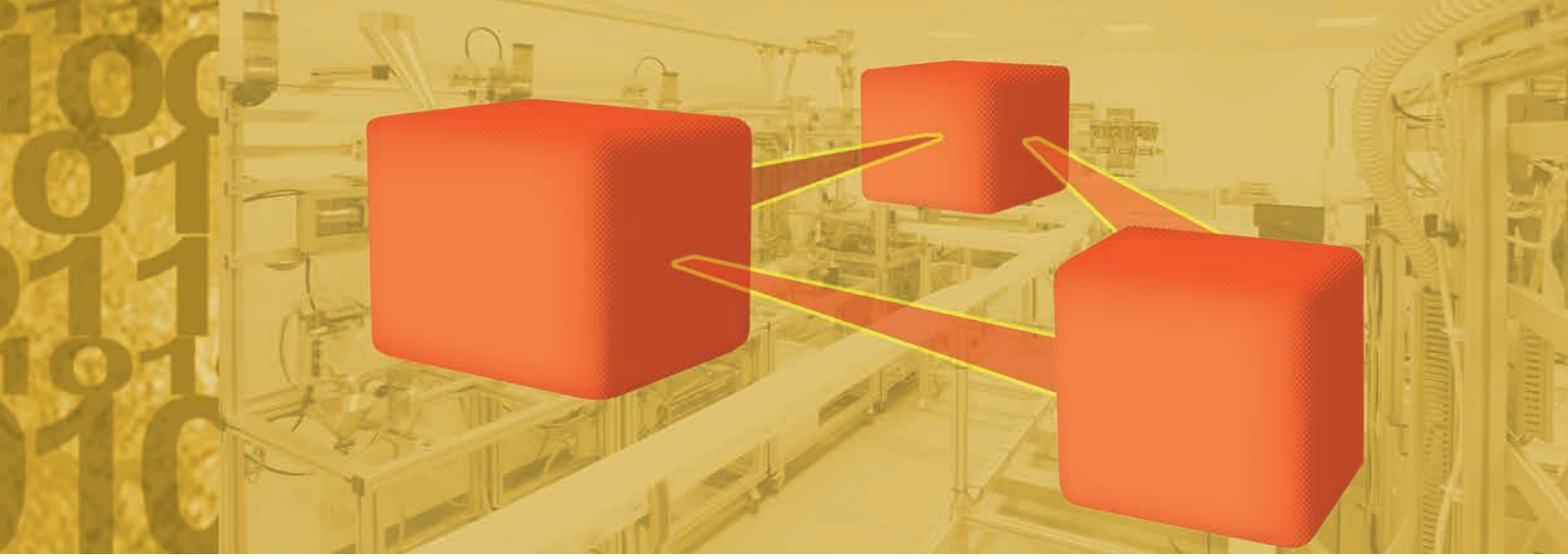
1 *IT Security Lab at IOSB Karlsruhe.*



FRAUNHOFER APPLICATION CENTER INDUSTRIAL AUTOMATION (INA)

Competencies and portfolio

The Fraunhofer Application Centre for Industrial Automation (INA) in Lemgo, which was founded in fall 2009 in the center of East Westphalia-Lippe, one of the most important regions in the German engineering industry, pursues ambitiously its research vision: "Intelligent automation technology for versatile, resource-efficient and ergonomic production systems." Cognitive processes in industrial automation are implemented to support people at work with the technical systems and make the ever increasing complexity manageable. These future intelligent systems configure themselves automatically by the plug-and-play principle and can react flexibly and quickly to unplanned requirements. The systems monitor and optimize themselves during the operating time to provide maximum efficiency (e.g. energy demand). Networking, analysis and monitoring of technical systems as well as the user-friendly design of these systems represent the core competencies of IOSB-INA.

Since 2010 INA is a partner of the Centrum Industrial IT (CIIT). The CIIT, which is based on the Campus of the University of Applied Science East Westphalia-Lippe, is Germany's first Science-to-Business Center in the field of automation technologies. Under the motto "Where IT meets Automation" science and industry has established an open partner network and develop technologies for future IT-based automation techniques under one roof.

The Fraunhofer Application Centre for Industrial Automation is a research institution in the BMBF-Edge Cluster "Intelligent Technical Systems East Westphalia-Lippe it´s OWL", which is currently the largest project in the field of Industry 4.0.

Research and development

The Fraunhofer Application Center Industrial Automation implements publicly funded research projects, works in the area of bilateral contract research, develops software and hardware prototypes and designs test and hedging solutions.

Areas of application are industrial IT, automation techniques, the machinery and equipment manufacturing and related sectors.

Currently our work is based on the following business areas:

Industrial Internet:

In the business area 'Industrial Internet' hardware and software solutions for intelligent networking of technical systems are developed. Our goal is the reliable provision of information at all levels of a production system or at an automated technical system in the required quality.

The basis for intelligent technical systems is placed by an appropriate technical networking of people, products and machines.

This includes per example:

- design and development services for hardware and software solutions of industrial communication interfaces and M2M communication
- studies, analyzes and workshops for networking of technical systems and equipment

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Intelligent Automation

In the business area 'Intelligent Automation' the Fraunhofer IOSB-INA offers R & D services and solutions to make industrial production systems adaptive, efficient and user-friendly.

The solutions are based on networking and cognitive information processing. Due to this, machines are able to adapt themselves to their environment or new requirements independently. They autonomously diagnose faults or wear and optimize characteristics, such as energy consumption.

This includes per example:

- Process data analytics
- Hard- and Software development
- Algorithms for an intelligent system development
- Design of machine learning methods
- Condition monitoring solutions
- Algorithms for system optimization
- Assistance systems

Usability of Technical Systems:

The interaction with industrial production systems is nowadays largely made by (complex) graphical user interfaces. In recent years, many developments of desktop, mobile and Web interfaces, as well as new interaction modalities, such as multi-touch, have been integrated in these user interfaces. Therefore a growing number of manufacturers attach great importance to the quality design of the user interface and the "user experience" in order to differentiate in the market.

In this context, it is essential to consider changes in demanding attitude of users and customers, and to ensure a degree of user friendliness, which is equivalent with web and mobile apps.

This includes per example:

- acceptance analyzes
- Evaluation of user interfaces
- Requirement analysis for usable work and interaction processes
- Development, evaluation and optimization of human-machine interfaces

1 *Lemgo Technology-Campus with CIIT and SmartFactoryOWL.*

SYSTEMS FOR MEASUREMENT, CONTROL AND DIAGNOSIS (MRD)

Competencies and portfolio

The acquisition and evaluation of sensory and other data plays a crucial role in many applications: in industry, sensory data, together with process models, establishes the basis for obtaining high-quality, universal functionality of products as well as facilitating an optimal productivity of production facilities.

A full understanding of the processing chain – from data acquisition through processing and evaluation to optimization or feedback into the process, and always considering the dynamics and other characteristics of the process – is essential also for other fields of application, such as environment processes, robotics, traffic and civil security. In this context the department Systems of Measurement, control and Diagnosis (MRD) offers the following core competencies:

- Modeling and simulation
  - Analytical, knowledge-based and data-driven modeling
  - Block-oriented and finite element models (e.g. using Matlab / Simulink, COMSOL)
  - Model reduction and parameter estimation (e.g. of finite element models for material and heat flows)
  - Modeling, simulation and synthesis for sensor systems (e.g. for automated visual inspection like deflectometry or under water)
  - Applications in process engineering, biotechnology, monitoring of drinking water networks, automated visual inspection and robotics
- Measurement and sensor techniques
  - Optical and imaging measurement techniques
  - Automated microscopy
  - Deflectometry and other image-based surface inspection methods
  - Solutions for special applications of common measurement techniques (e.g. laser triangulation in pipes)
- Control and feedback control techniques
  - Model predictive and structure-variable control for applications in process engineering, robotics, transportation and traffic engineering
  - Process control using data-driven models
  - Control using imaging sensors (visual servoing)
- Data analysis for technical processes
  - Development, adaptation and application of methods for classification, machine learning, and data mining
  - Generation of structure hypotheses, and analyses of causality
  - Performance and condition monitoring
  - Anomaly detection
  - Diagnosis (e.g. to identify cause-effect relationships)
- Information fusion
  - Multisensor fusion (e.g. for robot control)
  - Dynamic information fusion using heterogeneous sources (e.g. for environmental warning modules)
  - Fusion of image and geometry data (e.g. for pipe inspection, mobile robots, and surface inspection)
- Robotics
  - Safe human-robot interaction
  - Cooperating mobile robots
  - Environment-interactive path and trajectory planning for mobile platforms and (mobile) manipulators
  - Simultaneous localization and mapping (SLAM), also using multiple sensor sources
  - Advanced filtering and smoothing techniques
  - Detection of (dynamic) obstacles
  - Control of complex kinematics in mobile robotics and (mobile) manipulation
  - Robot control based on ROS middleware

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- Robot applications
  - Service robots (e.g. for home applications)
  - Mobile assistance and inspection robots
  - Applications of robotics in logistics and production
  - Robots for security applications
  - Agricultural robotics (e.g. for precision farming)
  - Processing of sensor data for unterwater robotics
- Image and signal processing
  - Real-time image and signal processing, suitable for industrial needs
  - Defect detection on surfaces (e.g. using adapted features and classification methods)
  - Generation of 3D data (e.g. using deflectometry, sidescan sonars, stereo cameras and other reconstruction methods)
  - Processing of 3D data (measurement data and reconstruction results)
  - 3D data and image processing for applications in robotics
  - Evaluation of esthetic defects

Applications and projects

- Monitoring, control and optimization in process engineering (e.g. chemical and biotechnological processes)
  - Model-based control in process engineering (e.g. for glass drawing and biotechnological processes)
  - Tools for online process monitoring (e.g. for chemical processes, drinking water networks, robots or wind energy plants)
- Quality and productivity assurance for process and manufacturing engineering
  - Optimization of production processes and products (e.g. for glass drawing processes and crop drying)
  - Tools for evaluating process and product data
  - Surface inspection (e.g. for painted, specular and textured surfaces)
- Sensor systems
  - Sensor development and adaptation for special applications (e.g. pipe inspection)
  - Image-based sensor systems for surface inspection
  - Systems for underwater applications
  - Automated microscopic inspection
  - Automated real-time detection of toxic contaminations in water
- Assistance systems
  - Assistance for efficient mobility (individual mobility and logistics)
  - Energy monitoring and optimization for home applications (e.g. coordination of heating and ventilation)
- Environment and resources
  - Quality control for water supply systems and waste water disposal
  - Multisensor inspection systems for water pipes and sewer ducts
  - Mass flux management (for water and soil)
- Security
  - Security for drinking water supply (including sensor systems and management systems)
  - Surveillance of buildings and assets
  - Reconnaissance in emergencies (e.g. mapping and localization for assistance robots; detection of victims and hazard sources)
  - Robot-based exploration
  - Mine clearance in former conflict areas

1 *Collaborative robot used for research on safe human-robot interaction.*

CORE COMPETENCE IMAGE EXPLOITATION


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digIT
Meta Daten Anzeige
Schloss Karlsruhe/Badisches Landesmuseum
Straße:
Schloss
Postleitzahl:
76131
Objektklasse:
Sehenswürdigkeit/Museum
Koordinate:
8.4043236220°E 49.0135616346 °N
Beschreibung
Das Karlsruher Schloss wurde 1715 als Residenz des Markgrafen Karl Wilhelm von Baden-Durlach errichtet.
Das Gebäude wurde, unter Leitung des Ingenieur-Leutnants Jakob Friedrich von Batzendorf errichtet.
1750 wurde das Schloss nach mehrfach geänderten Plänen von Balthasar Neumann durch den früheren Hofjunker
Friedrich von Keseliz umgebaut.
1949 wurde Großherzog Leopold aus dem Schloss vertrieben, das endgültige Ende der Fernilienresidenz kam 1918 mit
dem Ende der Monarchie.
1921 wurden in der ehemaligen Residenz die Sammlungen für Altertums- und Völkerkunde und die Bestände des
Kunstgewerbemuseums als Badisches Landesmuseum zusammengeführt.
Während des Zweiten Weltkriegs brannte das Karlsruher Schloss im September 1944 durch Bombenangriffe aus und
wurde als Badisches Landesmuseum mit neuem Grundriss wieder aufgebaut.
Medien
Medienbeschreibung
Medieninformationen
SAMSUNG

INTERACTIVE ANALYSIS AND DIAGNOSIS (IAD)

Profile and competencies

The department **Interactive Analysis and Diagnosis (IAD)** develops innovative interaction methods, smart environments and assistance systems with the aim of supporting people in various tasks.

On the one hand, IAD is focused on the development of **multimodal interaction** concepts and **smart environments**. The developed techniques cover multi-person tracking, recognition of hand and pointing gestures, eye gaze and head pose recognition and analysis, as well as deducing persons' activities within a smart environment. The implemented interaction modalities are mostly derived from these video-based methods and deployed speech recognition. Application areas are, e.g., operating rooms, vehicle interiors and production lines.

On the other hand, IAD develops **assistance systems**, which support people in the process of decision-making. Application areas are diagnosis of technical systems, image interpretation, and intelligent surveillance systems. Our concepts take into account the strengths of both computer systems and humans. Computer systems are capable of rapidly recording, searching and calculating large quantities of data. Humans are far superior when it comes to recognizing and interpreting complex information structures.

Accessing and processing large distributed data helps us to build more efficient interactive systems. Privacy and Security by Design allows us to incorporate legal requirements and data protection without sacrificing functionality, as often seen in conventional solutions. IAD employs a group of IT security professionals, who develop their privacy expertise in research projects and consult industry partners on how to combine data protection and functionality in their products.

The following solutions are currently provided:

Multimodal Interaction and Smart Environments

- Human-Machine-Interaction with and within multi-display environments
- Video-based hand-, body- and gesture-recognition for human-machine interfaces
- Gaze-based interaction and gaze analysis
- Multi-person tracking for presence-aware and adaptive HMI solution, e.g., building automation or safety means
- Interaction techniques for mobile augmented-reality applications
- Industrial Human-Machine-Interaction, e.g., for gesture-based quality assurance and documentation


1

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Assistance Systems

- Interactive and knowledge-based object recognition
- Machine learning and data mining for intelligent data analysis
- Situation analysis for crisis management and security services
- Set-up of geodata infrastructure and software architectures for surveillance systems
- Optical measurement and vibration analysis applied to wind turbines

The following products and projects are provided:

- SmartControlRoom – An intelligent crisis center including innovative interaction
- Digital Map Table – A multi-display workspace for computer-supported situation analysis
- InCarIn – situation- and activity context-adapted driver assistance
- RecceMan® – Interactive assistant for identification of objects and infrastructure
- Maritime situation assessment and anomaly detection for supporting situation awareness of decision makers
- KonsensOP – context-based assistance for a medical team in an operating room
- OnkoLeit – A medical expert system following clinical practical guidelines for diagnosis, treatment and follow-up of oncological diseases
- Image-based pitch angle analysis for wind turbines
- MCMXT – Embedded system for 3D measurement tasks based on optical markers
- KASTEL – competence center for applied IT security
- SecureAutoType – Secure and user-friendly password management

1 SmartControlRoom with multi-user, multi-display interaction.
2 Digital Map Table for team-oriented analysis of geographical information.
3 Intelligent data analysis for maritime anomaly detection.

INTEROPERABILITY AND ASSISTANCE SYSTEMS (IAS)

Competencies and portfolio

The department Interoperability and Assistance Systems (IAS) offers solutions to the market in which the interaction of people with complex information systems plays the key role. In a "system of systems" approach interoperability is vital.

With research and development projects in the field of software architecture for computer-based assistance systems with a focus on dialog design and semantic interoperability, we contribute to the technical and content networking of systems. By designing dialogs that are adapted to the users and tasks we promote collaborative work using innovative multi-modal and multi-media interaction technologies. With ontology-based information systems, web services and intelligent software agents the knowledge needed is distributed on time to the right people through suitable connections to personalized end-user devices in a layer-compliant granularity. Modern, technology-based learning environments and the use of "serious games" provide users with the required decision-making abilities. Providers of knowledge-intensive services will be supported in focusing on their core competencies and creativity.

The work includes the design, implementation and evaluation of system solutions for interactive sensor data analysis, knowledge creation and integration of knowledge into expert systems to support networked data analysis, the modeling of users, workflows and application domains, as well as competence management in distributed systems. Laboratory and field experiments on demonstrators and operational systems are performed to optimize system performance and to evaluate human-machine communication. In addition to developing basic system architectures that promote interoperability the department's product range includes components for interactive image analysis, ontology-based specialist databases, network-enabled information management systems, and training and education systems. Compliance with and monitoring of national and international software quality standards is an integral part of the development activities.

Our partners and clients include the German Federal Ministry of Defense (FMOD), Federal Office for equipment, information technology and use of the Armed Forces (BAAINBw), the defense industry and the European Union. In various international cooperations experience in the field of image-based reconnaissance and surveillance is exchanged. In our research we cooperate with universities, colleges and partner institutions. Applications are mainly in the fields of defense and civil security.

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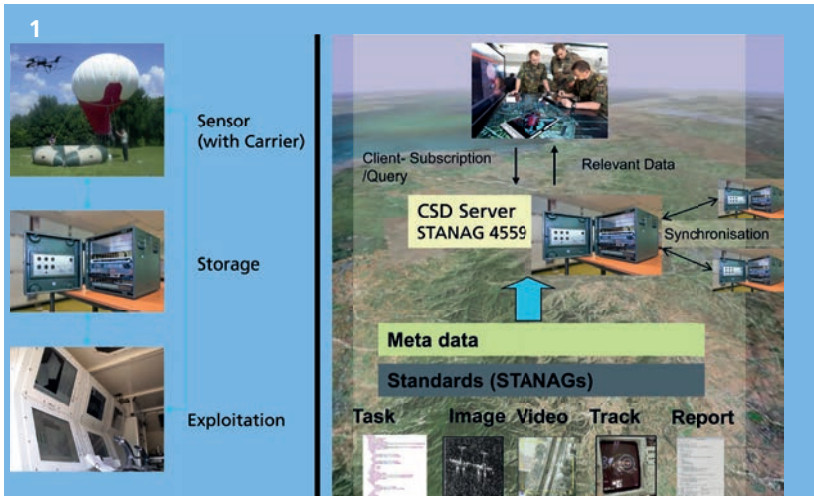
1 *Interoperability.*

Projects and products

- Image database – archiving system for the management of aerial and satellite images
- Image data management system for aerial and satellite image analysis in the field of reconnaissance and surveillance
- SAR Tutor – web-based training tool for SAR image analysis
- Crayons© – web-based authoring and learning environment
- ViSAR – simulator for visualizing geometric radar effects
- CSD/NSD Coalition/National Shared Database. Client-server system for distributing reconnaissance-relevant information (requests, orders, messages, sensor data and products) in accordance with STANAG 4559
- ISAAC (ISr Artifact Access Client) Software Suite (.lib, .bat, desk, .map, .web) for accessing CSD/NSD servers according to STANAG 4559 (NSILI – NATO Standard ISR Library Interface)
- ISVA – intelligent reconnaissance sensor combination for networking data, information, services and experts
- I2Exrep – database-supported form-based report generation for analysis of aerial and satellite images according to STANAG 3377/3596 and other reporting formats
- DbEd – Data Tree Editor for creation and maintenance of the reporting vocabulary used in image based reconnaissance
- MAJIIC 2 – Multi-INT All-source Joint ISR Interoperability Coalition
- AMFIS ground control station – Generic ground control station. AMFIS (reconnaissance and surveillance with miniature aircraft in sensor networks) for controlling and coordinating stationary and mobile sensors/sensor carriers, and for evaluating sensor data and situation reports

Equipment

- ISVA demonstrator – a hub for national and international secured networks in the field of reconnaissance and surveillance
- SaLVe – radar image database center: a multi-sensor image data archive for remote sensing
- AMFIS – reconnaissance and surveillance with miniature aircrafts in the sensor network (configurable ground control stations, various UAVs, UGVs and sensors)
- A mobile ad-hoc sensor network (GPS, imaging and acoustic, vibration, temperature, motion and light sensors)
- MAJIIC – demonstration laboratory (restricted area): Multi-sensor Aerospace-Ground Joint ISR Interoperability Coalition
- DNBL – development laboratory (restricted area): Distributed Network Battlelab Laboratory for certification and testing of components for networked intelligence gathering and reconnaissance



OBJECT RECOGNITION (OBJ)

Expertise and portfolio

The department Object Recognition (Objekterkennung - OBJ) develops and evaluates algorithms for automatic object detection and object tracking in sensor networks. The department's activities range from the evaluation of video streams in the infrared and visual spectral band and the analysis of laser sensor data to the semantic description of a three-dimensional, dynamic environment via multi-sensory data acquisition and automatic alerting in case of specifically defined occurrences. In addition, real-time implementations of the algorithms are evaluated on the basis of heterogeneous hardware structures.

The research work in the field of **Object Recognition in Sensor Networks** is focused on the detection and representation of objects in imagery data streams of interconnected mobile sensors. In this context the technologies investigated include aspect-independent descriptions of objects, the registration of sensor-generated images with three-dimensional context data, and bandwidth-economical transfer of object information.

Video Content Analysis combines methods for the detection and tracking of objects in video streams with algorithms for the conceptual description and analysis of the extracted quantitative information. The studies aim at devising systems for the semantic analysis of videos. This means that videos are not only analyzed quantitatively, but that the extracted information is associated with conceptual background knowledge in order to draw conclusions from the visually perceived environment.

Machine vision algorithms extend from simple filtering functions up to complex analysis methods. Currently available hardware also varies with respect to computing performance, programming paradigms, architectures, and power consumption. The field of **Heterogeneous Hardware Structures** deals with the specification and combination of hardware structures suitable for complex real-time vision systems.

