![Fraunhofer IVI logo]

Institute Report 2022

Unfolding potentials

Fraunhofer Institute for Transportation and Infrastructure Systems IVI

Unfolding Potentials

Two strong words outlining the topic of our annual report. Various different concepts of the term potential can be found in almost all branches of natural science, economics and the humanities. The adage »prudentia potentia est« is commonly attributed to statesman and philosopher Sir Francis Bacon. Here, the Latin term potentia stands for power and political domination, the latter of which recently seems to be characterized not by the political leaders' prudentia – meaning wisdom –, but rather by their ignorance. However, the term potentia is also used to denote efficiency, strength and ability.

Our efficiency has not been lost in 2022. The institute's economic situation is still comfortable. The commission books for the next two years are well-filled. Cooperations with partners from industry and science are proving stable even in times of economic stagnation. Having completed the renovation of the west wing of the institute building, over 70 new workspaces are available. As a family-friendly research institute offering excellent career opportunities, we should not be facing any challenges in recruiting competent and enthusiastic staff.

In physics, potential fields describe the spatially distributed ability to build up electric tension and carry out work. In our daily lives, tensions usually have an ambivalent effect. In this sense, the Fraunhofer-wide switch to a new administration software has created an exhausting and labor-intensive field of tension throughout the entire Fraunhofer-Gesellschaft. Therefore, I would like to offer special thanks to all my employees for their patience in bearing this unreasonable process, and for their commitment to carrying out all administrative tasks at the accustomed level of quality in spite of high workloads.

The term to fold, which is also referred to in this annual report's motto, has a fundamental significance in science and offers analogies to the development of our institute. Just as the folding of two mathematical functions creates a third one, new structures were created at the institute through cooperations with academic institutions and other Fraunhofer institutes. The application center in Ingolstadt has not only contributed to the overall economic success in 2022, but it has also strengthened our scientific reputation with numerous publications. In Berlin, Fraunhofer IVI is collaborating with three institutes to establish the Fraunhofer Center for the Security of Socio-Technical Systems (SIRIOS). In the middle of 2022, a contract was signed by TU Dresden and Fraunhofer with the objective of founding a joint DesignLab, which has set up its quarters at Fraunhofer IVI. In the DesignLab, employees of the Chair of Industrial Design Engineering and designers from three Fraunhofer institutes in Dresden work together and form an inspiring team.

In the hope that all of these potentials can unfold in the future in a world in which knowledge will be power again, I thank you for your interest and invite you to enjoy our annual report.

»

Cooperations with partners from industry and science are proving stable even in times of economic stagnation.«

Prof. Dr. Matthias Klingner

Director

Prof. Dr. Matthias Klingner
matthias.klingner@
ivi.fraunhofer.de
Phone +49 351 4640-800

Contents

Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft based in Germany is the world's leading applied research organization. Prioritizing key future-relevant technologies and commercializing its findings in business and industry, it plays a major role in the innovation process. It is a trailblazer and trendsetter in innovative developments and research excellence. The Fraunhofer-Gesellschaft supports research and industry with inspiring ideas and sustainable scientific and technological solutions and is helping shape our society and our future.

The Fraunhofer-Gesellschaft's interdisciplinary research teams turn original ideas into innovations together with contracting industry and public sector partners, coordinate and complete essential key research policy projects and strengthen the German and European economy with ethical value creation. International collaborative partnerships with outstanding research partners and businesses all over the world provide for direct dialogue with the most prominent scientific communities and most dominant economic regions.

Founded in 1949, the Fraunhofer-Gesellschaft currently operates 76 institutes and research units throughout Germany. Over 30,000 employees, pre-dominantly scientists and engineers, work with an annual research budget of €2.9 billion. Fraunhofer generates €2.5 billion of this from contract research. Industry contracts and publicly funded research projects account for around two thirds of that. The federal and state governments contribute around another third as base funding, enabling institutes to develop solutions now to problems that will become crucial to industry and society in the near future.

The impact of applied research goes far beyond its direct benefits to clients: Fraunhofer institutes enhance businesses' performance, improve social acceptance of advanced technology and educate and train the urgently needed next generation of research scientists and engineers.

Highly motivated employees up on cutting-edge research constitute the most important success factor for us as a research organization. Fraunhofer consequently provides opportunities for independent, creative and goal-driven work and thus for professional and personal development, qualifying individuals for challenging positions at our institutes, at higher education institutions, in industry and in society. Practical training and early contacts with clients open outstanding opportunities for students to find jobs and experience growth in business and industry.