Especially with regard to military tracking systems, performance evaluation is an essential topic. Based on years of experience the field **Tracking and Tracker Assessment** deals with the development and design of evaluation schemes that interrelate and evaluate both the performance ability of tracking algorithms and the risk analysis, while possible counter-measures are taken into account.

The acquisition and analysis of 3D data is of increasing importance in those application areas that require a high degree of automation and reliability of object recognition. The department's work in the field of **Object Recognition in 3D Data** is concerned with the development, optimization, and evaluation of methods for 3D data analysis for use with established sensor techniques as well as prototypical hardware. In addition to object recognition, data acquired by theses sensors is used for detecting changes and for providing context information for image exploitation.

Selected Projects

- THS® - Target Handoff System
- Semantic Video Analysis
- MODISSA – Mobile Distributed Situation Awareness
- Change Detection in Lidar sensor data
- VibroTrack – distant vibration measurement on running wind turbines

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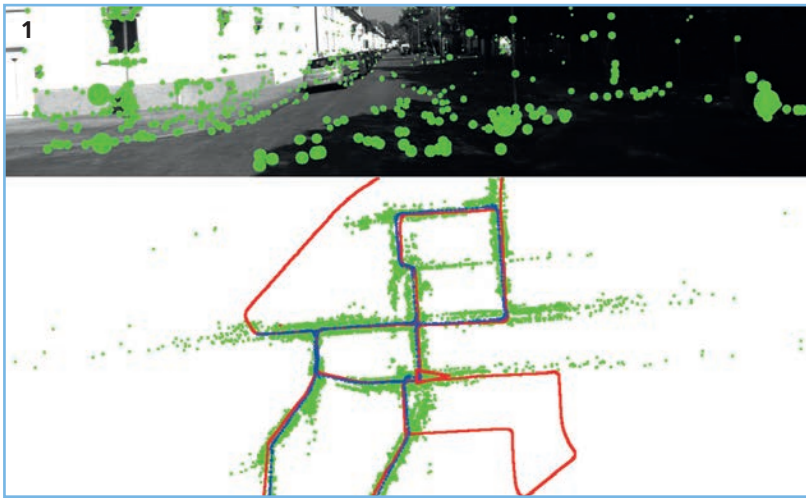
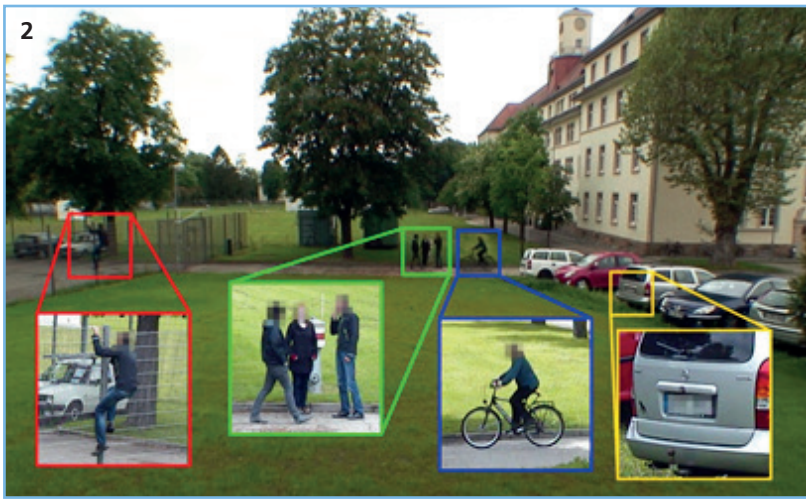
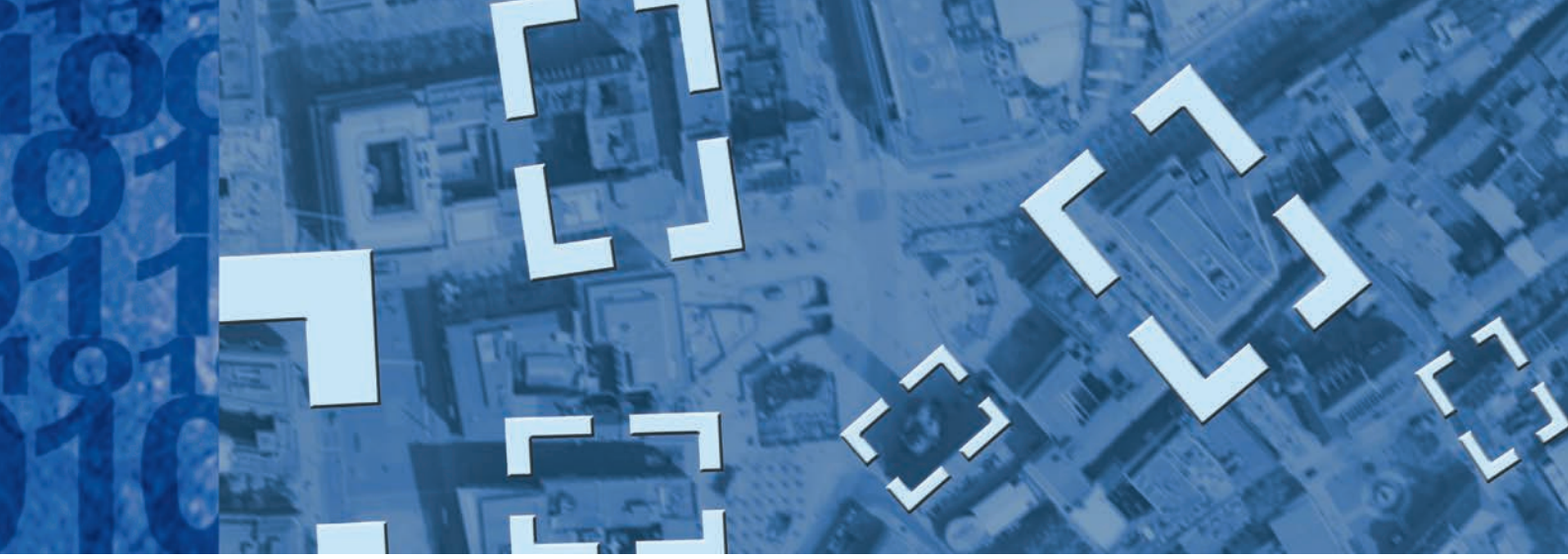
1 *Trajectory estimation of a moving camera based solely on visual information. Top: camera view together with overlayed visual features tracked in 3D during the process. Bottom: birds eye view on the estimated trajectory of the camera (blue), the ground truth path (red), and 3D features of the surrounding (green).*

2 *The project Semantic Video Analysis aims at detecting, classifying, and conceptually describing events and interrelations of events in visually perceivable scenarios.*







SCENE ANALYSIS (SZA)

Competencies and portfolio

Background of the department's research activities is the demand of intelligence and reconnaissance for the prompt availability of interpretation results with georeference. This includes both wide-ranging evaluation (screening) and local 3D scene reconstruction, required as a basis for decision making in the context of military operations and disaster management. A multitude of powerful airborne and spaceborne systems, e.g., Heron, SAR-Lupe and TerraSAR-X, delivers data that can no longer be evaluated by humans due to its sheer volume and the resulting work load. Automatic conditioning and processing of the data draws the interpreters attention to relevant sections, thereby also enabling the efficient processing of large data volumes. For a fast and precise evaluation, the interpreter needs assistance systems that are able to detect, analyze and classify objects and scene changes.

The Scene Analysis department develops and studies methods for the automatic evaluation of multi-sensor image data in reconnaissance networks. For this purpose efficient procedures are being developed for segmentation, classification, scene reconstruction, change detection, and fusion of a wide range of sensor data. The research focuses on

- Image interpretation
- 3D object analysis
- Cooperative data evaluation in sensor systems
- Exploitation of Synthetic Aperture Radar (SAR) images

In the scope of image interpretation the analysis of hyperspectral data is of particular importance. Here, methods for the extraction of relevant information take center stage. Applications range from the pure reduction of data for a better utilization of transmission bandwidths to the generation of indications in both single and multiple images (change detection and change categorization). The common exploitation of data from a multi-sensor platform (VIS, LWIR, Hyperspectral and LIDAR) is one of the key features of actual demonstrators or future operational systems. Data fusion and information extraction are the core competencies for a successful exploitation and are therefore one of the department's main research activities.

Often a scene can be evaluated properly only if its spatial extent can be determined. Therefore, the Scene Analysis department develops procedures for the automatic derivation of 3D descriptions of urban terrain based on the evaluation of multi-sensory image data acquired by spaceborne, airborne, or land-based reconnaissance systems.

To utilize the efficiency of networked sensor systems, the method of interconnected sensor data evaluation must be designed based on the "system of systems" concept. For this purpose, procedures are being developed which relate the data of imaging sensors to a common reference frame. The potential applications from the fusion of sensor data up to a real-time-generated overview of situations are being analyzed and adequate procedures realized.

Only few sensors can acquire evaluable image data, irrespectively of the daytime or current weather conditions. The performance of imaging radar systems, with a synthetic aperture (SAR) is hardly limited in this regard. Because of their phase-preserving evaluation, interferometric SAR systems are able to capture the 3D shape of a scene. Furthermore, by using time series, very small surface movements can be detected. SAR images are difficult to interpret by a human due to the specific mapping characteristics. Therefore, interpretation support is particularly valuable. SAR image analysis and simulation are therefore among the core competencies of the department, with a special focus on feature analysis, change detection and change categorization in SAR images.

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Research work focuses on the following core topics:

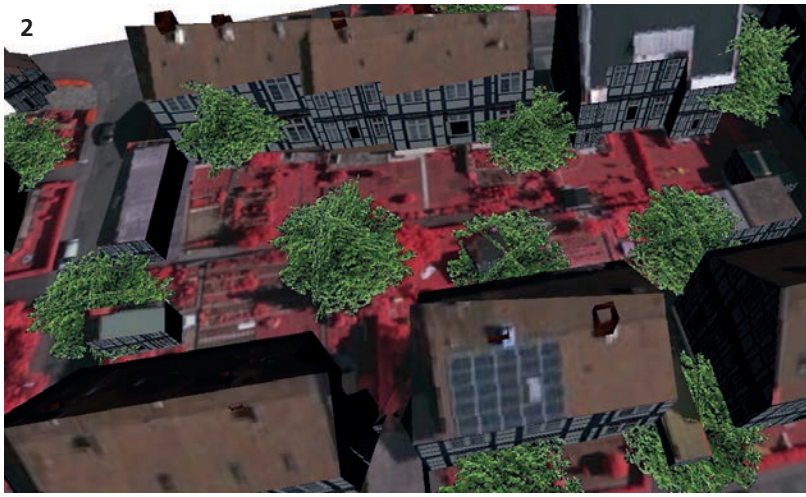
Image interpretation
- Efficient screening procedures for the analysis of large data volumes
- Structural change detection
- Analysis of hyperspectral image data
- Fusion and exploitation of data from multi-sensor systems

3D object analysis
- reconstruction of 3D objects from image sequences or laser scanner data
- Automatic derivation of 3D building models from 3D point clouds

Cooperative data evaluation for networked sensor systems
- Information fusion of sensor data and geo-information
- Automatic georeferencing of image contents
- Preparation of sensor data showing urban terrain for simulation systems

SAR image exploitation
- Feature extraction and analysis, change detection and categorization
- Simulation of SAR image signatures for interpretation assistance (CohRaSS: Coherent Raytracing-based SAR Simulator)
- Determination of ground heaving or depression by means of time series
- Model-based building reconstruction from interferometric SAR images

1 *Evaluation of hyperspectral sensor data.*
2 *View on an automatically extracted model of the scene "Vaihingen" with buildings, vegetation and terrain.*



VIDEO EXPLOITATION SYSTEMS (VID)

Competences and portfolio

Especially in image sequences pattern and situation recognition play a vital part in the fields of disaster management, criminalistics, homeland security, defense against terrorism, driving assistance, and industrial quality control. The complexity and demands for robustness, reliability, and efficiency of the results are steadily increasing.

The Video Exploitation Systems (VID) department is active in the fields of automatic processing and exploitation of image signals in complex, mainly non-cooperative surroundings. The image data comes mainly from image acquisition sensors in multi-modal platforms (space, air, land, or water). VID develops and integrates software for image processing, fusion, and exploitation for autonomous and human-operated systems.

The main sensors to be exploited are visual-optical, infrared, SAR (Synthetic Aperture Radar), and others. A major aspect of our work is the realization of components to be integrated into larger systems. In specific cases we can also develop the whole system. Further areas of expertise of the department include interoperability in heterogeneous networks and application domain knowledge. The use and performance profile of the developed software are measured by benchmarking and with test systems. Current activities include the development of components for land vehicles, unpiloted air systems, autonomous land robots for surveillance, and security applications. Military applications – the exploitation of airborne and space-borne imagery – are also being developed.

Another focus lies on developing new methods in the field of situational awareness and biometrical approaches.

Tasks and projects

- ABUL – video exploitation system for aerial, land or maritime based platforms:
  - LUNA (German Bundeswehr, EMT)
  - ADS-95 RANGER (armasuisse)
  - IMINT Training Center (German Bundeswehr, AZAALw)
  - AGS STANAG 4609 (NATO, Airbus)
  - SuViMar: Maritime Video exploitation (WTD 71)
- VABUL – Video Database ABUL: video database
- DetAktiv: Detektion and Tracking of moving objects in UAV-Video data
- NEST – CrowdControl: Video-based Crowd Density Estimation for Security at Large Events
- Federal Ministry of Education and Research (BMBF): Video-assisted system for riot detection
- Federal Ministry of Education and Research (BMBF): Person detection in forensic mass data
- Federal Ministry of Defense (BMVg): Automatic camouflage Assessment
- Federal Ministry of Defense (BMVg): Robust tracking of moving objects from moving platforms in real-time
- Federal Ministry of Defense (BMVg): Image and image feature fusion (e.g. for automatic image stitching with high precision)

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1 *Multi-Sensor Video Exploitation Systems.*
2 *Automatic Exploitation of Aerial and Satellite Image Data.*

- European union (EU): System for offshore monitoring (detection of illegal border crossings and, smuggling of people, weapons, and drugs)
- European union (EU): System for the detection of vehicle collisions
- European union (EU): Body identification assistance system
- European union (EU): MobilePass - Algorithms for Touchless Fingerprint and Face Verification With Mobile Devices for Border Control

VARIABLE IMAGE ACQUISITION AND PROCESSING (VBV) RESEARCH GROUP

Competencies and Research Topics

The Variable Image Acquisition and Processing (VBV) Research Group develops methods and systems for automated visual inspection that are based on variable image acquisition techniques, or, more generally, exploit various kinds of heterogeneous information. Multiple theoretical and application-related issues studied here in close cooperation with the other departments of the IOSB and the Vision and Fusion Laboratory (Lehrstuhl für Interaktive Echtzeitsysteme – IES) of the Karlsruhe Institute of Technology (KIT) include:

- Holistic systems theory-based modeling of image acquisition and optimization of the evaluation process
- Reproducible acquisition of optimal image series, for example by variation of illumination, focusing, camera position and optical filters
- Fusion of data from the image series and from the other available information sources
- Online control of the variable acquisition parameters (Active Vision)
- Inspection and reconstruction of partially or fully specular surfaces

The variability of image acquisition is crucial if a single image does not fully capture the features of interest of a studied object or scene. The control system may then take multiple images, adjusting the parameters – such as the camera's position or field of view (for example to improve visibility of the occluded objects) – or switching to different spectral bands. In combination with data fusion, this may provide a description quality that is hardly if at all achievable with other inspection methods. Facilitated by the availability of inexpensive camera and manipulation systems and by the progress in modeling and planning algorithms, this kind of approach paves the way for novel applications where traditional methods would fail or not be flexible enough.

Projects

- Ellipsometric inspection of thin films on curved surfaces
- Visual inspection of transparent objects
- Automated microscopic inspection of large surfaces
- Deflectometry in thermal infrared
- Situation analysis in maritime surveillance systems
- Navigation of autonomous deep-sea vehicles
- Open adaptive modeling of the environment for artificial cognitive systems
- Probabilistic planning methods for deflectometric surface inspection
- Model reduction for non-linear and spatially distributed processes
- Underwater Vision: acquisition and exploitation of underwater imagery
- Interactive techniques for augmented reality environments
- Detection of surface defects based on deflectometric measurement data
- Person identification and face recognition in video data
- Control of cyber-physical production systems
- Methods of face registration, 3D reconstruction, and super-resolution in video data
- Methods of classification in hyper-spectral inspection
- Planning and execution of maneuvers for autonomous vehicles in traffic
- Methods for specular 3D reconstruction

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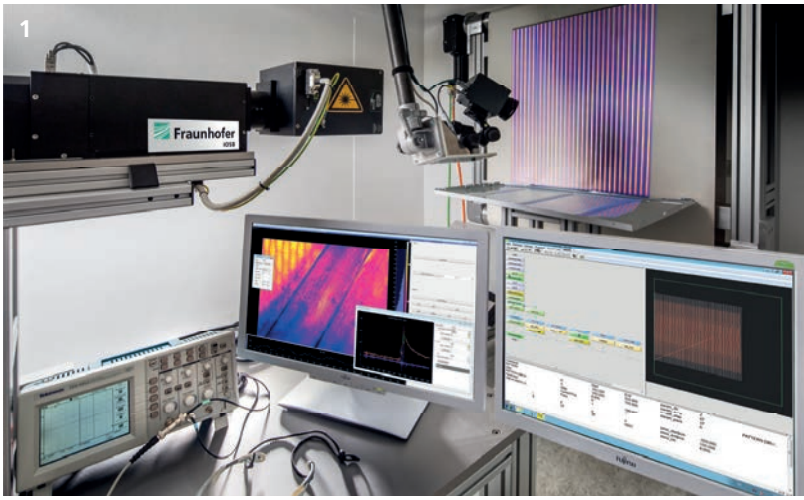
1 *Laboratory setup for infra-red-deflectometry.*
2 *Deflectometric inspection in Robot / MiniCAVE laboratory.*

Infrastructure and equipment

Robot laboratory:
The laboratory's industrial robot provides precise, automated, and reproducible adjustment of the image acquisition geometry. For example: illumination re-positioning allows very complex objects to be captured with a high degree of accuracy. In addition to traditional camera-based inspection, the laboratory is used for the inspection of specular objects with a deflectometric sensor head.

Infrared deflectometric laboratory:
Certain diffuse surfaces (such as metal sheets used in auto bodies) are specular when observed in the thermal infrared spectrum allowing their accurate inspection for the presence of dents, waves, and irregularities using deflectometry. However, unlike thermal infrared cameras, long-wavelength imaging devices are not readily available. The laboratory hosts several prototypes of devices to generate fast thermal deflectometric pattern series. In particular, one prototype utilizes a powerful laser to "draw" a pattern on a moving plastic band.

MiniCAVE laboratory:
Typically, the smaller the pattern projection screen, the longer a deflectometric inspection of a complex object takes. The radical way to increase the inspection area processed with a fixed camera-screen constellation is to completely enclose the object in a shell that serves as a screen. The MiniCAVE laboratory is equipped with digital projectors that enable a nearly complete coverage of the environment with encoding patterns (displayed on the walls and the ceiling). The research here is focused on calibration and measurement techniques in such environments and the associated advantages and challenges for the inspection tasks.



NAMES, DATES, EVENTS
NAMEN, DATEN, EREIGNISSE

ADVISORY BOARD
KURATORIUM

FRAUNHOFER INSTITUTE OF OPTRONICS, SYSTEM TECHNOLOGIES AND IMAGE EXPLOITATION
(DECEMBER 2015)

Dipl.-Ing. Roland Bent
Phoenix Contact GmbH & Co. KG, Blomberg

Dr. Jürgen Bestle
Airbus Defence and Space GmbH, Ulm

Prof. Dr. Rüdiger Dillmann
Karlsruher Institut für Technologie KIT, Karlsruhe
FZI Forschungszentrum Informatik, Karlsruhe

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Bundesministerium für Bildung und Forschung, Bonn

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Ministerium für Finanzen und Wirtschaft
Baden-Württemberg, Stuttgart

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Technologiemanagement, München

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Airbus Defence and Space GmbH, Immenstaad

Dr. Jörn Oprzynski
Siemens AG, Karlsruhe

Dipl.-Geogr. Marion Sielemann
BMVg - Bundesministerium der Verteidigung, Bonn

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Bayer Technology Services GmbH, Leverkusen

Prof. Dr. Christoph Stiller
Karlsruher Institut für Technologie KIT, Karlsruhe
FZI Forschungszentrum Informatik, Karlsruhe

Dr.-Ing. Frank Weber
Daimler AG, Sindelfingen

Ministerialrat Norbert Michael Weber
BMVg - Bundesministerium der Verteidigung, Bonn

SCIENTIFIC CONSULTANTS
WISSENSCHAFTLICHE BERATER

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Karlsruher Institut für Technologie (KIT), Karlsruhe

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Karlsruher Institut für Technologie (KIT), Karlsruhe

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Karlsruher Institut für Technologie (KIT), Karlsruhe

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Karlsruher Institut für Technologie (KIT), Karlsruhe

Prof. Dr. Rüdiger Heintz
Duale Hochschule Baden-Württemberg Mannheim, Mannheim

Prof. Dr.-Ing. Michael Heizmann
Hochschule Karlsruhe Technik und Wirtschaft, Karlsruhe

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Karlsruher Institut für Technologie (KIT), Karlsruhe

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Prof. Dr. Kristian Kroschel
Karlsruher Institut für Technologie (KIT), Karlsruhe

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Albert-Ludwigs-Universität Freiburg, Freiburg

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Technische Universität München, München

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Karlsruher Institut für Technologie (KIT), Karlsruhe

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Universität Bremen, Bremen

Prof. Dr.-Ing. Uwe Sörgel
Technische Universität Darmstadt, Darmstadt

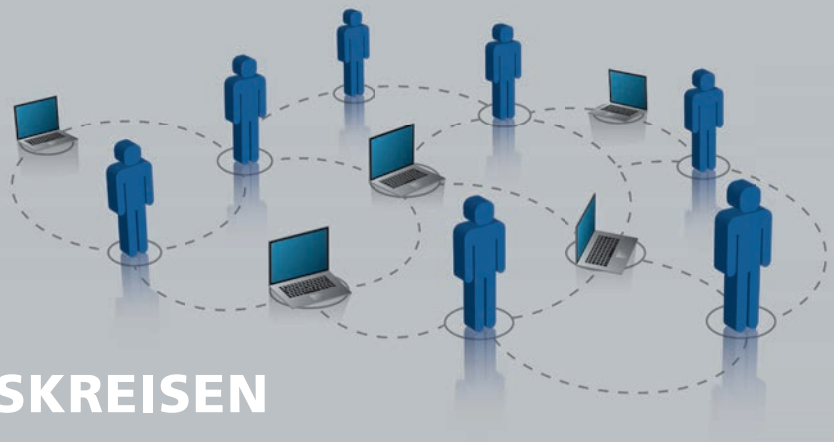
Prof. Dr.-Ing. Rainer Stiefelhagen
Karlsruher Institut für Technologie (KIT), Karlsruhe

Prof. Dr.-Ing. Dirk Westermann
Technische Universität Ilmenau, Ilmenau

APPEALS
BERUFUNGEN

Ernennung zum Professor für »Mechatronische Systeme« von **Dr.-Ing. Michael Heizmann** an der Hochschule Karlsruhe zum 1.9.2014

Ernennung zum Professor für »Mechatronik« von **Dr.-Ing. Stefan Werling** an der Dualen Hochschule Baden-Württemberg zum 1.10.2015



WORKING GROUPS
MITARBEIT IN ARBEITSKREISEN

Big Data
Thomas Usländer (Leitung),
Sebastian Abeck, Mathias Anneken, Thomas Bernard, Peter Bretschneider, Barbara Essendorfer, Christian Frey, Michael Heizmann, Christian Hofmann-Fuchs, Erik Krempel, Thomas Kresken, Birger Krägelin, Christian Kühnert, Eduardo Monari, Jürgen Moßgraber, Oliver Niggemann, Elisabeth Peinsipp-Byma, Alexander Pretschner, Olaf Sauer, Rainer Schönbein, Sebastian Schriegel, Tobias Schuchert, Gabriel Unmüßig, Sören Volgmann, Oliver Warweg

Counter-Improvised Explosive Device
Ilja Kaufmann (Leitung),
Jan Bartelsen, Yvonne Fischer, Jürgen Geisler, Wolfgang Gross, Reinhard Herzog, Klaus Jäger, Ilja Kaufmann, Wilmuth Müller, Alexander Schwarz, Peter Solbrig, Maurus Tacke

Energiewirtschaft
Björn Illing (Leitung),
Jürgen Demant, Andreas Reuter, Martin Werner

IOSB EU-Netzwerk
Kym Watson (Leitung),
Alexander Arnoldt, Bärbel Bathelt, Christoph Bier, Gunnar Brink, Yvonne Fischer, Holger Flatt, Divas Karimanzira, Jörg Kippe, Björn Kroll, Andreas Meissner, Wilmuth Müller, Jennifer Sander, Henning Schulte, Michael Voit

Maschinelles Lernen
Fabian Müller, Andreas Wenzel

Mobile Endgeräte
Frank Pagel (Leitung),
Ralf Eck, Alexander Enderle, Peter Frühberger, Mario Kaufmann, Erik Krempel, Siegbert Kunz, Simon Lemaire, Daniel Manger, Michael Okon, Hylke van der Schaaf, Gabriel Unmüßig

Multispektrale Datenerfassung und Auswertung
Thomas Längle (Sprecher),
Sebastian Bauer, Jürgen Beyerer, Fernando Chaves-Salamanca, Carsten Dachsbacher, Jörg-Detlef Eckhardt, Wolfgang Gross, Robin Gruna, Michael Heizmann, Christian Negara, Fernando Puente León, Henning Schulte, Uwe Sörgel, Günter Struck, Kai-Uwe Vieth, Max Winkelmann

Oberflächeninspektion
Michael Heizmann (Leitung),
Sebastian Höfer, Ilja Kaufmann, Thomas Längle, Wolfgang Melchert, Eduardo Monari, Thomas Müller, Christian Negara, Max-Gerd Retzlaff, Martina Richter, Matthias Richter, Masoud Roschani, Henning Schulte, Alexander Schwarz, Miro Taphanel, Markus Vogelbacher, Stefan Werling, Mathias Ziebarth

Optimierung
Liane Rublack (Leitung),
Alexander Arnoldt, Frank Karstädt, Clemens Kießhauer, Therese Klarner, Steffen Nicolai, Tobias Zimmermann

Prognose
Stefan Klaiber (Leitung),
Alexander Arnoldt, Peter Bretschneider

Regelungstechnik
Benjamin Fischer (Leitung),
Daniel Beyer, Sebastian Flemming, Frank Karstädt, Stefan Klaiber, Steffen Nicolai

Unterwassersensorik
Katrin Braesicke, Gunnar Brink, Marco Jacobi, Torsten Pfützenreuter, Helge Renkewitz

HONORS AND AWARDS
EHRUNGEN UND PREISE

Sebastian Bretthauer vom KIT und Erik Krempel vom IOSB haben auf der Konferenz IRI§ den LexisNexis Best Paper Award erhalten für ihren Beitrag: »Videomonitoring zur Sturzdetektion und Alarmierung – Eine technische und rechtliche Analyse«

Florian Segor, Chen-Ko Sung, Rainer Schönbein, Igor Tchouchenkov, Matthias Kollmann haben den Best Paper Award erhalten: Dynamic Pattern Utilization for Automatic UAV Control Support - The Ninth International Conference on Systems (ICONS 2015), Nizza, France, 13.-27.2.2014

Alexander Streicher, Daniel Szentes, Wolfgang Roller wurden auf der International Conference on Theory and Practice in Modern Computing, Madrid, Spain, 28.2.-2.3.2014, für den Beitrag: »SCENAS – Mobile Scenario Assistant for complex system configurations« mit einem Best Paper Award ausgezeichnet

Miriam Ruf, Jens Ziehn, Dieter Willersinn, Bodo Rosenhahn, Jürgen Beyerer, Heinrich Gotzig haben auf der International Conference on Mechatronics and Control (ICMC 2014), Jinzhou, China, July 3-5, 2014 für ihren Beitrag: »Evaluation of an Analytic Model for Car Dynamics« den Best Student Paper Award gewonnen

Dr. Miriam Schleipen und Dr. Olaf Sauer erhielten für ihre Einreichung »Universelle Schnittstellen für die Automatisierung« den Innovationspreis NEO 2014 der TechnologieRegion.

Dr. Karin Stein wurde von der Science and Technology Organization der NATO der Scientific Achievement Award 2014 zugesprochen für Ihre Verdienste um das Thema: »Mitigation of Ship Electro-Optical Susceptibility against Conventional and Asymmetric Threats«.

Dr. Karin Stein Abteilung SIG, wurde der »2014 NATO Science and Technology Organization's (STO) Scientific Achievement Award« zuerkannt. Der Preis wird ihr verliehen für ihre Beiträge zur SET-144 Task Group on »Mitigation of Ship Electro-Optical Susceptibility against Conventional and Asymmetric Threats«

Dr. Carl F. von Carmer, Abteilung SIG, wurde der »2014 NATO Science and Technology Organization's (STO) Scientific Achievement Award« zuerkannt. Der Preis wird ihm verliehen für seine Beiträge zur SET-144 Task Group on »Mitigation of Ship Electro-Optical Susceptibility against Conventional and Asymmetric Threats«

Christian Herrmann, Jürgen Beyerer erhalten den Best Student Paper Award für den Beitrag »Fast Face Recognition by Using an Inverted Index« auf der Konferenz »Image Processing: Machine, Vision Applications VII«, die Teil der »IS&T / SPIE Electronic Imaging« war und vom 8.-12.2.2015 in San Francisco, USA stattfand

Florian Segor, Igor Tchouchenkov, Rainer Schönbein, Matthias Kollmann, Christian Frey, Stefan Rilling, Rainer Worst haben den Best Paper Award erhalten: Dynamic Configuration of Distributed Systems for Disaster Managment – The Tenth International Conference on Systems (ICONS 2015), Barcelona, Spain, 19.-24.4.2015

Philipp Woock hat den Young Scientist Award erhalten: »Seafloor Heightmap Generation using 1D Kernel Reconstructions«. In: 3rd Underwater Acoustics Conference and Exhibition (UACE), Crete, Greece, 21.-26.6.2015

Sebastian Schriegel, Jürgen Jasperneite, Oliver Niggemann: WIP Best Paper Award für die Veröffentlichung »Plug-and-Work für verteilte Echtzeitsysteme mit Zeitsynchronisation«. In: Echtzeit 2010 - Industrie 4.0 und Echtzeit, GI / GMA / ITG-Fachausschuss Echtzeitsysteme, Boppard, 20.-21.11.2014

Lidia Yatcheva aus der Abteilung SIG hat bei der diesjährigen SPIE Remote Sensing Konferenz »Optics in Atmospheric Propagation and Adaptive Systems« den Best Student Paper Award gewonnen

Am 10. November 2015 wurde das Fraunhofer-Institut für Optronik, Systemtechnik und Bildauswertung (IOSB) für seine Lösungen zu universellen Schnittstellen für Maschinen und produktionsnahe IT ausgezeichnet. Diese Ehrung bezog sich auch auf das aktuelle Industrie 4.0-Großprojekt »Secure-PLUGandWORK«.

INTERNATIONAL GUESTS AND VISITING SCIENTISTS
INTERNATIONALE GÄSTE UND GAST-WISSENSCHAFTLER

Dr. Max Winkelmann wurde mit dem «NATO STO Science Achievement Award 2015« zusammen mit den Mitgliedern der »NATO-SCI Research Task Group on Mission Effectiveness of Denial and Deception« ausgezeichnet.

Patrick Philipp und Dr. Elisabeth Peinsipp-Byma wurde für ihr Paper »Decision Support in Context of a Standard-Based Usability Evaluation« bei der 2nd Annual Global Online Conference on Information and Computer Technology (GOCICT 2015) in Louisville, USA, einen der drei Best Professional Paper Awards verliehen. Die GOCICT ist eine in Scopus gelistete Konferenz.

Qiucheng Li, PhD-Student China, China Agriculture University, 1.9.2012-30.8.2016

Duc Long Nguyen, DAAD China, 01.10.2013-30.09.2016

Toshimasa Iijima, Researcher, Industrial Research Institute Hokkaido Research Organization, http://www.hro.or.jp, Sapporo, Japan, Forschungsaufenthalt, 1.11.2013-31.3.2014

Ph.D. Todd du Bosq, Night Vision & Electronic Sensors Directorate, USA, 1.8.2014 - 30.6.2015

20 Teilnehmer aus 6 Ländern,
Sustainable Water Management (NaWaM), 15.-26.9.2014

Prof. Dr. Alexander van Eijk, TNO Den Haag, Die Niederlande / Ecole Centrale de Nantes, Frankreich, Forschungsaufenthalt 6.10.2014 bis heute

Dr. Roberto Baena-Gallé, Real Academia de Ciencias y Artes de Barcelona, Spanien, Forschungsaufenthalt 1.4.-31.7.2015

Prof. Dr. rer. nat. Ralf Denzer, Hochschule für Technik und Wirtschaft des Saarlandes, Gaiberg, 1.4.-30.9.2015

Daoliang Li, Gastwissenschaftler, China, China Agriculture University, 2.6.15-23.7.2015

Mrs. R. Erdenezeg, Mitarbeit an internationalem Wasserprojekt, Mongolian Ministry of Construction and Urban Development, 4.-14.6.2015

Mr. Tsend, Mitarbeit an internationalem Wasserprojekt, General director of GEREGE GROUP in Mongolia, 4.-14.6.2015

Dewei Li, China, National Deep Sea Centre, Gastwissenschaftler, 30.6.2015-30.6.2016

Dr. Esdras Anzuola, Department of Signal Theory and Communications at the Polytechnic University of Barcelona in Spanien, Forschungsaufenthalt 1.7.2015-30.6.2016

Yiqi Liu, Gastwissenschaftler, South China University of Science and Technology, 1.9.-31.10.2015

SPECIAL EVENTS
BESONDERE VERANSTALTUNGEN

2014 2014 2014 2014 2014 2014

24. Sitzung des Fachausschusses 3.51 »Bildverarbeitung in der Mess- und Automatisierungstechnik« der VDI/VDE-GMA, Organisation und Leitung: Prof. M. Heizmann, Frankfurt a. M., 17.1.2014, 11 Teilnehmer

2. Counter-IED Workshop, Fraunhofer IOSB, Organisation: I. Kaufmann, Ettlingen, 11.-12.2.2014, 40 Teilnehmer

48. Regelungstechnisches Kolloquium, Organisatorische Leitung: Prof. M. Heizmann, Boppard, 19.-21.2.2014, 30 Beiträge, 190 Teilnehmer

Seminar »Wie wird das Wetter gemacht?« Hector-Kinder-Akademie, Leitung: Dr. Karin Stein, am IOSB, Ettlingen, 22.2.2014, 11 Teilnehmer

74. Sitzung des Fachausschusses 1.10 »Grundlagen Messsysteme« der VDI/VDE-GMA, Organisation und Leitung: Prof. M. Heizmann, Frankfurt a. M., 17.3.2014, 10 Teilnehmer

Girls'Day 2014 – Mädchen-Zukunftstag, Fraunhofer IOSB, 27.3.2014, 44 Teilnehmer

Regelungstechnisches Kolloquium in Boppard 2014.

Seminar »Licht und Farbe« Hector-Kinder-Akademie, Leitung: Dr. Karin Stein, am IOSB, Ettlingen, 29.3.2014, 11 Teilnehmer

Seminar »Sehen was andere nicht sehen« Hector-Kinder-Akademie, Leitung Dr. Karin Stein, am IOSB, Ettlingen, 5.4.2014, 12 Teilnehmer

Fraunhofer Energietage, Ausrichter: Fraunhofer-Allianz Energie, Berlin 29.-30.4.2014

Konferenz »Multisensor, Multisource Information Fusion: Architectures, Algorithms, and Applications 2014«, Mitarbeit im Programmausschuss: Prof. M. Heizmann, SPIE Defense, Security, and Sensing, Baltimore (MD, USA), 6.-7.5.2014, 22 Beiträge, 15 Zuhörer

Sitzung des EMS-EDM PROPHET® Produktbeirates, Ausrichter: AST Ilmenau, eins energie in sachsen GmbH & Co. KG Chemnitz, 8.5.2014, 12 Teilnehmer

Unified Vision 2014 (NATO Übung/JISR Trial) mit den Systemen CSD Server, NSD- Server, ISAAC.web PLUS, CSD- SPS++, i2exrep. Oerland Main Air Station (MAS), Norwegen, 11.-28.5.2014

Konferenz des VDI-Wissensforums »Condition Monitoring und Diagnose«, Inhaltliche Koordination und Sitzungsleitung: Prof. M. Heizmann, Karlsruhe, 13.-14.5.2014, 20 Teilnehmer

25. Sitzung des Fachausschusses 3.51 »Bildverarbeitung in der Mess- und Automatisierungstechnik« der VDI/VDE-GMA, Organisation und Leitung: Prof. M. Heizmann, Frankfurt a. M., 16.5.2014, 9 Teilnehmer

Research and Strategic Meeting: ONERA/DOTA and Fraunhofer IOSB on Optronics and Optics, Organisation: Dr. R. Ebert, J. Fartak, IOSB Ettlingen, 19.-20.5.2014, 8 Teilnehmer

EMS-EDM PROPHET® Anwenderkonferenz, Ausrichter AST Ilmenau, Eisenach, 11.-12.6.2014, 62 Teilnehmer

10th International ITBM&S Workshop (IR Target and Background, Modeling and Simulation), Fraunhofer IOSB und ONERA/DOTA, Organisation und Durchführung: E. Repasi und B. Rosier, Ettlingen, 23.-26.6.2014, 35 Teilnehmer

Workshop »Advanced Threat Warning, Tracking and Laser Countermeasures in Atmospheric Turbulence«, Organisation: C. Schweitzer, Ettlingen, 24.-26.6.2014, 12 Teilnehmer

TRM-Workshop, Fraunhofer IOSB, Organisation: J. Mündel, Ettlingen, 30.6.-1.7.2014, 10 Teilnehmer

MAJIIC 2 Interim Meeting, Multinationales Projektmeeting, IOSB Karlsruhe, 7.-11.7.2014, 23 Teilnehmer

DAAD Serial Summer School: Sustainable Water Management, TU Ilmenau in Kooperation mit Fraunhofer IOSB, Ilmenau, 15.-26.9.2014, 20 Teilnehmer

18. Technologietag, Fraunhofer IOSB, Karlsruhe, 24.9.2014, 29 Teilnehmer

75. Sitzung des Fachausschusses 1.10 »Grundlagen Messsysteme« der VDI/VDE-GMA, Organisation und Leitung: Prof. M. Heizmann, Frankfurt a. M., 26.9.2014, 4 Teilnehmer

26. Sitzung des Fachausschusses 3.51 »Bildverarbeitung in der Mess- und Automatisierungstechnik« der VDI/VDE-GMA, Organisation und Leitung: Prof. M. Heizmann, Frankfurt a. M., 10.10.2014, 9 Teilnehmer

IHK Friedrichshafen: Prof. H. Steusloff: Normung und KMU, Friedrichshafen, 10.10.2014, 30 Teilnehmer

Technologietag Verteidigungsforschung am IOSB, Organisation und Leitung: Dr. J. Geisler, A. Erb; 14.10.2014, 60 Teilnehmer

Fraunhofer Vision Technologietag 2014, Fraunhofer-Zentrale, München, 15.-16.10.2014

VISION (VDMA-Technologietag als KCM), Messe-Stuttgart, 4.-6.11.2014

Seminar »Daten- und Informationsfusion« der Carl-Cranz-Gesellschaft e. V., Organisation und Leitung: Prof. M. Heizmann, Karlsruhe, 10.-13.11.2014, 7 Teilnehmer

Sitzung des EMS-EDM PROPHET® Produktbeirates, Ausrichter: AST Ilmenau, SWE Energie GmbH Erfurt, 13.11.2014, 12 Teilnehmer

VDI/VDE-GMA-Veranstaltung »Forum Bildverarbeitung«, Organisation, Mitarbeit im Programmausschuss und Leitung: Prof. M. Heizmann, Regensburg, 27.-28.11.2014, 32 Beiträge, 50 Teilnehmer

Fraunhofer VISION-Seminar mit Praktikum: Inspektion und Charakterisierung von Oberflächen mit Bildverarbeitung, Fraunhofer IOSB, Karlsruhe, 3.-4.12.2014

SPECIAL EVENTS
BESONDERE VERANSTALTUNGEN

2015 2015 2015 2015 2015 2015

Research and Strategic Meeting: ONERA/DOTA and Fraunhofer IOSB on Optronics and Optics, Organisation: Dr. R. Ebert, J. Fartak, IOSB Ettlingen, 12.-13.1.2015, 5 Teilnehmer

MAROS 2015 – Roadmapentwicklung für die Maritime Robotik und Sensorik, Ausrichter: Enitech GmbH, Universität Rostock, DFKI Bremen, IOSB-AST Ilmenau, Rostock, 20.-22.1.2015, 100 Teilnehmer

27. Sitzung des Fachausschusses 3.51 »Bildverarbeitung in der Mess- und Automatisierungstechnik« der VDI/VDE-GMA, Organisation und Leitung: Prof. M. Heizmann, Frankfurt a. M., 23.1.2015, 13 Teilnehmer

US-GE DEA 1837, Organisation: Dr. R. Ebert, Meeting at NVESD, Fort Belvoir, USA, 9.-11.2.2015, 15 Teilnehmer

Workshop: Open IoT Day. Fraunhofer IOSB. International Workshop, Leitung des Workshops: T. Usländer, R. Herzog, IOSB Karlsruhe, 11.2.2015, 50 Teilnehmer

49. Regelungstechnisches Kolloquium, Organisatorische Leitung: Prof. M. Heizmann, Boppard, 4.-6.3.2015, 30 Beiträge, 190 Teilnehmer

76. Sitzung des Fachausschusses 1.10 »Grundlagen Messsysteme« der VDI/VDE-GMA, Frankfurt a. M., Organisation und Leitung: Prof. M. Heizmann, 12.3.2015, 5 Teilnehmer

Tagung »Multisensorik in der Fertigungsmesstechnik 2015« der VDI-Wissensforum GmbH, Mitarbeit im Programmausschuss und Tagungsleitung: Prof. M. Heizmann, Nürtingen, 17.-18.3.2015, 19 Vorträge, 45 Teilnehmer

Fraunhofer IOSB KCM SpectroNet Collaboration Forum 2015, IOSB, Karlsruhe, 17.3.2015, 66 Teilnehmer

2nd International Conference on Optical Characterization of Materials (OCM 2015), IOSB, Karlsruhe, 18.-19.3.2015, 73 Teilnehmer

IHK München: Prof. H. Steusloff: Normen oder Patente? Schutz von IPR. München, 15.4.2015, 30 Teilnehmer

Girls'Day 2015 – Mädchen-Zukunftstag, Fraunhofer IOSB, 23.4.2015, 35 Teilnehmer

28. Sitzung des Fachausschusses 3.51 »Bildverarbeitung in der Mess- und Automatisierungstechnik« der VDI/VDE-GMA, Organisation und Leitung: Prof. M. Heizmann, Frankfurt a. M., 24.4.2015, 9 Teilnehmer

3. VDI-Fachkonferenz »Big Data Technologien in der Produktion 2015« der VDI-Wissensforum GmbH, Tagungsleitung: Prof. M. Heizmann, Karlsruhe, 19.-20.5.2015, 55 Teilnehmer

Workshop: Geospatial ICT Support for Crisis Management and Response. ISCRAM 2015, Leitung des Workshops: T. Usländer, Kristiansand, Norwegen, 24.-27.5.2015

Sitzung des EMS-EDM PROPHET® Produktbeirates, Ausrichter: AST Ilmenau, Bielefeld, 2.-3.6.2015, 10 Teilnehmer

OPTIMAX 2015 (NATO Interoperabilitätsexperiment) mit den Systemen CSD Server, CSD- SPS++, ISAAC.web PLUS, i2exrep, ReportAnalyzer. NATO Communications and Information Agency (NCIA), Den Haag, 4.-26.6.2015

Consortium Meeting INTUITEL, IOSB Karlsruhe, 7.-17.6.2015, 17 Teilnehmer

EMS-EDM PROPHET® Anwendertage für Kunden von EMS-EDM PROPHET®, Ausrichter AST Ilmenau, Zeulenroda-Triebes, 24.-25.6.2015, 58 Teilnehmer

12th International Conference on Advanced Video and Signal-based Surveillance (AVSS), Fraunhofer IOSB / KIT, Karlsruhe, 25.-28.8.2015, ca. 140-150 Teilnehmer - aus 17 Ländern

10. »Future Security« 15.9. - 17.9.2015
Bei der internationalen Konferenz des Fraunhofer-Verbunds Verteidigungs- und Sicherheitsforschung VVS, die im September in Berlin stattfand, diskutierten rund 220 Experten aus Forschung, Industrie, Behörden und Anwenderkreisen über aktuelle Fragen der Sicherheitsforschung. Unter dem Leitthema „In Sicherheit frei" standen u.a. Cyber Security, Big Data, Sensortechnologie sowie Abwehr von Kleindrohnen und rechtliche Fragen auf dem Programm.