The prestigious nonprofit Fraunhofer-Gesellschaft's namesake is Munich scholar Joseph von Fraunhofer (1787–1826). He enjoyed equal success as a researcher, inventor and entrepreneur.
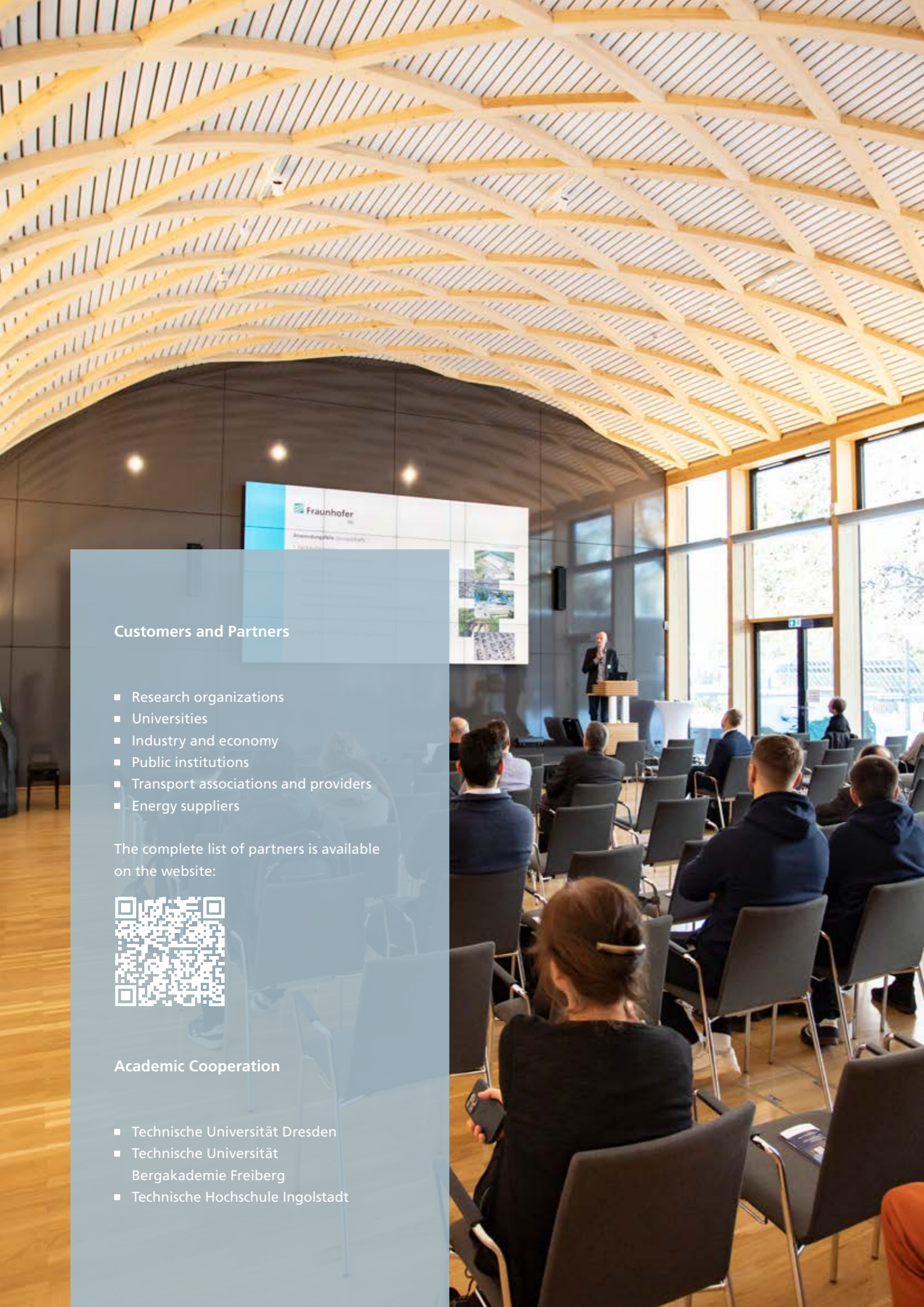
(Figures as of: January 2022)