Festveranstaltung »Institutsneubau und 20 Jahre Systemtechnik«, Ausrichter: AST, IIS-DVT, Ilmenau, 17.9.2015
100 Teilnehmer

ML4CPS – Machine Learning for Cyber Physical Production Systems, Lemgo, 1.-2.10.2015, 58 Teilnehmer

The Industrial Internet of Things (IIoT) and Future of Food Security. Poster auf der Konferenz Global Food Security, (Brink, G., Chaves Salamanca, F., Watson, K.) New York, 11.-14.10.2015

8. Fraunhofer VISION-Technologietag 2015, IPA, Stuttgart, 14.-15.10.2015

Fraunhofer VISION-Seminar mit Praktikum: Inspektion und Charakterisierung von Oberflächen, IOSB Karlsruhe, 9.-10.12.2015

10. »Future Security« Konferenz in der Landesvertretung Nordrhein-Westfalen (Berlin).

TRADE FAIRS AND EXHIBITIONS
MESSEN UND FACHAUSSTELLUNGEN

2014

E-world energy & water 2014
Essen, 11.-13.2.2014
Exponat:
- EMS-EDM PROPHET®

4. Erneuerbare-Energien-Konferenz »Thüringen Erneuer!bar«
Weimar, 12.2.2014
Stand mit Vorstellung Abteilung NRG

Energy Storage Europe
Düsseldorf, 25.-27.3.2014
Exponat:
- SmartRegion Pellworm

CeBIT 2014
Hannover, 10.-14.3.2014,
Exponat:
- TOPDOCUMATION
- Automatisierte Mikroskopie im MicroLab
- Prüfsystem für lackierte Bauteile aller Baugrößen
- SENEKA
- Vibration measurements of rotating wind turbine blades

Hannover Messe 2014
Hannover, 7.-11.4.2014
Exponat:
- Montagelinie der SmartFactoryOWL
- maschinelles Lernen
- Funktionsmuster sMobiliTy (Gemeinschaftsstand Fraunhofer-Allianz Energie)

IFAT – Weltleitmesse für Wasser-, Abwasser,- Abfall & Rohstoffwirtschaft
München, 5.-9.5.2014
Exponat:
- AquaBioTox – Trinkwasserüberwachung
- Touch Screen IWRM-MoMo (auf dem Gemeinschaftsstand Fraunhofer-Allianz SysWasser)

Control 2014 – 28. Control - Internationale Fachmesse für Qualitätssicherung
Stuttgart, 6.-9.5.2014
Exponat:
- Inspektion gekrümmter Oberflächen mit Reflektometrie und Deflektometrie
- Recycling schwarzer Kunststoffe „blackValue“

28. AFCEA-Fachausstellung
Bonn-Bad Godesberg,
7.-8.5.2014
Exponate:
- Coalition Shared Data Server (CSD)
- Interoperable Videoauswertung für die Aufklärung und Überwachung mit UAS (ABUL)
- Gestengesteuerte Lagevisualisierung mit genormten Geodaten am Digitalen Lagetisch
- Serious Games für das Training in der abbildenden Aufklärung (SIMBAS)
- Aufklärung mit mobilen und ortsfesten Sensoren im Verbund (AMFIS)

Tag der offenen Tür im Bundespresseamt
Berlin, 30.-31.8.2014
Exponat:
- Die Welt der Energie in Zahlen, interaktive Energielandschaft

it-sa
Nürnberg, 7.-9.10.2014
Exponate:
- IT-Sicherheitslabor-Rollup
- CyphWay
- SecureAutoType
- Datenschutzfitnesstest
- NurseEye
- P²PIM

7. Fraunhofer Vision-Technologietag
München, 15.-16.10.2014
Exponat:
- Inspektion und Charakterisierung von Oberflächen

eCarTec 2014
München, 21.-23.10.2014
Exponat: Funktionsmuster sMobiliTy (Gemeinschaftsstand sMobiliTy)

ThEGA-Forum 2014
Weimar, 27.10.2014
Stand mit Präsentation der Abt. NRG

inova - Die Karrieremesse an der TU Ilmenau
Ilmenau, 28.10.2014
Gemeinschaftsstand »Fraunhofer in Thüringen«

VISION 2014, Weltleitmesse für Bildverarbeitung
Stuttgart, 4.-6.11.2014
Exponat:
- Handapparat Deflektometrie

Forum Maschinenbau (FMB) 2014
Bad Salzuflen, 5.-7.11.2014
Exponat:
- Augmented-Reality Handarbeitsdemo

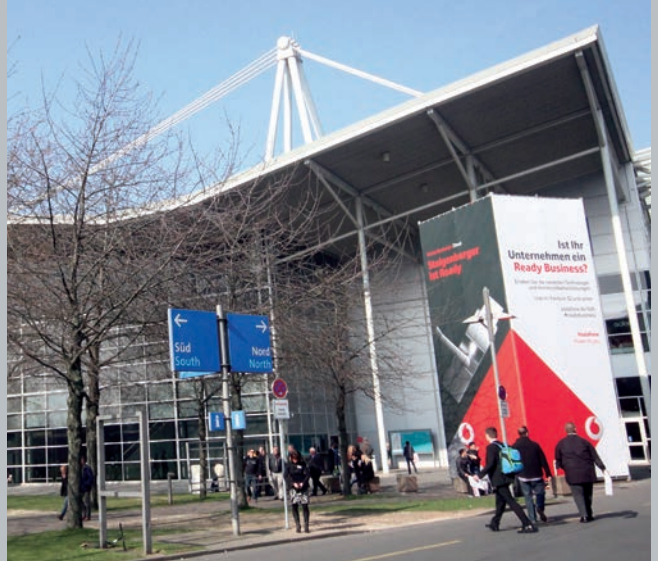
Oberflächenseminar Allianz Vision
Fraunhofer IOSB Karlsruhe,
3.-4.12.2014
Exponat:
- Demonstrator Deflektometrie

2015

E-world energy & water 2015
Präsentationsstand EMS-EDM PROPHET®,
Essen, 10.-12.2.2015
Exponat:
- EMS-EDM PROPHET®

IT&Media
Darmstadt, 19.2.2015
Exponat:
- IT-Sicherheitslabor-Rollup
- ISO 27000
- SecureAutoType
- Datenschutzfitnesstest

Energy Storage Europe
Düsseldorf, 9.-11.3.2015
Exponat:
- Leitsystem hybrider Stadtspeicher



CeBIT 2015
Hannover, 16.-20.3.2015
Exponat:
- sMobiliTy-Demonstrator (BMWi-Gemeinschaftsstand)

Prof. H. Steusloff: Teilnahme an einer Podiumsdiskussion: W3C – Web of Things Initiative, 18.3.2015

WASSER BERLIN INTERNATIONAL 2015
23.-27.3.2015
Posterpräsentation von Projekten

HMI 2015
Hannover, 11.-17.4.2015
Exponat:
- EBITA
- DocuMation 2.0
- IT-Sicherheitslabor Industrie 4.0
- Unterwasser-Signalverarbeitung
- Montagelinie der SmartFactoryOWL
- Secure-PLUGandWORK-Adapter
- DeDAvE Mockup (Gemeinschaftsstand InWatersolutions)

ThEGA-Forum 2015
Weimar, 20.4.2015
Stand mit Präsentation der Abt. NRG

29. AFCEA-Fachausstellung
Bonn-Bad Godesberg, 6.-7.5.2015
Exponat:
- Blickbasierte Interaktion mit automatisierten Trackingverfahren
- Interoperable Videoauswertung für die Aufklärung und Überwachung mit UAS
- Serious Game für das Training in der abbildenden Aufklärung: LostEarth 2307
- Aufklärung mit mobilen und ortsfesten Sensoren im Verbund

Control 2015 – 29. Control - Internationale Fachmesse für Qualitätssicherung
Stuttgart, 5.-8.5.2015
Exponat:
- System zur Inspektion von Oberflächen mit Deflektometrie im Durchlauf
- CCT-Sensor für inlinefähige konfokale 3D-Messtechnik für spiegelnde und diffuse Oberflächen

LIGNA 2015
Hannover, 11.-14.5.2015
Exponat:
- Montagelinie der SmartFactoryOWL

Interschutz – Internationale Leitmesse für Brand-/Katastrophenschutz, Rettung und Sicherheit
Hannover, 8.-13.6.2015
Exponat:
- SENEKA u.a. QUANJO TDS

Tag der offenen Tür im Bundespresseamt
Berlin, 29.-30.8.2015
Exponat:
- Die Welt der Energie in Zahlen, interaktive Energielandschaft

Intergeo
Stuttgart, 15. -17.9.2015
Präsentation von Sensoren

HUSUM Wind 2015
Husum, 15.-18.9.2015
Exponat:
- Distante Vibrationsmessung an Rotorblättern von Windenergieanlagen im Betrieb

It&Business
Stuttgart, 29.9.-1.10.2015
Exponat:
- IT-Sicherheitslabor
- SecureAutoType
- ISO 27000

it-sa
Nürnberg, 6.- 8.10.2015
Exponat:
- IT-Sicherheitslabor
- SecureAutoType
- ISO 27000

TechNet
Berlin, 20.-22.10.2015
Exponat ABUL, Automatische Generierung von Simulationsgeländen aus Sensordaten, Cholera EWS

inova - Die Karrieremesse an der TU Ilmenau
Ilmenau, 27.10.2015
Gemeinschaftsstand »Fraunhofer in Thüringen«

5. Erneuerbare-Energien-Konferenz »Thüringen Erneuer!bar«
Weimar, 28.10.2015
Exponat:
- Die Welt der Energie in Zahlen

Forum Maschinenbau (FMB) 2015
Bad Salzuflen, 4.-6.11.2015
Exponat:
- Vorausschauende Wartungs-Demo

SpaceTech Expo
Bremen, 17.-19.11.2015
Exponat BRDF: Measurement of reflective properties

SPS Drives
Nürnberg, 24.-26.11.2015
Exponat:
- IT-Sicherheitslabor

PARTICIPATION IN COMMITTEES
MITARBEIT IN GREMIEN

Adomeit, U.:
- Vorsitzender der NATO-Gruppe SET-ET-083 »Assessment and modelling the performance of digital night vision image fusion«
- Mitglied der NATO-Gruppe SET-ET-94 »Short Wave Infrared Technology«
- Mitglied der NATO-Gruppe SET-209 »Exploitation of Human Signatures for Threat Determination«

Arnoldt, A.:
- Mitglied und Vertreter der Abt. NRG des IOSB-AST im Fraunhofer-Netzwerk Windenergie
- Mitglied im VDE/DKE Backendsysteme
- Mitglied im Fraunhofer EU-Netzwerk
- Mitglied im IOSB EU-Netzwerk

Batz, T.:
- Mitglied in der Gesellschaft für Informatik, Fachgruppe Datenbanksysteme
- Mitglied in der Gesellschaft für Informatik, Fachgruppe Requirements Engineering
- Mitglied in der Gesellschaft für Projektmanagement (GPM)

Baumann, M.:
- Mitglied im Industriearbeitskreis »Produktionslogistik für die variantenreiche Serienfertigung«

Becker, S.:
- Session Chair IAPR MVA2015 (International Conference on Machine Vision Applications), Session 9; Pedestrian

Bernard, T.:
- Mitglied in der ERNCIP Thematic Group »Chemical & Biological Risks in the Water Sector«
- Stellvertretende Ombudsperson im IOSB zur Sicherung guter wissenschaftlicher Praxis

Beyer, D.:
- Mitarbeit im BITKOM

Beyerer, J.:
- Vorsitzender des Fraunhofer-Verbundes für Verteidigungs- und Sicherheitsforschung VVS
- Mitglied des Kuratoriums des Forschungszentrums Informatik (FZI), Karlsruhe
- Vorstandsmitglied des Kuratoriums der Hochschule Karlsruhe Technik und Wirtschaft
- Leitung des Technischen Forums der Firma inspectomation GmbH, Mannheim
- Mitglied der acatech - Deutsche Akademie der Technikwissenschaften e.V., München und Berlin
- Sprecher Themennetzwerk Sicherheit, acatech - Deutsche Akademie der Technikwissenschaften e.V., München und Berlin
- Member of IEEE Computer Society
- Member of IEEE Intelligent Transportation Systems
- Member of Society for Industrial and Applied Mathematics (SIAM)
- Member of The International Society for Optical Engineering (SPIE)
- Mitglied der Deutschen Arbeitsgemeinschaft für Mustererkennung e.V. (DAGM)
- Mitglied im VDE
- Mitglied im Beirat der Deutschen Initiative für NetzwerkInformation (DINI)
- Mitglied im Präsidium der Deutschen Gesellschaft für Wehrtechnik (DWT)
- Mitglied im wissenschaftlichen Beirat der Zeitschrift at – Automatisierungstechnik der GMA (VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik) und der NAMUR (Interessengemeinschaft Prozessleittechnik der chemischen und pharmazeutischen Industrie)
- Mitglied im Beirat der Zeitschrift »Strategie und Technik«
- Mitglied im Beirat der Zeitschrift »Europäische Sicherheit und Technik«
- International Member of the Advisory Board, Institute for Computer Science and Control (SZTAKI), Hungarian Academy of Sciences, Budapest
- Member of the Editorial Board der Buchreihe »Technologien in der intelligenten Automation«, Springer-Verlag
- Member of the Advisory Board of the European Journal for Security Reserarch, Springer-Verlag
- Mitglied im Programmkomitee der Teilkonferenz: Crisis Management – Information Systems, Humanitarian Logistics and IT-based Decision Support, Multikonferenz Wissenschafts-informatik, Paderborn, 26.-28.2.2014

- Konferenzleiter der vom VDI Wissensforum organisierten Konferenz »Zustandsüberwachung und Optimierung von Produktionsanlagen – Von der Datenerfassung bis zur Systemanalyse«, Karlsruhe, 13.-15.4.2014
- Member of the Program Committee »International Workshop on Computer Vision with Local Binary Patterns Variants (LBP 2014)«, in conjunction with ECCV 2014, Zurich, 6.9.2014
- Mitglied im Programmausschuss der »9th Future Security«, Berlin, 16.-18.9.2014
- Mitglied im Programmkomitee »10th Symposium on Formal Methods for Automation and Safety in Railway and Automotive Systems FORMS/FORMAT«, Institute for Traffic Safety and Automation Engineering, Technische Universität Braunschweig, Braunschweig, 30.9.-2.10.2014
- Mitglied im Programmkomitee des IEEE-Workshops »Sensor Data Fusion – Trends, Solutions, and Applications«, Bonn, 8.-10.10.2014
- Mitglied im Programmausschuss Forum Bildverarbeitung 2014 (International Forum on Image Processing 2014), Regensburg, 27.-28.11.2014
- General Chair der 2nd International Conference on Optical Characterization of Materials (OCM 2015), Karlsruhe, 18.-19.3.2015
- Conference Chair der Conference Automated Visual Inspection and Machine Vision, SPIE Optical Metrology, München 22.-25.6.2015
- General Chair der 12th IEEE International Conference on Advanced Video and Signal-based Surveillance (AVSS 2015), Karlsruhe, 25.-28.8.2015
- Chairman and Member of the Program Committee of the 10th Future Security, Berlin, 15.-17.9.2015
- Mitglied im Programmkomitee der Teilkonferenz: Crisis Management – IT-Sicherheit für Kritische Infrastrukturen, Multikonferenz Wissenschaftsinformatik, Ilmenau, 9.-11.3.2016

Bier, C.:
- Mitglied im DIN-Gremium DIN NIA AK 27-05 Identitätsmanagement und Datenschutz-Technologie

Bohn, S.:
- Mitglied VDE Arbeitskreis Smart Grids

Boldt, M.:
- Session Chair, SPIE Remote Sensing Europe 2014 (Amsterdam, Niederlande), Conference: Earth Resources and Environmental Remote Sensing / GIS Applications V, Sessions: Infrastructures and Urban Areas II / Sensors and Platforms II
- Session Chair, SPIE Remote Sensing Europe 2015 (Toulouse, Frankreich), Conference: Earth Resources and Environmental Remote Sensing / GIS Applications, Session: Environmental Monitoring Concepts I
- Programme Committee Member, SPIE Remote Sensing Europe 2015 (Toulouse, Frankreich), Conference: Earth Resources and Environmental Remote Sensing / GIS Applications

Bretschneider, P.:
- Stellv. Sprecher Fraunhofer-Allianz Energie
- Koordinator des Fraunhofer-Netzwerk Intelligente Energienetze
- Mitglied im Fraunhofer-Netzwerk Windenergie
- Mitglied im Fraunhofer-Netzwerk Energiespeichersysteme und Netze
- Mitglied im GMA FA 5.14 »Computational Intelligence« (GI Fachgruppe Fuzzy-Systeme und Soft-Computing)
- Mitarbeit im BDI-Arbeitskreis »IT für Energiemärkte der Zukunft«
- Institut für Energiewirtschaftsrecht Jena
- Stellv. Vorstandsvorsitzender des Thüringer Erneuerbare Energien Netzwerk (ThEEN)
- Mitglied des BDI-Arbeitskreises »Internet der Energie«

Brink, G.:
- Mitglied des International Expert Panel for Innovation Management bei der Administrative Assessment Exercise (AAE) am KTH Royal Institute of Technology Stockholm, Schweden
- Vertretung des Fraunhofer-Vorstandes in der General Assembly EIT ICT Labs

Bulatov, D.:
- Reviewer »Photogrammetrie – Fernerkundung – Geoinformation (PFG)«
- Reviewer »ISPRS-Journal of Photogrammetry and Remote Sensing«
- Reviewer »ISPRS International Journal of Geo-Information«
- Session Chair for the SPIE Conference Session »Infrastructure and Urban Area«

PARTICIPATION IN COMMITTEES
MITARBEIT IN GREMIEN

Carmer von, C.F.:
- Mitglied in der NATO-SET-211 Gruppe »Naval Platform Protection in the EO/IR Domain«
- Mitglied in der NATO SCI-224 Gruppe »ET on EO & IR-Countermeasures against Anti-ship Missiles«
- Mitarbeit CSSM WG 2 on Above Water Ship Signature Management DEU, NLD, CAN, NOR, BEL
- Reviewer Int. J. Heat Fluid Fl.
- Mitglied VDI, AIAA, IAHR

Chaves, F.:
- Vertreter des IOSB im Koordinierungsausschuss F+E IuK im Rahmen der Kooperation INOVUM des Umweltministeriums Baden-Württemberg
- Mitglied in der Gesellschaft für Informatik, Fachgruppen »Arbeitsplatzrechensysteme und Personal Computer« und Multimediale und hypermediale Systeme« sowie Regionalgruppe Karlsruhe
- Mitglied des Vereins Angewandte Informatik Karlsruhe AIK e. V.
- Mitglied (Technical Alternate) im Technical Committee des Open Geospatial Consortium (OGC)

Demant, J.:
- Vertreter des Fraunhofer IOSB-AST in der EDNA (Bundesverband Energiemarkt und Kommunikation)

Eberle, B.:
- Mitglied der NATO-Gruppe SCI-264 »High Energy Laser Weapons: Tactical Employment in the Shared Battlespace«
- Vorsitzender der NATO-Gruppe SET-198 »Visible Laser Dazzle – Effects and Protection«

Ebert, R.:
- Co-Chair Symposium SPIE Security and Defence Europe, Amsterdam, 22.-25.9.2014
- Member of the Program Committee of the International Conference OPTRO 2014 and OPTRO 2016

Eck, R.:
- Mitglied im Fachbereich 2 »Dienste und Anwendungen« der Informationstechnischen Gesellschaft (ITG) im VDE

Eisele, C.:
- Mitglied in der Fraunhofer WISA Agnes Gruppe »AlGaN-Detektoren zur Emissionsüberwachung von UV-Strahlern«
- Mitglied der NATO-SET-211 Gruppe »Naval Platform Protection in the EO/IR Domain«

Essendorfer, B.:
- Mitglied im Programm Commitee of AETOS international conference on »Research challenges for future RPAS/UAV systems«, 2014

Even, M.:
- Mitglied in der NATO-RTO-SET-220 Gruppe »Geospatial Information Extraction From Space-Borne SAR-Images for NATO-Operations«
- Mitglied in der NATO-RTO-SCI-248 Gruppe »Vulnerability of NATO operations to current and future commercial space-based Synthetic Aperture Radar (SAR) sensors«
- Reviewer »IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing«
- Reviewer »IEEE Transactions on Geoscience and Remote Sensing«
- Reviewer »Photogrammetrie – Fernerkundung – Geoinformation (PFG)«
- Reviewer »ISPRS Journal of Photogrammetry and Remote Sensing«

Fischer, Y.:
- Mitglied Technical Programme Committee CogSIMA

Fitz, D.:
- Mitglied in der NATO-SCI-ET-013 Gruppe »Evaluation Methods and Assessment of Camouflage in Operational Context«

Frey, C.:
- Mitglied im VDI/VDE-GMA-Fachauschuss 5.14 »Computational Intelligence«

Geisler, J.:
- Mitglied im Programmkomitee der »10th Future Security«, Berlin, 15.-17.9.2015
- Mitglied im Panel für Systems, Concepts and Integration (SCI) der NATO-STO
- Leiter der NATO-STO Research Task Group SCI-280 on »System-of-systems approach to task driven sensor resource management for maritime situational awareness«

Gladysz, S.:
- Mitglied in der NATO-SET-226 Gruppe »Turbulence mitigation for Electro Optics (EO) and laser systems«
- Mitglied im Programmausschuss, »Propagation through and Characterization of Distributed Volume Turbulence and Atmospheric Phenomena« Konferenz, 2014 und 2015

- Mitglied im Programmausschuss, session presider, »Adaptive Optics: Analysis, Methods & Systems« Konferenz, 2015
- Koordinierungsausschuss, »Advanced Threat Warning, Tracking and Laser Countermeasures in Atmospheric Turbulence« Workshop, 2014, Ettlingen
- Zusammenarbeit mit der Royal Academy of Sciences and Arts of Barcelona
- Kooperation mit dem Institut für Technische Optik der Universität Stuttgart im Rahmen einer Doktorarbeit
- Kooperation mit dem Kiepenheuer-Institut für Sonnenphysik in Freiburg im Rahmen einer Doktorarbeit
- Kooperation mit Institut für Photonik und Quantenelektronik am KIT im Rahmen der Masterarbeiten
- Reviewer für Optics Express, Applied Optics und Journal of the Optical Society of America

Göhler, B.:
- Mitglied der NATO-Gruppe SET-205 »Active Electro-Optic Sensing for Target Identifi-cation and Tactical Applications«

Groß, W.:
- DEU - CHE Kooperation »Hyperspectral Imaging«
- DEU - ISR Kooperation »Hyper Spectral Remote Sensing Technologies«

Gruna, R.:
- Mitglied im Programmausschuss »2nd International Conference on Optical Characterization of Materials« (OCM 2015)

Heizmann, M.:
- Stellvertretender Vorsitzender des Fachbeirats des Fachbereichs 3 »Fertigungsmesstechnik« der VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA) seit 01/2012
- Leitung des Fachausschusses 3.51 »Bildverarbeitung in der Mess- und Automatisierungstechnik« der VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA) seit 03/2006
- Leitung des Fachausschusses 1.10 »Grundlagen der Messsysteme« der VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA) seit 04/2011, Mitarbeit seit 11/2005
- Mitarbeit in der Arbeitsgruppe »Fertigungsmesstechnik 2020« der VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA) seit 09/2008
- Vertretung des Fraunhofer IOSB im Arbeitskreis der Fraunhofer-Allianz Vision seit 06/2004
- Leitung des Arbeitskreises »Oberflächeninspektion« am Fraunhofer IOSB seit 10/2010
- Mitglied des Fachbeirats des Fachbereiches 1 »Grundlagen und Methoden der Mess- und Automatisierungstechnik« der VDI/VDE-Gesellschaft für Mess- und Automatisierungstechnik (GMA) 01/2013
- Mitglied im wissenschaftlichen Beirat des Kooperativen Promotionskollegs »Entwurf und Architektur Eingebetteter Systeme (EAES)« der Hochschule Pforzheim und der Universität Tübingen seit 12/2012
- Organisatorische Leitung des Regelungstechnischen Kolloquiums in Boppard
- Mitarbeit im Programmausschuss »2nd International Conference on Optical Characterization of Materials« (OCM 2015)

Henßen, R.:
- Mitarbeit in der Arbeitsgruppe »DKE K941.0.2 AutomationML« der Deutschen Kommission Elektrotechnik Elektronik Informationstechnik.
- Mitarbeit in der IEC Working group 9 of SC 65E
- Leitung der Arbeitsgruppe Materialfluss des AutomationML e.V.

Herzog, R.:
- MSG-ET-035: Leitung der NATO Arbeitsgruppe »Development of High Level Architecture (HLA) Federation Compliance Test Tool«
- MSG-106: Mitarbeit in der NATO Arbeitsgruppe »Enhanced CAX architecture, design and methodology«
- Mitarbeit in der Standards Working Group des Open Geospatial Consortium »Sensor Web for IoT SWG«

Jacobi, M.:
- Vertreter des IOSB-AST im ZIM-Netzwerk Mini-ROV

PARTICIPATION IN COMMITTEES
MITARBEIT IN GREMIEN

Jasperneite, J.:
- Evaluator in EU Horizon 2020 SME
- Secretary IEEE Industrial Electronics Society, Factory Automation
- Co-Chair des Subcommittee on Information Technology in Industrial and Factory Automation (IES FA 5) in der IEEE Industrial Electronics Society
- Fachredaktion der ATP
- Mitglied GMA-Fachausschuss 5.12 Echtzeitsysteme
- Mitglied GMA-Fachausschuss 6.15 Zuverlässiger Betrieb Ethernet-basierter Bussysteme in der industriellen Automatisierung
- Mitglied GMA-Fachausschuss 7.21 »Industrie 4.0« - Begriffe, Referenzmodelle, Architekturkonzepte
- Vorstandmitglied OWL-Maschinenbau
- stv. Sprecher der Fraunhofer-Allianz Embedded Systems
- Mitglied TuLAUT
- IEEE Senior Member
- Mitglied Plattform Industrie 4.0, AG 3 »Forschung & Innovation«
- Gutachter Österreichische Forschungsförderungsgesellschaft (FFG)
- Gutachter Stiftung Rheinland-Pfalz für Innovation
- Gutachter Programm ZAFH, Baden-Württemberg

Kerth, C.:
- Mitglied im STANAG 4559 Custodian Support Team (CST)

Krägelin, B.:
- Mitglied im Beirat der Deutschen Initiative für Netzwerkinformationen e.V. (DINI)
- Mitglied der Gesellschaft für Informatik
- Mitglied der Arbeitsgruppe »Arbeitsplatzsysteme« der Gesellschaft für Informatik
- Mitglied im VDI
- Mitglied des Sprecherkreises der IT-Sicherheitsbeauftragten der Fraunhofer-Gesellschaft
- Session Chair Future Security 2015, »Systems Engineering, Assessment and Modeling«, 16.9.2015
- Mitglied des Advisory Boards, 2nd Smart Factory Innovation Forum, München, 23.-24.9.2015

Kresken, T.:
- Mitglied Allianz für Cyber-Sicherheit
- Mitglied Cyberforum e.V.

Kühnert, C.:
- Mitglied in der ERNCIP Thematic Group »Chemical & Biological Risks in the Water Sector«

Kunz, S.:
- Mitglied in der Deutschen Gesellschaft für Projekt-management (GPM)
- Mitarbeit als QM-Beauftragter im QM-Netzwerk der Fraunhofer-Gesellschaft
- Mitglied (Technical Alternate) im Technical Committee des Open Geospatial Consortium

Längle, T.:
- Paritätische Kommission zum Leistungsentgelt am Fraunhofer IOSB
- Leitung des Arbeitskreises »Multispektral« am Fraunhofer IOSB
- Vorsitzender im Programmausschuss »2nd International Conference on Optical Characterization of Materials« (OCM 2015)
- Vertretung des Fraunhofer IOSB im Arbeitskreis der Fraunhofer-Allianz Vision
- Program Committee SPIE Symposium »Optical Metrology«
- Mitglied im Verein Deutscher Ingenieure (VDI)
- Vertretung des Fraunhofer IOSB beim SpectroNet International Collaboration Cluster

Li, P.:
- Mitglied der Studiengangkommission Ingenieurinformatik
- Mitglied der Studiengangkommission Computers and Systems Engineering
- Mitglied der Stipendienkommission der chinesischen Regierung für chinesische Studenten
- Beauftragter vom Rektor für den wissenschaftlichen Austausch China-Südasien

Lutzmann, P.:
- Mitglied der NATO-Gruppe SET-205 »Active Electro-Optic Sensing for Target Identifi-cation and Tactical Applications«

Meidow, J.:
- Mitglied in der Deutschen Gesellschaft für Photogrammetrie und Fernerkundung (DGPF)
- Mitglied der Deutschen Arbeitsgemeinschaft für Muster-erkennung e.V. (DAGM)
- Mitglied im Verein Deutscher Ingenieure (VDI)
- Member of NATO-SET-167 Task Group on »Navigation Sensors and Systems in GNSS Denied Environments«
- Mitarbeit bei DEU – SWE Kooperation »Navigation in Urban Terrain«
- Member of Program Committee, reviewer and session chair ISPRS conference on »Photogrammetric Image Analysis 2015«, March 25-27, 2015, Munich

- Member Scientific Committee and reviewer ISPRS workshop on »City Models, Roads and Traffic 2015«, October 2, 2015, La Grande Motte, France
- Reviewer »The Photogrammetric Record«
- Reviewer »Measurement Science and Technology«

Meißner, A.:
- Vertreter des Fraunhofer IOSB im BITKOM Arbeitskreis Öffentliche Sicherheit
- Mitglied im Beirat des VfS – Verband für Sicherheitstechnik
- Mitglied der ISCRAM Association (Information Systems for Crisis Response and Management)
- Vorsitzender des Programmkomitees der »10th Future Security«, Berlin, 15.-17.9.2015

Meyer, J.:
- Mitglied im Programmausschuss »2nd International Conference on Optical Characterization of Materials« (OCM 2015)

Michaelsen, E.:
- Chair IAPR-TC7 (International Association for Pattern Recognition – Technical Committee 7, Remote Sensing and Mapping)
- Associate Editor, Pattern Recognition Letters, Elsevier Verlag

Middelmann, W.:
- DEU - CHE Kooperation »Hyperspectral Imaging«

Monari, E.:
- Mitglied IEEE

Nicolai, S.:
- Vertreter des IOSB-AST im ThEEN AG »Energiespeicher«

Niggemann, O.:
- Mitglied Cooperation in the AutomationML Gremium
- Mitglied GMA Fachausschuss 7.20 Cyber-physical Systems
- Mitglied GMA-Fachausschuss 5.58 Middleware
- Mitglied Internationales Promotionskolleg »Intelligente Systeme in der Automatisierungstechnik« (ISA)

Okon, M.:
- Mitglied im Arbeitskreis Mess- und Automatisierungstechnik (GMA) im VDI Bezirksverein Karlsruhe

Peinsipp-Byma, E.:
- Mitglied Gesellschaft für Informatik
- Session Chair der Future Security 2015
- Reviewer der Zeitschrift »at-Automatisierungstechnik«

Pfützenreuter, T.:
- Vertreter des IOSB-AST in der Gesellschaft für Maritime Technik e.V.
- Vertreter des IOSB-AST im Subsea Monitoring Network

Pohl, M.:
- Mitglied der NATO-Gruppe SET-198 »Visible Laser Dazzle – Effects and Protection«

Rauschenbach, T.:
- Mitglied des VDI / VDE GMA-Fachausschuss 5.14 »Computational Intelligence«
- Mitglied der Gesellschaft für Maritime Technik (GMT)
- Mitglied im VDE
- Mitglied IEEE, Oceanic Engineering Society
- Mitglied Fraunhofer Allianz SysWasser
- Mitglied der Foren bei German Water Partnership (Länderforen China und Vietnam)
- Mitglied in Deep Sea Mining Alliance

Repasi, E.:
- Mitglied der NATO-Gruppe SET-ET-084 »Simulation of Active Imaging Systems«
- Mitglied der NATO Gruppe SET-219 »Simulation of Active Imaging Systems«
- Mitglied der NATO-Gruppe SET-ET-090 »Computational Imaging and Compressive Sensing for EO/IR Systems«

Richter, M.:
- Mitglied im Programmausschuss »2nd International Conference on Optical Characterization of Materials« (OCM 2015)

Ritt, G.:
- Mitglied der NATO-Gruppe SET-198 »Visible Laser Dazzle – Effects and Protection«

Röcker, C.:
- Mitglied Australian Research Council (ARC)
- Mitglied Luxembourg National Research Fund (FNR)

PARTICIPATION IN COMMITTEES
MITARBEIT IN GREMIEN

Roller, W.:
- Mitglied Bitkom Arbeitskreis »Learning Solutions«
- Mitglied Institutsbildungsausschuss (IBA)
- Mitglied Arbeitskreis »Personalentwicklungskonzept« (PEK)

Sander, J.:
- Mitglied in »Technical Program Committee« der International Conference on Information Fusion (/Fusion 2014/Fusion 2015)

Sauer, O.:
- Leitung des Fachbereichs »Informationstechnik« in der VDI-Gesellschaft GPP
- Leitung des VDI-GPL-Richtlinienausschusses »Digitaler Fabrikbetrieb«
- Mitglied im VDI-GPL-Fachausschuss »Digitale Fabrik«
- Mitglied im VDI-GPP-Fachausschuss »MES«
- Mitglied des VDI-GPP-Richtlinienausschusses »Logische Schnittstelle MES-Maschine«
- Mitglied in der VDA-ITA »Informationstechnologie für die Automobilindustrie«
- Mitglied im CIRP »STC »O« Optimization of Manufacturing Systems«
- Mitglied in der »OPC Foundation«
- Mitglied des Automotive Engineering Netzwerks Südwest
- Vorstand Wirtschaftsstiftung Südwest
- Mitglied im VDI-Fachausschuss Modellierung und Simulation
- Mitglied im Fachbeirat Digitale Fabrik@Produktion
- Erstansprechpartner des IOSB in der Innovationsallianz der Technologieregion Karlsruhe

Scharaw, B.:
- Head of Section Central Asia, GWP
- Mitglied des wissenschaftlichen Rates der Deutsch-Mongolischen Gesellschaft
- Mitglied im Kharaa River Basin Administration

Schilling, H.:
- DEU - CHE Kooperation »Hyperspectral Imaging«

Schleipen, M.:
- Mitarbeit in der Arbeitsgruppe »DKE K941.0.2 AutomationML« der Deutschen Kommission Elektrotechnik Elektronik Informationstechnik
- Mitarbeit im DIN AK 060-30-05-04 des Normenausschuss Maschinenbau (NAM, gepflegt durch den VDMA)
- Mitarbeit im Fachausschuss 6.12 »Durchgängiges Engineering von Leitsystemen« der VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA)
- Mitarbeit im Fachausschuss 7.21 »Industrie 4.0« der VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA)
- Mitarbeit im Fachausschuss 140 »Manufacturing Execuction Systems« der VDI-Gesellschaft Produkt- und Prozessgestaltung (GPP)
- Mitarbeit in der IEC Working group 9 of SC 65
- Leitung der gemeinsamen Arbeitsgruppe der OPC Foundation und des AutomationML e.V.
- Leitung der Unterarbeitsgruppe Begriffe des Fachausschusses 7.21 »Industrie 4.0« der VDI/VDE-Gesellschaft Mess- und Automatisierungstechnik (GMA)

Schönbein, R.:
- Mitglied der Deutschen Gesellschaft für Wehrtechnik e.V., Bonn
- Mitglied der Human Factors and Ergonomics Society, Santa Monica, CA
- Mitglied im Fachausschuss T 5.4 Anthropotechnik; Deutsche Gesellschaft für Luft- und Raumfahrt (DGLR)
- Mitglied im editorial board of the International Journal On Advances in Systems and Measurements (IARIA Journals)
- Mitglied im Programmausschuss ICONS

Schuchert, T.:
- Mitglied der Deutschen Arbeitsgemeinschaft für Mustererkennung e.V.
- Mitglied IEEE

Schulte, H.:
- Vertretung des Fraunhofer IOSB im Arbeitskreis der Fraunhofer-Allianz Food Chain Management (FCM)
- Mitglied im Programmausschuss »2nd International Conference on Optical Characterization of Materials« (OCM 2015)

Schulz, K.:
- Conference Chair for the SPIE Conference: »Earth Resources and Environmental Remote Sensing/GIS Applications«
- Session Chair for several SPIE Conference Sessions
- DEU - ISR Kooperation »Hyper Spectral Remote Sensing Technologies«
- Member of IEEE Geoscience and Remote Sensing Society
- Mitglied in der NATO-RTO-SCI-248 Gruppe »Vulnerability of NATO operations to current and future commercial space-based Synthetic Aperture Radar (SAR) sensors«
- Mitglied in der NATO-RTO-SET-220 Gruppe »Geospatial Information Extraction From Space-Borne SAR-Images for NATO-Operations«

- Reviewer »Photogrammetrie – Fernerkundung – Geoinformation (PFG)«
- Reviewer »IEEE Transactions on Geoscience and Remote Sensing«

Schwarz, A.:
- Mitglied in der NATO SCI-230 Gruppe »Advanced Materials, Systems and Evaluation Methods for Adaptive Camouflage«

Schweitzer, C.:
- Mitglied in der NATO-SCI-268 Gruppe »NATO Space: S&T Developments to Enhance Resiliency and Effectiveness of NATO Operations«
- Mitglied in der NATO-SCI-279 Gruppe »Enabling Technical Considerations for a NATO-Common Space Domain Operating Picture«
- Mitglied in der NATO-SCI-283 Gruppe „NATO STO Symposium on Considerations for Space and Space-Enabled Capabilities in NATO Coalition Operations", Programme Committe
- IOSB-Vertreterin Allianz Space

Segor, F.:
- Mitglied im Programmausschuss ICONS

Seiffer, D.:
- Mitglied in der NATO-SET-ET-089 Gruppe »Environmental limitations of fielded EO-TDAs«
- Mitwirkung in der Arbeitsgruppe ALWS »Airborne Platform Effects On Laser Systems And Electro-Optical Warning Sensors«
- Mitglied in der Fraunhofer WISA Agnes Gruppe »AlGaN-Detektoren zur Emissionsüberwachung von UV-Strahlern«
- Member of Program Committee, »Technologies for Optical Countermeasures« bei der SPIE Security + Defence

Sprung, D.:
- Mitwirkung in der Kooperation mit dem Kiepenheuer-Institut für Solarphysik (KIS), Freiburg, »Bestimmung der optischen Turbulenz am Observatorium VTT auf dem Teide / Teneriffa, Spanien«
- Mitwirkung in der deutsch-israelischen Arbeitsgruppe mit dem Soreq/Israel »Wind and turbulence measurements«
- Mitwirkung in der deutsch-südafrikanischen Kooperation mit dem Council for Scientific and Industrial Research (CSIR) Südafrika zu »Determination of the vertical distribution of optical turbulence over savannah«

Stein, K.:
- Chair Conference SPIE Remote Sensing »Optics in Atmospheric Propagation and Adaptive Systems«, Amsterdam, 21.-25.9.2014
- Program Committee, SPIE Optics & Photonics, conference »Laser Communication and Propagation through the Atmosphere and Ocean«, San Diego, 17.-22.8.2014
- Chair Conference SPIE Security & Defence, »Target and Background Signatures«, Toulouse, 20.-24.9.2015
- Chair Conference SPIE Remote Sensing, »Optics in Atmospheric Propagation and Adaptive Systems« Toulouse, 20.-24.9.2015
- CCG-Kurs Warnsensorik (UV, IR, mmW, Terahertz) und Gegenmaßnahmen SE 3.11, »Grenzen der Detektion und Verfolgung von Seeziel-Flugkörpern« Oberpfaffenhofen, 18.11.2014
- Mitglied in der NATO-SET-174 Gruppe »EO Sensor Performance Modeling«
- Mitglied der NATO-SET-211 Gruppe »Naval Platform Protection in the EO/IR Domain«
- NATO-SCI-287 »Assessment Methods for Camouflage in Operational Context (SCI-287)«
- Chair in der NATO-SCI-ET-017 Gruppe »Development of Methods for Measurements and Evaluation of Natural Background Colours«
- Mitglied der NATO-SCI-265 Gruppe »Systems Concepts and Integration Technical Program«
- Mitglied der NATO-SCI-269 Gruppe »Flight Testing of Unmanned Aerial Systems«
- Mitglied der NATO-SCI-273 Gruppe »Guidelines for Toxicity Testing of Smokes, Obscurants, and Pyrotechnic Mixtures«
- NATO SCI-Panel, Member at Large
- Reviewer for »Meteorology and Atmospheric Physics«
- Reviewer for »Optics Letters«

PARTICIPATION IN COMMITTEES
MITARBEIT IN GREMIEN

Steusloff, H.:
- Kurator des Heinz Nixdorf Instituts, Universität Paderborn
- Vorsitzender des DIN-Präsidialausschusses SO-FIE (Forschung, Innovation, Entwicklung)
- Vorsitzender des DIN-Präsidialausschusses FOCUS ICT
- stellv. Vorsitzender der DKE (Deutsche Kommission Elektrotechnik Elektronik Informationstechnik)
- Vorsitzender des DKE-Beraterkreises Technologie (BKT)
- Vorsitzender des DKE-Lenkungsausschusses »Elektromobilität« von DKE und DIN NAAutomobil
- Vorsitzender der DKE-Fokusgruppe »Netzintegration Lastmanagement und dezentrale Energieerzeugung« (NeLDE)
- stellv. Vorsitzender der Regionalkonferenz der TechnologieRegion Karlsruhe
- Mitglied im Technologieausschuss der IHK Karlsruhe
- Mitglied im Cercle de l'ILL, Straßburg
- Member of the China Instrument and Control Society (CIS)
- Mitglied der Gesellschaft für Informatik (GI)
- Mitglied im Verein Deutscher Ingenieure (VDI)
- Mitglied im Verband der Elektrotechnik Elektronik Informationstechnik e.V. (VDE)
- Mitglied im Beirat des Fachausschusses »Informatik« der Fachgesellschaft GPP im VDI
- Mitglied im Wirtschaftsrat Deutschland, Sektion Karlsruhe-Bruchsal
- Beiratsvorsitzender der IWRM (Integrated Water Resources Management)-Konferenz 2014 der Karlsruher Messe- und Kongress GmbH (KMK), Karlsruhe, 10.-20.11.2014

Taphanel, M.:
- Mitglied im Programmausschuss »2nd International Conference on Optical Characterization of Materials« (OCM 2015)
- Mitglied der Deutsche Physikalische Gesellschaft (DPG)

Thomalla, C.:
- IOSB-Beauftragter für das betriebliche Vorschlagswesen
- Mitglied im VDI
- Mitglied im VDI/VDE-GMA Fachausschuss »5.23 XML in der Automation«
- Mitglied in der Arbeitsgruppe »Logische Schnittstellen MES - Maschinenebene« des VDI-KfIT, Fachausschuss 2.5.1 »MES«
- Mitglied in der Gesellschaft für Operations Research (GOR)
- Mitglied in DIN AK 060-30-05-04 Normenausschuss Maschinenbau (NAM, gepflegt durch den VDMA)
- Mitglied im MES D.A.C.H Verband e.V., Technik Gruppe UMCM

Usländer, T.:
- Mitglied im VDI/VDE-GMA Fachausschuss 7.21 »Industrie 4.0 - Begriffe, Referenzmodelle, Architekturkonzepte«
- Mitglied im VDI Fachausschuss »Ressourceneffizienz«
- Mitglied im BITKOM AK Interoperabilität Industrie 4.0 und der Projektgruppe Standardisierung Industrie 4.0
- stimmberechtigter Vertreter der Fraunhofer-Gesellschaft im Technical Committee des Open Geospatial Consortium (OGC)
- Vertreter der Fraunhofer-Gesellschaft im European Virtual Institute for Integrated Risk Management (EU-VRi)
- Technical Representative des IOSB im Industriekonsortium Object Management Group (OMG)
- Vertreter des IOSB im Koordinierungsausschuss F+E IuK im Rahmen der Kooperation INOVUM des Umweltministeriums Baden-Württemberg
- Mitglied in der Arbeitsgruppe 5.11 »Computers and Environment« der International Federation for Information Processing (ifip)
- Mitarbeit in der Fraunhofer Allianz Big Data
- Mitglied in der W3C Interest Group »Web of Things«

Vieth, K.:
- Paritätische Kommission zum Leistungsentgelt am Fraunhofer IOSB

Wagner, B.:
- Mitglied in der DGfK (Deutsche Gesellschaft für Kartographie e.V.)
- Mitglied im OGC (Open Geospatial Consortium)

Warweg, O.:
- Mitarbeit im VDE/ITG Energieinformationsnetze
- Mitarbeit und Vertreter des Fraunhofer IOSB-AST in der Fraunhofer Allianz Big Data
- Vertreter des Fraunhofer IOSB-AST in der Fraunhofer Academy

Watson, K.:
- Co-Chair der GEO Health and Environment Community of Practice
- Co-Chair OGC Domain Working Group Health
- Mitglied GEO Integrated Global Water Cycle Observations Community of Practice
- Mitglied Fraunhofer-EU-Netzwerk, Ko-Leitung AG Proposal / Projektmanagement

Wendelstein, N.:
- Mitglied in der NATO-SET-174 Gruppe »EO Sensor Performance Modeling«
- Mitglied in der NATO-SET-ET-089 Gruppe »Environmental limitations of fielded EO-TDAs«
- Mitwirkung in der Arbeitsgruppe ALWS »Airborne Platform Effects On Laser Systems And Electro-Optical Warning Sensors«

Wenzel, A.:
- Mitglied Fraunhofer Allianz Embedded
- Mitglied VDI/VDE-GMA FA 7.20 Cyber Physical Systems

Werling, S.:
- Beauftragter für Schutzrechte im IOSB (Patente, Marken etc.)

Winkelmann, M.:
- Deutscher Vertreter in der Arbeitsgruppe »Multispectral Camouflage Concealment and Deception« der deutsch-israelischen Kooperation
- Mitglied in der NATO-SCI-ET-017 Gruppe »Development of Methods for Measurements and Evaluation of Natural Background Colours«
- Mitglied der NATO-SCI-270 Gruppe »Process Development for D&D Field Trials and Associated Data Analysis«

Zielinski, A.:
- Mitglied Clarin F-AG-7 »Angewandte Sprachwissenschaft, Computerlinguistik«
- Mitglied der COST Action »Multilingual and multifaceted interactive information access (MUMIA)«

PATENTS AND UTILITY MODELS 2014 - 2015
PATENTE UND GEBRAUCHSMUSTER 2014 - 2015

Anstett; G.; Ebert, R.:
Einrichtung und Verfahren zur Erkennung von Laserstrahlung
DE 10 2012 221 164 A1
Veröffentlichung der Anmeldung: 30.04.2014
WO2014/057136
Veröffentlichung der Anmeldung: 30.05.2014
EP 2906917
Veröffentlichung der Anmeldung: 19.08.2015

Anstett, G.; Eberle, B.; Ritt, G.:
Verfahren und Schutzvorrichtung zur Begrenzung einer optischen Leistung
DE 10 2014 213 970.8
Anmeldung 17.07.2014

Anstett, G.; Bürsing, H.:
Verfahren und Vorrichtung zur Bestimmung der Turbulenz
DE 10 2014 219 927.1
Anmeldung 01.10.2014

Arens, M.; Michaelsen, E.; Meidow, J.; Hebel, M.:
System und Verfahren zur interaktiven Rekonstruktion von Artefakten und anderen zerlegten Gegenständen
DE 10 2015 205 357.1
Anmeldung 24.03.2015

Beyerer; J.; Heizmann, M.; Frühberger, P.:
Anordnung und Verfahren zur multisensorischen Erfassung von Probenbereichen einer Probe
DE 10 2013 205 001 B3
Veröffentlichung der Erteilung: 28.04.2014

Dengler, S.; Hege, C.; Eberle, B.; Muller, O.:
Verfahren zur Begrenzung einer optischen Leistung, Leistungsbegrenzer und damit ausgestattetes Gerät
PCT/EP2015/057506
Anmeldung 07.04.2015

Eberle, B.; Ritt, G.:
Schutzvorrichtung zum Schutz vor Laserstrahlung
DE 10 2014 205 908.9
Anmeldung 31.03.2014

Eberle, B.; Ritt, G.; Anstett, G.:
Verfahren zur Detektion von transparente Materialien durchdringende Laserstrahlung
DE 10 2014 205 907.0
Anmeldung 31.03.2014

Eberle, B.; Ritt, G.:
Verfahren und Vorrichtung zur Begrenzung einer transmittierten optischen Leistung und Entfernungsmesser
DE 10 2013 201 139
Veröffentlichung der Anmeldung: 24.07.2014
WO 2014/114548 A1
Veröffentlichung der Anmeldung: 31.07.2014

Frühberger, P.; Heizmann, M.; Ijsselmuiden, J.; Peinsipp-Byma, E.:
Einrichtung und Verfahren zur mikroskopischen Probenerfassung mittels berührungsfreier Interaktion und flächigen Anzeigen
DE 10 2013 206 546 A1
Veröffentlichung der Anmeldung: 16.10.2014

Greiner, T.; Le, T.-T.; Heizmann, M.; Ziebarth, M.:
Optimierte Filter zur Erkennung von Bildmerkmalen - Image classification
EP 14 002 562.8
Anmeldung 22.07.2014

Gruna, R.; Schulte, H.; Richter, M.; Kühnel, W.:
Verfahren zum Detektieren von Fremdkörpern in Lebensmittelabschnitten während des Schneidvorgangs sowie Anordnung zur Durchführung eines solchen Verfahrens
DE 10 2015 207 839.6
Anmeldung 28.04.2015

Gruna; R.; Vieth, K.-U.; Schulte, H.; Längle, T.; Hanebeck, U.; Baum, M.; Noack, B.:
Verfahren und Vorrichtung zur Schüttgutsortierung durch prädiktive Multiobjektverfolgung
DE 10 2014 207 157 A1
Veröffentlichung der Anmeldung: 03.09.2015
WO 2015/128174
Veröffentlichung der Anmeldung: 03.09.2015

Hammer, J.; Voit, M.:
Verfahren und Vorrichtung zur kamerabasierten Überwachung von Fertigung und Montage
DE 10 2015 215 407.6
Anmeldung 12.08.2015

Hartrumpf, M.:
Vorrichtung und Verfahren zur optischen Charakterisierung von Materialien
EP 2 848 916 A1
Veröffentlichungsdatum 18.03.2015

Hartrumpf, M.; Längle, T.; Heizmann, M.; Schulte, H.; Monari, E.; Vogelbacher, M.; Gruna, R.:
Vorrichtung und Verfahren zur Prüfung strukturierter transparenter Artikel insbesondere der Böden von Behältergläsern
DE 10 2014 217 771.5
Anmeldung 05.09.2014
EP15183848.9
Anmeldung 04.09.2015

Jakoby, A.; Feuchter, M.; Birnstill, P.:
Netzübergangskomponente mit Anfrage/Antwort-Zuordnung und Überwachung
DE 10 2015 208 290
Veröffentlichung der
Erteilung: 20.02.2014

Jakoby, A.; Helwig, D.:
Hardware-Kryptomodul und System zur Kommunikation mit einer externen Umgebung
DE 10 2013 223 366 A1
Veröffentlichung der Anmeldung: 21.05.2015
US 14/542,036
Anmeldung 14.11.2014

Krempel, E.; Peinsipp-Byma, E.; Van de Camp, F.; Voit, M.:
Vorrichtung und Verfahren zur Wiedergabe von Inhalten basierend auf von einem Anwender autorisierten Daten
DE 10 2015 206 733.5
Anmeldung 15.04.2015

Krempel, E.; Kaufmann, M.:
Authentisierungs-Stick
DE 10 2014 219 297.8
Anmeldung 24.09.2014
PCT/EP2015/071364
Anmeldung 17.09.2015

Matz, S.; Pfützenreuter, T.; Weber. D.:
Gehäuse für ein Propellerantriebsaggregat – Housing for a propeller drive unit
DE 10 2013 209 682 A1
Offenlegungstag: 27.11.2014
WO 87711 A1
Internationales Veröffentlichungsdatum: 27.11.2014

Matz, S.; Pfützenreuter, T.; Weber, D.:
Speichervorrichtung
DE 10 2013 216 271 A1
Offenlegungstag: 19.2.2015
PCT/EP2014/067353
Internationales Anmeldedatum: 13.8.2014

Michaelsen, E.; Arens, M.; Scherer-Negenborn, N.:
Erfindungsmeldung: Residuen-Frequenzanalyse zur Parameterschätzung und Modellauswahl bei der Objektverfolgung mit projizierten Messungen
Meldung vom 28.05.2015

Otero, E.; Wahlandt, M.; Hadda, A.; Ziehn, J.; Willersinn, D.:
System und Verfahren für ein Fahrzeug zur akustischen Erkennung einer Verkehrssituation
DE 10 2014 210 932.9
Anmeldung 06.06.2014

Pak, A.:
Verfahren und Vorrichtung zur Übertragung mechanischer Energie
DE 10 2012 221 907 A1
Veröffentlichung der Anmeldung: 05.06.2014

Pak, A.:
Vorrichtung und Verfahren zum optischen Vermessen von Gegenständen mittels optischem Fluss und Stereo-Regularisierung
DE 10 2014 224 274.6
Anmeldung 27.11.2014

Patzer, F.; Kresken, T.; Jakoby, A.:
Vorrichtung, die Zugriffsschutz für strukturhaltige verteilte Daten realisiert
DE 20 2015 005 361.0
Anmeldung 03.08.2015

PATENTS AND UTILITY MODELS 2014 - 2015
PATENTE UND GEBRAUCHSMUSTER 2014 - 2015

Perpeet, D.; Dörfel, R.; Meidow, J.:
Verfahren zur Größenbestimmung von Flächen, Datenträger, Daten repräsentierende Signalfolie und Smartphone
DE 10 2014 221 093.3
Anmeldung 17.10.2014

Ritt; G.; Eberle, B.; Anstett, G.; Ebert, R.; Beyerer, J.:
Personal Laser protection device
WO2014/056543
Veröffentlichung der Anmeldung: 17.04.2014
EP 2906159
Veröffentlichung der Anmeldung: 19.08.2015

Ritt, G.; Eberle, B.; Anstett, G.:
Vorrichtung zum Schutz natürlicher und künstlicher Sensoren gegen Blendung und Zerstörung durch intensive Lichtquellen
DE 10 2012 217 135 A1
Veröffentlichung der Anmeldung 28.05.2014

Schatz, V.:
Messverfahren zur Bestimmung des Zeitverhaltens von Kameras und Messanordnung
DE 10 2015 206 012.8
Anmeldung 02.04.2015

Schatz, V.:
Messverfahren, Messanordnung und Computerprogrammprodukt
DE 10 2015 206 013.6
Anmeldung 02.04.2015

Scherer-Negenborn; N.; Lutzmann, P.; Scherer-Klöckling, C.:
Vorrichtung und Verfahren zur Messung von Schwingungen
EP2887030
Veröffentlichung der Anmeldung: 24.06.2015

Schulte, H.; Brode, T.:
Urinanalyse im Durchfluss in Echtzeit mittels spektraler Messung
DE 10 2015 214 926.9
Anmeldung 05.08.2015

Taphanel, M.; Zink, R.:
Chromatisch konfokale Sensoranordnung
PCT/EP2014/063968
Anmeldung: 01.07.2014

Van de Camp, F.:
Vorrichtung, System und Verfahren zur Bestimmung einer Position an einer Anzeigevorrichtung
DE 10 2014 212 084
Veröffentlichungsdatum 17.09.2015
PCT/EP2015/063820
Anmeldung 19.06.2015

Van de Camp, F.
Medikamentenaufbewahrungsbehälter, System zur Überwachung der Entnahme eines Medikaments und Verfahren zur automatischen Füllstandsüberwachung von Medikamenten
DE 10 2014 220 178.0
Anmeldung 06.10.2014

Vieth, K.-U.:
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Arens, M.:
- Einführung in die Bildfolgenauswertung, SS 2015
  Fakultät für Informatik, Karlsruher Institut für Technologie (KIT)

Beyerer, J.:
- Mustererkennung, SS 2014, SS 2015
- Automatische Sichtprüfung und Bildverarbeitung, WS 2014/2015
- Seminar: Technologie-gestütztes Lernen, SS 2014, SS 2015
- Seminar: Bildauswertung und -fusion, SS 2014; SS 2015, WS 2014/2015
- Proseminar: Anthropomatik: Von der Theorie zur Anwendung, SS 2014, WS 2014/2015 (gemeinsam mit Prof. Uwe Hanebeck)
  Fakultät für Informatik, Karlsruher Institut für Technologie (KIT)

Bretschneider, P.:
- VDE Hochschulgruppe, Thema: Bericht zur ThEGA-Studie »Analyse und Prognose der Technologien und Anwendungsfelder thermischer und elektrischer Energiespeicher auf Nieder- und Mittelspannungsebene«, 12.5.2014
- 2 Vorlesungsstunden zum Thema Energieprognose im Rahmen der Lehrveranstaltung »Elektrische Energieversorgung III« von Prof. Westermann, 13.6.2015
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  Fakultät für Elektrotechnik und Informationstechnik, Technische Universität Ilmenau

Brink, G.:
- Wissenschaftliches Arbeiten und Publizieren, 12.3.2015
  Graduate School of Excellence advanced Manufacturing Engineering der Universität Stuttgart
- Business Modell Creation Methods, 26.8.2014
- Business Modell Creation Methods, 3.8.2015
  Smart Energy Systems Summer School der EIT ICT Labs und EIT Inno Energy am Karlsruher Institut für Technologie (KIT)

Bulatov, D.:
- Ausgewählte Kapitel aus Computer Vision, WS 2014/2015
  Institut der Photogrammetrie und GeoInformatik (IPI), Leibnitz Universität Hannover

Even, M.:
- Gastvorlesung »Neuere Entwicklungen der SAR-Interferometrie: Deformationsanalyse unter Einbeziehung von Distributed Scatterern nach dem Vorbild von SqueeSAR«, 26.1.2015
  Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften, Karlsruher Institut für Technologie (KIT)

Flatt, H.:
- embedded systems design, WS 2014, WS 2015
  Fachbereich Elektrotechnik und Technische Informatik, Hochschule Ostwestfalen-Lippe, Lemgo

Geisler, J.:
- Mensch-Maschine-Wechselwirkung in der Anthropomatik: Basiswissen, WS 2014/2015
  Fakultät für Informatik, Karlsruher Institut für Technologie (KIT)

Heizmann, M.:
- Einführung in die Informationsfusion, WS 2013/2014, WS 2014/2015, WS 2015/2016
  Fakultät für Informatik, Karlsruher Institut für Technologie (KIT)
- Technische Kognition, SS 2014
- Mechatronische Systeme, WS 2014/2015, WS 2015/2016
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  Fakultät für Maschinenbau und Mechatronik, Hochschule Karlsruhe

Heizmann, M.; Skricka, N.:
- Technische Mechanik 3 – Dynamik, WS 2015/2016
  Fakultät für Maschinenbau und Mechatronik, Hochschule Karlsruhe

Heizmann, M.; Werling, S.:
- Qualitätsmanagement Labor, SS 2015
  Fakultät für Maschinenbau und Mechatronik, Hochschule Karlsruhe

Jacobi, M:
- Maritime Robotik
  Hochschule Schmalkalden, 7.7.2015

Jasperneite, J.:
- Rechnernetze, SS 2014, SS 2015
- Communication for distributed systems (CDS), SS 2014, SS 2015
- Maschinennahe Vernetzung, WS 2014, WS 2015
- Weitverkehrsnetze, WS 2014, WS 2015
- Protocol-Engineering/Entwurf von Kommunikationsprotokollen, WS 2014, WS 2015
  Fachbereich Elektrotechnik und Technische Informatik, Hochschule Ostwestfalen-Lippe, Lemgo

Krägelin, B.:
- Grundlagen Information, Informationsmanagement, Informationssysteme, WS 2014/2015, WS 2015/2016
- Informationsbeschaffung, SS 2014, SS 2015
  Fachbereich Wirtschaft, Duale Hochschule Baden-Württemberg (DHBW), Karlsruhe

Längle, T.:
- Echtzeitsysteme, SS 2014, SS 2015
- Projektpraktikum Robotik und Automation I, SS 2014
- Projektpraktikum Robotik und Automation II, WS 2014/2015, SS 2015
- Einführung in die Informatik für Naturwissenschaftler und Ingenieure I, WS 2014/2015
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- Informatik für Naturwissenschaftler und Ingenieure II, WS 2015/2016
  Fakultät für Informatik, Karlsruher Institut für Technologie (KIT)
- Duale Hochschule Baden-Württemberg (DHBW) Karlsruhe, Kognitive Systeme, WS 2014/2015

Li, P.:
- Control Engineering, WS 2013/14, WS 2014/15, WS 2015/16
- Regelungs- und Systemtechnik 2, WS 2014/15
- Prozess- und Umweltsystemtechnik, WS 2013/14, WS 2014/15, WS 2015/16
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- Dynamische Prozessoptimierung, SS 2014, SS 2015
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  Fakultät für Informatik und Automatisierung, Technische Universität Ilmenau

Meidow, J.:
- Gastvorlesung »Ausgleichungsmodelle für Auswertung von Bildsequenzen«, 23.1.2014 und 29.1.2015
  Fakultät für Bauingenieur-, Geo- und Umweltwissenschaften, Karlsruher Institut für Technologie (KIT)

Monari, E.:
- Digital Image Processing, SS 2015
  Fakultät für Elektro- und Informationstechnik, Hochschule Karlsruhe – Technik und Wirtschaft

Müller, F.:
- Spezielle Verfahren der Zustandsschätzung für (autonome) mobile Trägersysteme
  Hochschule Schmalkalden, 7.7.2015

Niggemann, O.:
- Algorithmen und Datenstrukturen 1, SS 2014
- Verteilte Systeme, SS 2014, SS 2015
- Theoretische Informatik, WS 2014, WS 2015
- Algorithmen und Datenstrukturen 2, WS 2014, WS 2015
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  Fachbereich Elektrotechnik und Technische Informatik, Hochschule Ostwestfalen-Lippe, Lemgo

Paelke, V.:
- Programmiersprachen 1, SS 2014, SS 2015
  Fachbereich Elektrotechnik und Technische Informatik, Hochschule Ostwestfalen-Lippe, Lemgo

Peinsipp-Byma, E.; Sauer, O.:
- Gestaltungsgrundsätze für Interaktive Echtzeitsysteme, SS 2015
  Fakultät für Informatik, Karlsruher Institut für Technologie (KIT)

Pieper, C.:
- Hardware eingebetteter Systeme, SS 2014, SS 2015
  Fachbereich Elektrotechnik und Technische Informatik, Hochschule Ostwestfalen-Lippe, Lemgo

Rauschenbach, T.:
- Diagnose- und Vorhersagesysteme, WS 2013/14, SS 2014, WS 2014/15, SS 2015, WS 2015/16
  Fakultät für Informatik und Automatisierung, Technische Universität Ilmenau

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Röcker, C.:
- Rechnerorganisation und Betriebssysteme, SS 2014, SS 2015
- Usability Engineering, SS 2014, SS 2015
  Fachbereich Elektrotechnik und Technische Informatik,
  Hochschule Ostwestfalen-Lippe, Lemgo

Roller, W.; Streicher, A.; Szentes, D.; Kannegieser, E.:
- Seminar zum Technologiegestützten Lernen (TGL), SS 2014, SS 2015
- Seminar in Kooperation mit dem Forschungszentrum Informatik (FZI), der Hochschule Karlsruhe für Technik und Wirtschaft (HsKa) und dem Institut für Berufspädagogik (KIT/IBP) für die Fachrichtungen Informatik, Informationswirtschaft und Wirtschaftswissenschaften, Karlsruher Institut für Technologie (KIT)

Scharaw, B.:
- Integrated Urban water management
  On Faculty of Construction and Water Technology Mongolian University of Science and Technology, 18.-19.2.2014, 3.-4.8.2015
  On Hydrology Institute of China Agricultural University in Hohhot (China), 18.-20.11.2014, 14.-15.9.2015

Schuchert, T.:
- Grundlagen der Informatik I, WS 2014/2015
- Grundlagen der Informatik II, SS 2015
  Fakultät für Elektro- und Informationstechnik,
  Hochschule Karlsruhe -Technik und Wirtschaft

Wenzel, A.:
- Embedded Systems, WS 2013/14, WS 2014/15, WS 2015/16
- Mikrocontrollertechnik, WS 2013/14, WS 2014/15, WS 2015/16
- Mikroprozessortechnik, SS 2014, SS 2015
  Fachhochschule Schmalkalden

Werling, S.:
- Industrielle Messtechnik, SS 2015
  Fakultät für Maschinenbau und Mechatronik,
  Hochschule Karlsruhe

Windmann, S.
- Algorithmen und Datenstrukturen 2, WS 2014, WS 2015
  Fachbereich Elektrotechnik und Technische Informatik,
  Hochschule Ostwestfalen-Lippe, Lemgo

Zielinski, A.:
- Vorlesung Text Mining, WS 2014/2015
  Institut für Computerlinguistik,
  Ruprecht-Karls-Universität Heidelberg

DISSERTATIONS
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Brauer, Jürgen:
Human Pose Estimation with Implicit Shape Models
Fakultät für Informatik,
Karlsruher Institut für Technologie (KIT), 2014

van de Camp, Florian:
glueTK: A Framework for Multi-modal, Multi-display Interaction
Fakultät für Informatik,
Karlsruher Institut für Technologie (KIT)

Dimitrov, Todor:
Permanente Optimierung dynamischer Probleme der Fertigungssteuerung mit Unterstützung von Benutzerinteraktionen
Fakultät für Informatik,
Karlsruher Institut für Technologie (KIT)

Fischer, Yvonne:
Wissensbasierte probabilistische Modellierung für die Situationsanalyse am Beispiel der maritimen Überwachung
Fakultät für Informatik,
Karlsruher Institut für Technologie (KIT)

Illing, Björn:
Berechnungsansätze für Netznutzungsentgelte zur Beeinflussung des Lastverlaufs in der Verteilernetzebene
Fakultät für Elektrotechnik und Informationstechnik,
Technische Universität Ilmenau

Ijsselmuiden, Joris:
Interaction Analysis in Smart Work Environments through Fuzzy Temporal Logic
Fakultät für Informatik,
Karlsruher Institut für Technologie (KIT)

Ribe-Baumann, Elizabeth:
Resource and Location Aware Robust, Decentralized Data Management
Fakultät für Informatik und Automatisierung,
Technische Universität Ilmenau

Schick, Alexander:
Human Pose Estimation with Supervoxels
Fakultät für Informatik,
Karlsruher Institut für Technologie (KIT)

Taphanel, Miro:
Chromatisch konfokale Triangulation – Hochgeschwindigkeits 3D-Sensorik auf Basis der Wellenlängenschätzung mit optimierten Filtern
Fakultät für Informatik,
Karlsruher Institut für Technologie (KIT)

Teutsch, Michael:
Moving Object Detection and Segmentation for Remote Aerial Video Surveillance
Fakultät für Informatik,
Karlsruher Institut für Technologie (KIT)

LECTURES
VORTRÄGE

2014 2014 2014 2014 2014 2014

Adomeit, U.:
Bewertung von Wärmebildgeräten. Lehrgang »Grundlagen der Optronik« des Bildungszentrums der Bundeswehr, Mannheim, 8.7.2014

Adomeit, U.:
Assessing the Performance of Focal Plane Arrays for Night Vision. Military Dismounted Night Vision Systems Conference, Belgien, Brüssel, 15.9.2014

Adomeit, U.:
Verfahren zur Leistungssteigerung von Wärmebildgeräten. Seminar SE 1.02 »Infrarottechnik – Grundlage, Trends und moderne Anwendungen« der Carl-Cranz-Gesellschaft e.V., Oberpfaffenhofen, 13.10.2014

Adomeit, U.:
IR-Detektorentwicklung. Seminar SE 3.11 »Warnsensorik (UV, IR, mmW, Terahertz) und Gegenmaßnahmen« der Carl-Cranz-Gesellschaft e.V., Oberpfaffenhofen, 18.11.2014

Adomeit, U.; Schuberth, W.:
Thermisches Reichweitenmodell zur Punktzielauffassung. Seminar SE 3.11 »Warnsensorik (UV, IR, mmW, Terahertz) und Gegenmaßnahmen« der Carl-Cranz-Gesellschaft e.V., Oberpfaffenhofen, 18.11.2014

Agsten, M.:
Beiträge zur Netzstabilisierung aufgrund elektrischen Ladens von Elektrofahrzeugen. Erste Smart Grid Fachtagung der Wago GmbH & Co. KG, Frankfurt am Main, 19.-20.2.2014

Agsten, M.; Beyer, D.; Bohn, S.:
Open Research and Operation Prototype – OROP. EMS-EDM PROPHET Anwenderkonferenz, Eisenach, 11.6.2014

Agsten, M.; Beyer, D.; Bohn, S.:
Integration einphasig ladender Elektrofahrzeuge in Verteilernetze. VDE Symposium »Netzleit-, Zähler-& Informationstechnik«, Weimar, 4.9.2014

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Last- und Einspeisemanagement zum Laden von E-Fahrzeugen. Thega-Forum, Erfurt, 22.10.2014

Agsten, M.; Beyer, D.; Bohn, S.; Pfab, X.; Bretschneider; P.:
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Almeida de Sá Barros, R.; Keary, S.; Yatcheva, L.; Toselli, I.; Gladysz, S.:
Experimental setup for investigation of laser beam propagation along horizontal urban path. SPIE Remote Sensing, Niederlande, Amsterdam, 22.9.2014

Beyerer, J.:
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Beyerer, J.:
Nutzen und Herausforderungen von Überwachungs- und Diagnosesystemen. 2. VDI-Fachkonferenz Zustandsüberwachung und Optimierung von Produktionsanlagen, Karlsruhe, 13.5.2014

Beyerer, J.:
Bildauswertung für Sicherheitsaufgaben. Plenarvortrag safe.tech - Automobiltechnik, Bahntechnik und Automatisierungstechnik auf neuen Wegen, München, 20.-21.5.2014

Beyerer, J.:
Industrie 4.0. IuK-Roundtable: Industrie 4.0 mit Mitarbeitern der Bundestagsabgeordneten, Berlin, 27.8.2014

Beyerer, J.:
Optische Oberflächenprüfung. 18. IOSB-Technologietag Oberflächenprüfung, Karlsruhe, 24.9.2014

Becker, S.; Hübner, W.; Arens, M.:
Independent motion detection with a rival penalized adaptive particle filter. SPIE Security + Defence 2014, Niederlande, Amsterdam, 22.-25.9.2014

Bier, C.:
Herkunft verpflichtet. Data Provenance. Auch Daten haben ihre Geschichte. Karlsruher IT-Sicherheitsinitiative, Fraunhofer IOSB, Karlsruhe, 3.4.2014

Birnstill, P.:
Interdisziplinäre Forschung an der Schnittstelle zwischen Technik und Recht am Beispiel intelligenter Videoüberwachung. Schwetzinger Informationsrechtstage 2014, Schwetzingen, 18.9.2014

Bohn, S.; Fetisova, M.:
Das europäisch-nordafrikanische Verbundnetz der Zukunft. VDE-Vortragsreihe, Ilmenau, 3.11.2014

Boldt, M.:
Change Analysis at Stuttgart Airport Using TERRASAR-X Imagery. SPIE-conference on Earth Resources and Environmental Remote Sensing/GIS Applications, Niederlande, Amsterdam, 22.-25.9.2014

Brauer, J.; Krah, S.; Hübner, W.; Arens, M.:
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Bericht zur ThEGA-Studie: Analyse und Prognose der Technologien und Anwendungsfelder thermischer und elektrischer Energiespeicher auf Nieder- und Mittelspannungsebene. Technische Universität Ilmenau, Fakultät für Elektrotechnik und Informationstechnik, VDE Hochschulgruppe, 12.5.2014

Breuer, T.; Bodensteiner, C.; Arens, M.:
Low Cost Commodity Depth Sensor Comparison and Accuracy Analysis. SPIE Security + Defence 2014, Niederlande, Amsterdam, 22.-25.9.2014

Caesar, H.; Leuck, H.; Hübner, W.; Stahl, C.:
Image-based Activity Recognition using Unmanned Aerial Vehicles. SPIE Security + Defence 2014, Niederlande, Amsterdam, 22.-25.9.2014

van de Camp, F.:
Out of the box interaction technology for large displays. Barco Technology Days 2014, Belgien, Kuurne, 19.2.2014

Dunau, P.:
Side scan sonar for underwater mine detection – Evaluating observer performance for classification. IMT (Südafrika), IOSB Ettlingen, 1.12.2014

Eberle, B.:
- **Einführung in das Thema Laser-Radar.**
- **Operationelle Grundlagen für Lasersensoren.**
- **Laser-Radar: Verfahren und Systeme.**
- **Fernerkennung von Bedrohungen und Gefahren.**

Seminar SE 1.02 »Neue Lasersensoren für den militärischen und sicherheitsrelevanten Einsatz« der Carl-Cranz-Gesellschaft e.V., Ettlingen, 8.4.2014

Eberle, B.:
Laser-Radarsysteme für Zielaufklärung und Navigation. Seminar SE 2.28 »Intelligente Sensorik I: Grundlagen und Anwendungen« der Carl-Cranz-Gesellschaft e.V., Oberpfaffenhofen, 6.5.2014

Eberle, B.:
- **Zukünftige passive Infrarot-Sensoren.**
- **Potenzial zukünftiger Laser-Sensoren.**

Seminar SE 2.31 »Intelligente Sensorik II: Entwicklungspotential und zukünftige Systeme« der Carl-Cranz-Gesellschaft e.V., Oberpfaffenhofen,12.11.2014

Eberle, B.:
Optische Sensorik – Technologietrends. Seminar VS 2.38 »Infanterist der Zukunft (IdZ) – Anforderungen, Konzepte, Technologien« der Carl-Cranz-Gesellschaft e.V., Schweiz, Thun, 6.11.2014

Eberle, B.:
Laser-Hinderniswarnung. Seminar SE 3.11 »Warnsensorik (UV, IR, mmW)« der Carl-Cranz-Gesellschaft e.V., Oberpfaffenhofen, 20.11.2014

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Ebert, R.:
Passive and Active Imaging Devices for Defence and Security. (Keynote paper), International Symposium on Optronics in Defence and Security, OPTRO 2014, Frankreich, Paris, 28.-30.1.2014

Ebert, R.:
Bildgebende passive und aktive Sensorik. DWT-Konferenz: Angewandte Forschung für Verteidigung und Sicherheit in Deutschland, Berlin, 5.2.2014

Ebert, R.:
Fraunhofer IOSB Activities in the Field of Optronic. NATO SET PBM Berlin, 1.-3.10.2014

Ebert, R.:
Laser Vibrometry for wind turbines inspections. International Conference on Advanced Solid State Lasers, ASSL 2014, China, Shanghai, 16.-21.11.2014

Ebert, R.:
Remote Laser Vibrometry for Large Mechanical Stuctures. (invited Paper), International Conference and Exhibition on optics and electro-optics, OASIS 5 , Israel, Tel Aviv, 3.-4.3.2015

Ebert, R.:
Remote Laser Vibrometry for wind turbine inspection. Application of Lasers for sensing & free Space communication, LS&C 2015, USA, Arlington, VA, 7.-12.6.2015

Eck, R.:
Bewertung von Effektivität und Effizienz unter dem Blickwinkel der Ergononie. Präventionstage Karlsruhe, 12.5.2014

Eck, R.:
Disaster management by working interactively with Geodata. GIScience 2014, Österreich, Wien, 23.-26.9.2014

Essendorfer, B.:
Coalition Shared Data (CSD) Server. BGX, NATO Headquarters. Belgien, Brüssel, 20.1.2014

Essendorfer, B.:
Informationsaustausch in Verbünden mit dem CSD* Konzept. BDSW- Colloquium. Karlsruhe, 21.1.2014

Essendorfer, B.:
IT-Architektur von Kooperationsmodellen. BDSW- Technik Tagung. Frankfurt am Main, 11.4.2014

Essendorfer, B.:
Coalition Shared Data. 106. Meeting of the NATO AIR FORCE ARMAMENTS GROUP. Norwegen, Trondheim, 26.5.2014

Essendorfer, B.:
ISR – Combined and Joint. Technische und organisatorische Anforderungen an den streitkräftegemeinsamen, nationenübergreifenden Informationsraum. CCG- Seminar, FA1.15: Luft- und raumgestützte Bildaufklärung im Systemverbund, Fraunhofer IOSB, Karlsruhe, 6.-9.10.2014

Essendorfer, B.:
NATO-Interoperabilität in der Nachrichtengewinnung und Aufklärung. 14. Sitzung DKE/BKT »Beraterkreis Technologie«, DKE Deutsche Kommission Elektrotechnik Elektronik Informationstechnik im DIN und VDE, Frankfurt am Main, 4.11.2014

Essendorfer, B.:
Informationsmanagement. CCG- Seminar, FA1.07: Daten- und Informationsfusion, Fraunhofer IOSB, Karlsruhe, 10.-13.11.2014

Even, M.:
Cost Functions for Phase Unwrapping with Redundant Integration of Finite Differences. EUSAR 2014 – 10th European Conference on Synthetic Aperture Radar, Berlin, 3.-5.6.2014

Even, M.:
A study of cost functions for phase unwrapping with redundant integration of finite differences. International Geoscience and Remote Sensing Symposium 2014 (IGARSS 2014), Kanada, Quebec, 13.-18.7.2014

Fischer, Y.; Reiswich, A.; Beyerer, J.:
Modeling and Recognizing Situations of Interest in Surveillance Applications. CogSima 2014, USA, San Antonio, 3.-6.3.2014

Fischer, Y.; Krempel, E.; Birnstill, P.; Unmüßig, G.; Monari, E.; Moßgraber, J.; Schenk, M.; Beyerer, J.:
Privacy-aware smart video surveillance revisited. 9th Future Security 2014, Berlin, 16.-18.9.2014

Flemming, S.:
Hierarchische Betriebsführung eines hybriden Speichersystems im Projekt Smart Region Pellworm. Smart Grids Woche 2014, Energieagentur Rheinland-Pfalz, Mainz, 13.10.2014

Fränzel, N.; Schroeder, T.; Weichert, F.; Wenzel, A.; Ament, C.:
Range Estimation System for Powered Wheelchairs, Shaping the future by engineering. 58th IWK, Ilmenau Scientific Colloquium, Ilmenau, 8.-12.9.2014

Fränzel, N.; Weichert, F.; Wenzel, A.; Ament, C.:
A prototyping system for smart wheelchairs. BMT; DGBMT Annual Conference; DGBMT Jahrestagung Hannover, Hannover, 8.-10.10.2014

Frey, C.:
Assistenz für den Menschen bei der Arbeit in der Zukunft. Mechatronic Dialogue Karlsruhe, Steinbeis-Transferzentrum Mechatronik und Nachhaltigkeit, IHK Karlsruhe, 19.5.2014

Frese, C.:
Multisensorielle Arbeitsraumüberwachung für manipulationsfähige mobile Roboter. VDI/VDE-GMA Fachausschuss 4.13 »Steuerung und Regelung von Robotern«, Weßling-Oberpfaffenhofen, 10.4.2014

Gabler, R:
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Filtering Local Features for Logo Detection and Localization in Sports Videos. IEEE International Conference on Signal and Image Processing Applications (ICSIPA), Malaysia, Kuala Lumpur, 19.-21.10.2015

Marin, P.; Zepp, A.; Gladysz, S.:
Adaptive Optics: Methods, Analysis and Applications. Digital holographic wavefront sensor. OSA-Conference, USA, Arlington, 7.6.2015

Meidow, J.:
Indoor Navigation, Lehrgang »Navigation«. Bildungszentrum der Bundeswehr (BiZBw), Mannheim, 7.7.2015

Meyer, J.:
Automatische Sichtprüfung transparenter Objekte. IES-Sommerseminar 2015 - Fachtagung Bildverarbeitung, Mustererkennung und Informationsfusion, Triberg Nussbach, 23.7.2015

Michaelsen, E.:
Towards Understanding Urban Patterns and Structures. Photogrammetric Image Analysis (PIA15), München, 25.-27.3.2015

Molina-Martel, F.; Baena-Gallé, R.; Gladysz, S.:
Fast PSF estimation under anisoplanatic conditions. SPIE Remote Sensing, Frankreich, Toulouse, 20.-24.9.2015

Monari, E.:
3D Face Reconstruction and Super-Resolution from Single Images. Invited Talk at University of Alcálá, Spanien, Madrid, 2.2.2015

Münch, D.; Becker, S.; Kieritz, H.; Hübner, W.; Arens, M.:
Knowledge-based situational analysis of unusual events in public places. 10th Future Security 2015, Security Research Conference, Berlin, 15.-17.9.2015

Münch, D.; Hilsenbeck, B.; Kieritz, H.; Becker, S.; Grosselfinger, A.-K.; Hübner, W.; Arens, M.:
Knowledge-based Video Surveillance for Infrastructure Manipulation. SPIE Security + Defence 2015, Frankreich, Toulouse, 21.-24.9.2015

Mündel, J.:
Leistungsbewertung optischer Systeme mit TRM4. 8. Tagung »Optik und Optronik in der Wehrtechnik«, Hamburg, 21.-23.9.2015

Negara, C.:
Polarisationsmessungen und Schichtdickenschätzung bei absorbierenden Oberflächen. IES-Sommerseminar 2015 - Fachtagung Bildverarbeitung, Mustererkennung und Informationsfusion, Triberg Nussbach, 22.7.2015

Nicolai, S.:
SmartRegion Pellworm – Results from the field test of an hybrid storage System. IRES 2015, Düsseldorf, 10.3.2015

Nicolai, S.:
Beitrag von Industrie und Gewerbe zur Energiewende. ThEGA-Forum, Weimar, 20.4.2015

Niggemann, O.:
Industrie 4.0 - Anwendungen, Systeme, Potenziale. 15. Euroforum Jahrestagung, Köln, 19.3.2015

Okon, M.:
PCFF - Plug&Control für flexible Fördertechnik. AML-PlugFest, IOSB Karlsruhe, 14.-15.10.2015

Okon, M.:
Plug-and-Work für Fördertechnikanlagen mit offenen Standards. VPP2015, TU Chemnitz, 22.-23.10.15

Peinsipp-Byma, E.:
Interaktive Assistenzsysteme für die Abbildende Aufklärung. Wehrtechnisches F&T Symposium »Assistenzsysteme«, Mannheim, 17.6.2015

Peinsipp-Byma, E.:
Rechnergestützte Satelliten- und Luftbildauswertung. CCG Seminar 1.06, Oberpfaffenhofen, 9.6.2015

Peinsipp-Byma, E.:
Erkennungsunterstützung. CCG Seminar 1.15 »Luft- und raumgestützte Bildaufklärung«, Karlsruhe, 23.6.2015

Peinsipp-Byma, E.:
Lagevisualisierung. Informationsveranstaltung Führung, Durchhaltefähigkeit & Schutz der griffity GmbH, Sankt Augustin, 9.7.2015

Petereit, J.:
Sensornetzwerk mit mobilen Robotern für das Katastrophenmanagement SENEKA. In: Forum Unmanned Vehicles V, Bonn Bad Godesberg, 1.-2.6.2015

Philipp, P.; Fischer, Y.; Hempel, D.; Beyerer, J.:
Modelling of Clinical Practice Guidelines for Interactive Assistance in Diagnostic Processes. HIMS 2015, USA, Las Vegas, 27.-30.7.2015

Pohl, M.:
Gap-closing 3D building reconstruction by aligning boundaries of roof segments and detecting uncovered details. Photogrammetric Image Analysis (PIA15), München, 25.-27.3.2015

Rauschenbach, T.:
System Engineering: Approach to water Management. China, Nanjing Business School, 29.4.2015

Richter, M.:
Bag of Visual Words für die Schüttgutsortierung. 49. Regelungstechnisches Kolloquium, Boppard, 6.3.2015

LECTURES
VORTRÄGE

Richter, M.:
Towards many-class classification of materials based on their spectral fingerprints. 2nd International Conference on Optical Characterization of Materials (OCM 2015), Karlsruhe, 19.3.2015

Richter, M.:
Visual words for automated visual inspection of bulk materials. IAPR International Conference on Machine Vision Applications (MVA 2015), Japan, Tokio, 20.5.2015

Richter, M.:
Datengetriebene Merkmale für visuelle Inspektionsaufgaben. IES-Sommerseminar 2015 - Fachtagung Bildverarbeitung, Mustererkennung und Informationsfusion, Triberg Nussbach, 23.7.2015

Ritt, G.:
Bewertung von Laserblendschutzmaßnahmen für bildgebende Sensoren. 8. Tagung »Optik und Optronik in der Wehrtechnik«, Hamburg, 21.-23.9.2015

Roller, W.:
SAR-Grundlagen. CCG- Seminar, FA1.15: Luft- und raumgestützte Bildaufklärung im Systemverbund, Fraunhofer IOSB, Karlsruhe, 22.-25.6.2015

Schaller, F.; Agsten, M.:
Elektromobilität und Strominfrastruktur.
REM2030 Symposium, Karlsruhe, 17.-18.6.2015

Scharaw, B.:
Leak detection and priorities for drinking water network rehabilitation in Darkhan city. National Dialogue on the Urban Nexus »Challenges and Opportunities for integrated water and wastewater solutions in Ger areas of Ulaanbaatar city«, Mongolia, Ulaanbaatar, 6.4.2015

Schenk, M.:
Modelling of an Ontology for a Communication Platform.
SEMAPRO Conference, Frankreich, Nizza, 19.-24.7.2015.

Scherer-Klöckling, C.; Lutzmann, P.:
Distante Schwingungsvermessung von Rotorblättern im Betrieb mittels Laservibrometrie. VDI-Fachtagung »Schwingungen von Windenergieanlagen 2015«, Bremen, 16.-17.6.2015

Schick, A.; Stiefelhagen, R.:
3D Pictorial Structures for Human Pose Estimation with Supervoxels. IEEE Winter Conference on Applications of Computer Vision WACV 2015, USA, Waikoloa Beach, 5.-9.1.2015

Schilling, H.:
Object-based detection of vehicles in airborne data.
SPIE-conference on Image and Signal Processing for Remote Sensing (SPIE), Frankreich, Toulouse, 21.-24.9.2015

Schleipen, M.:
Gemeinsame Arbeitsgruppe OPC UA und AutomationML.
Hannovermesse Industrie, Vortrag beim Forum Industrie 4.0, Hannover, 14.4.2015

Schleipen, M.:
OPC UA and AutomationML - collaboration partners for one common goal: Industrie 4.0. OPC Europe Day, Frankreich, Paris, 19.5.2015

Schleipen, M.:
Plug-and-Work - universelle Schnittstelle. Entwicklertag Karlsruhe 2015,
https://www.youtube.com/watch?v=ISkAoHISxS4
Karlsruhe, 20.5.2015

Schleipen, M.:
Nutzung offener Standards für Industrie 4.0 – Auto-mationML und OPC UA in der Smart Factory.
FFG Produktionsforum 2015, https://www.ffg.at/forumproduktion, Österreich, Wien, 27.5.2015

Schleipen, M.:
- **MoMo - Mobile Monitoring und smarte Datenanalyse basierend auf offenen Standards.**
- **Automatisierter Austausch und semantische Anreicherung von CAD-Planungsdaten in der Fördertechnik mit AutomationML (Automated Exchange and semantic lifting of CAD planning data in transport with AutomationML).**

Automation, Baden-Baden, 11.-12.6.2015

Schönbein, R.:
- **Grundlagen der luft- und raumgestützten Bildaufklärung.**
- **ISR – Combined and Joint Anforderungen an den nationenübergreifenden Informationsraum.**
- **Stand und Perspektiven für die abbildende Aufklärung.**

CCG- Seminar, FA1.15: Luft- und raumgestützte Bildaufklärung im Systemverbund, Fraunhofer IOSB, Karlsruhe, 22.-25.6.2015

Schuchert, T.:
Video exploitation system for RPAS. 17th European RPAS Conference & RPAS Regulatory & Policy Form, Belgien, Bruessel, 23.6.2015

Schulte, H.:
Utilization of Spectral Signatures of Food for Daily Use. 2nd International Conference on Optical Characterization of Materials (OCM 2015), Karlsruhe, 18.-19.3.2015

Schwan, G.; Scherer-Negenborn, N.:
An Approach to Select the Appropriate Image Fusion Algorithm for Night Vision Systems. SPIE Security + Defence 2015, Frankreich, Toulouse, 21.-24.9.2015

Schwarz, A.:
Tarnen & Täuschen. Allgemeine Wehrtechnik, Bildungszentrum der Bundeswehr, Lehrgangskurs Allgemeine Wehrtechnik, Mannheim, 28.1.2015

Schwarz, A.:
Tarnen & Täuschen. Allgemeine Wehrtechnik, Bildungszentrum der Bundeswehr, Lehrgangskurs Allgemeine Wehrtechnik, Mannheim, 14.7.2015

Schwarz, A.:
Tarnen & Täuschen. Allgemeine Wehrtechnik, Bildungszentrum der Bundeswehr, Lehrgangskurs Allgemeine Wehrtechnik, Mannheim, 28.7.2015

Schwarz, A.:
- **Adaptive Camouflage in the VIS and IR: Basic Principles and Mechanisms.**
- **Hyperspectral Signatures. (Session Chair)**

SPIE Security & Defence, Frankreich, Toulouse, 20.-24.9.2015

Schwarz, A.:
Basic Principles and Mechanisms for Adaptive Camouflage in the VIS and IR. ISIP Tagung, Bad Reichenhall, 19.-23.10.2015

Schweitzer, C.; Geisler, J.:
Scenario simulation to optimize the performance of future space-based sensors-systems. SCI-275 Workshop, Italien, La Spezia, 24.-26.2.2015

Schweitzer, C.; Stein, K.:
Simulation of atmospheric and terrestrial background signatures for detection and tracking scenarios. SPIE Security & Defence, Frankreich, Toulouse, 20.-24.9.2015

Segor, F.:
Dynamic Configuration of Distributed Systems for Disaster Management. The Tenth International Conference on Systems (ICONS 2015), Spanien, Barcelona, 19.-24.4.2015

Seiffer, D.; Eisele, C. u. a.:
Quantification of helicopter rotor downwash effects on electro-optical defensive aids suites. SPIE Security & Defence, Frankreich, Toulouse, 20.-24.9.2015

Seiffer, D. u. a.:
Helicopter engine exhaust rotor downwash effects on laser beams. SPIE Security & Defence, Frankreich, Toulouse, 20.-24.9.2015

Sprung, D.; Großmann, P.; Sucher, E.:
Vertikale Profilmessung der Turbulenz in der unteren atmosphärischen Grenzschicht. DWT-Tagung, Hamburg, 21.-23.9.2015

Stein, K.; Eijk van, L.:
Atmospheric limitations on the performance of electro-optical systems: a brief overview. ATM Atmospheric Transmission Modelling, Aerosols in the maritime environment, USA, Dullas, 9.-11.6.2015

Streicher, A.:
Using Text Segmentation Algorithms for the Automatic Generation of E-Learning Courses. LEARNTEC. Karlsruhe, 27.-29.1.2015

Streicher, A.:
Grundlagen der Web-Didaktik mit Fokus auf Interaktivität. Forum Interaktive digitale Didaktik. Darmstadt, 26.3.2015

LECTURES
VORTRÄGE

Streicher, A.:
Intelligente Kopplung von Ausbildungs- & Assistenzsystemen in der Bildauswertung. F&T Symposium Assistenzsysteme. Bundesausbildungszentrum der Bundeswehr Mannheim, Mannheim, 17.6.2015

Streicher, A.:
Interoperable Adaptivität für Serious Games und Simulationen in der Bildauswertung. 11. Berliner Werkstatt Mensch-Maschine-Systeme. Berlin, 7.-9.10.2015

Taphanel, M.:
Multiplex acquisition approach for high speed 3D measurements with a chromatic confocal microscope. SPIE Optical Metrology, München, 11.6.2015

Tchouchenkov, I.:
Kleine unbemannte Fluggeräte: Gefahren und mögliche Gegenmaßnahmen. BKA, Wiesbaden, 29.4.2015

Tchouchenkov, I.:
Erweiterte Einsatzmöglichkeiten von kleinen Unmanned Aerial Vehicles (UAV). SGW-Forum Unmanned Vehicles, Bad Godesberg, 1.6.2015

Thomé, S.; Michaelsen, E.; Scherer-Negenborn, N.; Jäger, K.:
Fusion of Trackers on Thermal Image Sequences. Fusion 2015, USA, Washington D.C., 6.-9.7.2015

Usländer, T.:
Prozessüberwachung und –diagnose: Welche neuen Möglichkeiten ergeben sich durch das Internet der Dinge und Big Data? 2. VDI-Fachtagung, Düsseldorf, 28.-29.1.2015

Usländer, T.:
Industrie 4.0 startet ins Web of Things - Wirtschaftliche Chancen und technische Herausforderungen. Teilnahme an der CeBIT 2015 Roundtable, future talk Veranstalter: DFKI und W3C, Hannover, 18.3.2015

Usländer, T.:
OpenIoT - Cloud-basierte Integrationsplattform für IoT Anwendungen. Hannover Messe HMI, 14.4.2015

Usländer, T.:
Analysis and Design of Industry 4.0 Software Applications. MedTec, Stuttgart, 21.-23.4.2015

Usländer, T.:
Industrie 4.0 - Engineering of IOT Applications for Industrial Production. Keynote beim Internet of Things e Big Data Summit, Italien, Mailand, 11.6.2015

Usländer, T.:
Engineering von Industrie 4.0 Software-Anwendungen. 3. Markt & Technik Industrie 4.0 Industrial Internet Summit, München, 20.-21.10.2015.

Usländer, T.:
Engineering von Industrial Internet-Anwendungen – was ist zu beachten? Data Centre World, Messe Frankfurt, 10.11.2015

Vieth, K.:
Bulkgoods Sorting at Fraunhofer IOSB using SiliconSoftware Framegrabber. Sales-Meeting der Firma SiliconSoftware, Speyer, 26.7.2015

Vogelbacher, S.; Sprung, D.; Stein, K.; Eijk van, A.M.J.:
Influence of aerosols on atmospheric transmission at the Baltic Sea: Comparison of experimental results with model simulations using MODTRAN. SPIE Remote Sensing, Frankreich, Toulouse, 20.-24.9.2015

Voit, M.:
Intuitive MMI für Computersysteme von Morgen. Der Vorteil kamerabasierter Mensch-Maschine-Interaktionstechniken in Leitständen der Zukunft, Tagung der Consulectra Netzleittechnik, Hamburg, 25.6.2015

Voit, M.:
InCarIn. Referat über den wissenschaftlichen Anteil des aktuell laufenden BMBF-Projekts InCarIn, 2. BMBF Zukunftskongress, Berlin, 29.6.2015

Voth, S.; Monari, E.:
OpenCASE - Open Camouflage Assessment Suite. Bundeswehr Symposium ISIP, Bad Reichenhall, 20.-23.10.2015

Walther, C.:
Automated Classification of Stages of Anaesthesia by Populations of Evolutionary optimized Fuzzy Rules. BMT-Kongress 2015, Lübeck, 16.-18.9.2015

Walther, C.:
Machine-specific Approach for Automatic Classification of Cutting Process.Efficiency. Machine Learning for Cyber Physical Systems, Lemgo, 1.-2.10.2015

Warweg, O.:
Erfahrungen aus dem Projekt HyPROM. EMS-EDM PROPHET Anwenderkonferenz 2015, Zeulenroda-Triebes, 25.6.2015

Watson, K.:
Introducing the Open Geospatial Consortium Health Domain Working Group.
Webinar am 14.7.2015 mit E. Oldfield und S. Simmons

Winkelmann, M.:
Denial and Deception. NATO Imagery and IMINT Orientation Course, NATO Schule, Oberammergau, 22.4.2015

Winkelmann, M.:
Tarnen und Täuschen gegen heutige und zukünftige Aufklärungssysteme. CCG, Lehrgangskurs FA1.06, Oberpfaffenhofen, 10.6.2015

Winkelmann, M.:
- **Spectral analysis of the vegetative background in the NIR and SWIR spectral range.**
- **Analysis of exploitable spectral features of target and background materials.**

SPIE Security & Defence, Frankreich, Toulouse, 20.-24.9.2015

Winkelmann, M.:
Denial and Deception. NATO Imagery and IMINT Orientation Course, NATO Schule, Oberammergau, 1.10.2015

Winkelmann, M.:
Spectral features of backgrounds and targets with focus on vegetation. ISIP Tagung, Bad Reichenhall, 19.-23.10.2015

Winzer, P.; Beyerer, J.; Schnieder, E.:
Brücken zwischen »Safety« und »Security«.
Wuppertaler Sicherheitstage, Wuppertal, 27.-28.5.2015

Wuttke, S.:
Concept for a compound analysis in active learning for remote sensing. Photogrammetric Image Analysis (PIA15), München, 25.-27.3.2015

Yatcheva, L.; Almeida de Sá Barros, R.; Segel, M.; Sprung, D.; Sucher, E.; Eisele, C.; Gladysz, S.:
Ultimate Turbulence Experiment: Simultaneous Measurements of Cn2 near the Ground Using Six Devices and Eight Methods, (Best Student Paper Award), Optics in Atmospheric Propagation and Adaptive Systems.
Frankreich, Toulouse, 20.-24.9.2015

Zepp, A.; Gladysz, S.; Almeida de Sá Barros, R.; Stein, K.; Osten, W.:
Realization of an Analogue Holographic Wavefront Sensor.
10th International Workshop on Adaptive Optics for Industry and Medicine, Italien, Padua, June 15.6.2015

Zepp, A.; Gladysz, S.; Almeida de Sá Barros, R.; Osten, W.; Stein, K.:
Analogue holographic wavefront sensor – a performance analysis. SPIE-Conference: Laser Communication and Propagation through the Atmosphere and Oceans IV,
USA, San Diego, 11.8.2015

Zielinski, A.; Bock, J.:
A Case Study on the Use of Semantic Web Technologies for Learner Guidance. 24th International World Wide Web Conference. Italien, Florenz, 18.-22.5.2015

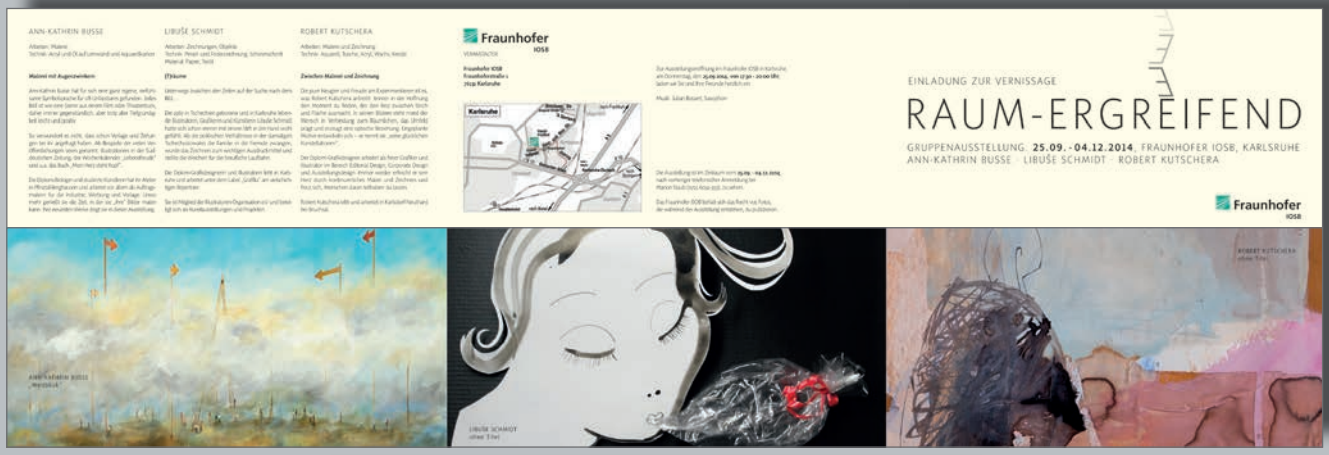
Zielinski, A.:
A Utility-based Semantic Recommender for Technology-Enhanced Learning. INTUITEL final Conference. House of Living Labs Karlsruhe, 18.6.2015

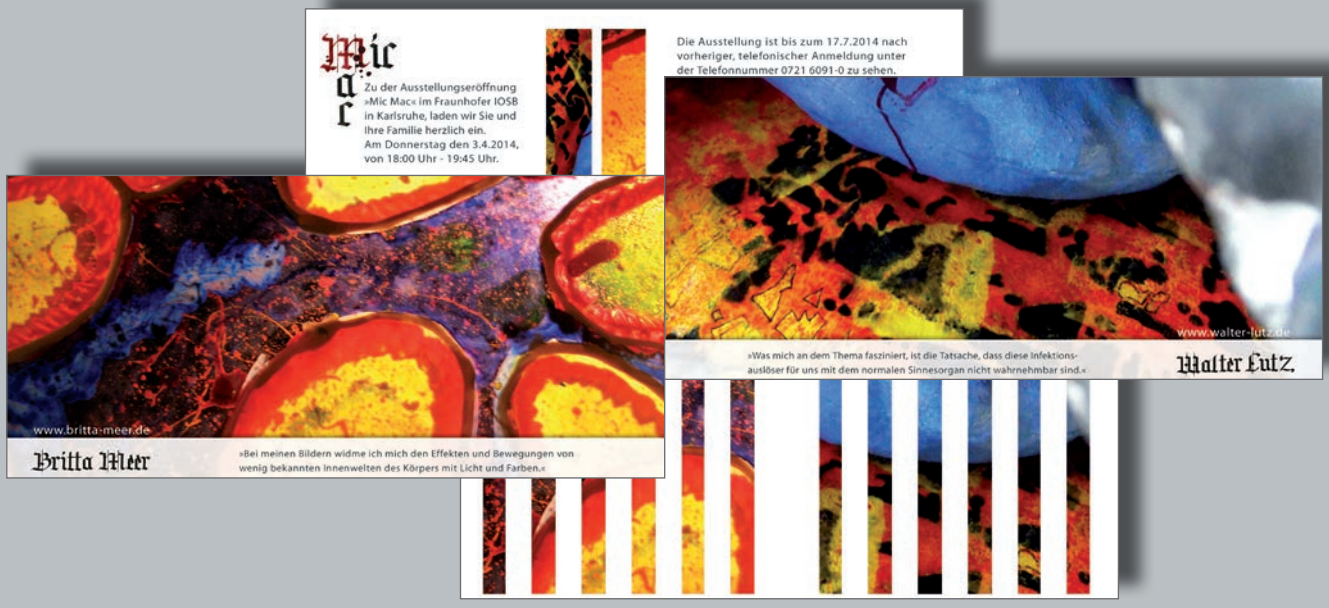
Zielinski, A.:
A Utility-based Semantic Recommender for Technology-Enhanced Learning. 15th IEEE International Conference on Advanced Learning Technologies (ICALT2015). Taiwan, Hualien, 6.-9.7.2015

VERNISSAGES
VERNISSAGEN
IOSB Karlsruhe

Fotographs, paintings and sculputres – 2014 and 2015 Fraunhofer IOSB had all of them.

Fotographien, Malereien und Skulpturen – 2014 und 2015 war all dies im Fraunhofer IOSB zu sehen.






farben scheinen auf
tanzen und springen
bilder tauchen auf
und werden erinnert
ohne den zauber zu stören
wahren sie ein geheimnis
zeitlos verleihen sie
dem vergänglichen dauer
Die Ausstellung ist bis zum 23. April
nach vorheriger, telefonischer Anmeldu
der Nummer 0721 6091-333 zu sehen.
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von 17:30 - 19:45 Uhr,
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Dauer der Ausstellung:
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Vorsitzender Kunstverein Nürtingen
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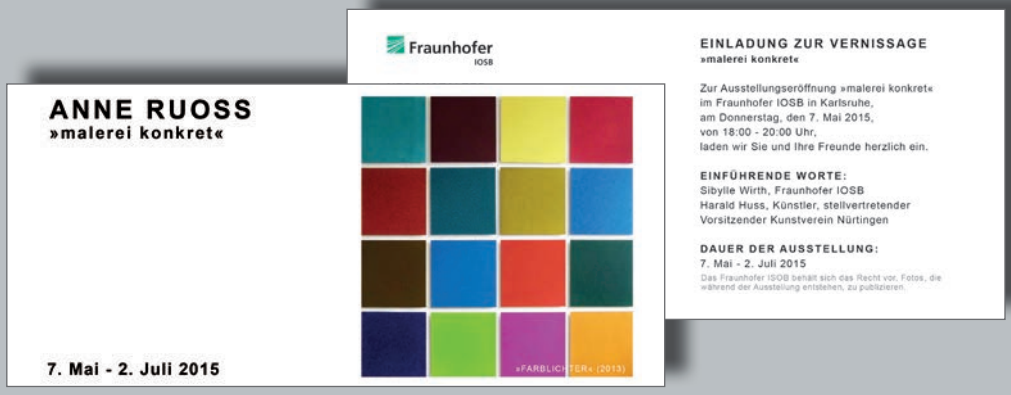
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Zur Ausstellungseröffnung »malerei konkret«
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am Donnerstag, den 7. Mai 2015,
von 18:00 - 20:00 Uhr,
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EINFÜHRENDE WORTE:
Sibylle Wirth, Fraunhofer IOSB
Harald Huss, Künstler, stellvertretender
Vorsitzender Kunstverein Nürtingen
DAUER DER AUSSTELLUNG:
7. Mai - 2. Juli 2015


Fraunhofer IOSB
Fraunhoferstraße 1
Zur Ausstellungseröffnung im
Fraunhofer IOSB in Karlsruhe,
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von 18:00 – 20:00 Uhr,
laden wir Sie und Ihre Freunde herzlich ein.
KREATIVITÄT IST NAHRUNG FÜR DIE SEELE
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&
MONIKA RIESTERER


Email: monikariesterer@gmx.de
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am Donnerstag, den 24.9.2015
von 18:00 – 20:00 Uhr.
Ausstellungsdauer
vom 24.9.2015 – 10.12.2015
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Marion Staub, Fraunhofer IOSB
Monika Riesterer
Petra Roquette
MUSIKALISCHER BEITRAG
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