6

Fraunhofer in Dresden

Institutes, Branches and Research Institutions

- Fraunhofer Institute for Ceramic Technologies and Systems IKTS
- Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP
- Fraunhofer Institute for Photonic Microsystems IPMS
- Fraunhofer Institute for Transportation and Infrastructure Systems IVI
- Fraunhofer Institute for Material and Beam Technology IWS
- Dresden branch of the Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM, Bremen
- Dresden branch of the Fraunhofer Institute for Machine Tools and Forming Technology IWU, Chemnitz
- Division Processing Technology of the Fraunhofer Institute for Process Engineering and Packaging IVV, Freising
- Division EAS (Engineering of Adaptive Systems) of the Fraunhofer Institute for Integrated Circuits IIS, Erlangen
- Project Group ASSID (All Silicon System Integration Dresden) of the Fraunhofer Institute for Reliability and Microintegration IZM-ASSID, Berlin
- Dresden branch of the Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS, Sankt Augustin

Fraunhofer IVI

ICT Group

Chairman of the Group
Prof. Dr. Boris Otto
boris.otto@isst.fraunhofer.de

Managing Director
Alexander Nouak
alexander.nouak@iuk.fraunhofer.de

Fraunhofer IVI contact
Prof. Dr. Matthias Klingner
matthias.klingner@ivi.fraunhofer.de

www.iuk.fraunhofer.de/en

Alliances

**Fraunhofer Big Data and
Artificial Intelligence Alliance**

Alliance Manager
Dr. Dirk Hecker

Fraunhofer IVI contact
André Rauschert
andre.rauschert@ivi.fraunhofer.de

www.bigdata-ai.fraunhofer.de/en

**Fraunhofer Traffic and
Transportation Alliance**

Chairman of the Alliance
Prof. Dr. Uwe Clausen

Member of the Steering Group
Prof. Dr. Matthias Klingner
matthias.klingner@ivi.fraunhofer.de

www.verkehr.fraunhofer.de/en

Fraunhofer Energy Alliance

Spokesperson of the Alliance
Prof. Dr. Hans-Martin Henning

Fraunhofer IVI contact
Dr. Martin Ufert
martin.ufert@ivi.fraunhofer.de

www.energie.fraunhofer.de/en

Fraunhofer Battery Alliance

Spokesperson of the Alliance
Prof. Dr. Jens Tübke

Fraunhofer IVI contact
Dr. Martin Ufert
martin.ufert@ivi.fraunhofer.de

www.batterien.fraunhofer.de/en

Customers and Partners

- Research organizations
- Universities
- Industry and economy
- Public institutions
- Transport associations and providers
- Energy suppliers

The complete list of partners is available
on the website:

Academic Cooperation

- Technische Universität Dresden
- Technische Universität
  Bergakademie Freiberg
- Technische Hochschule Ingolstadt

Organization Chart

Director
Prof. Dr. Matthias Klingner
Phone +49 351 4640-800
matthias.klingner@ivi.fraunhofer.de

Administration

Head of Administration
Kornelia Brüggert
Phone +49 351 4640-670
kornelia.brueggert@ivi.fraunhofer.de

International Business
Mandy Koritz
Phone +49 351 4640-637
mandy.koritz@ivi.fraunhofer.de

Human Resources
Susann Störmer
Phone +49 351 4640-683
susann.stoermer@ivi.fraunhofer.de
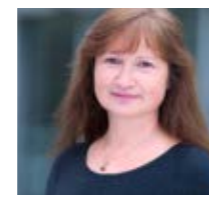
European Business
Marlen Kittelmann
Phone +49 351 4640-893
marlen.kittelmann@ivi.fraunhofer.de

Strategic Development

Scientific Coordination
Elisa Seiler
Phone +49 721 4640-354
elisa.seiler@ivi.fraunhofer.de

**Science Communication
and Design**
Elke Sähn
Phone +49 351 4640-612
elke.saehn@ivi.fraunhofer.de

**DesignLab
for Applied Research**
Prof. Dr. Jens Krzywinski
Phone +49 351 4633 5750
jens.krzywinski@ivi.fraunhofer.de

Departments

Mobility and Digital Services
Dr. Torsten Gründel
torsten.gruendel@ivi.fraunhofer.de | Phone +49 351 4640-664
Data Systems and Travel Assistance *Sebastian Pretzsch* | Ticketing and Fares *N. N.*

Vehicle Systems
Dr. Frank Steinert
frank.steinert@ivi.fraunhofer.de | Phone +49 351 4640-846
Vehicle Engineering *Dr. Marcel Markgraf* | Monitoring and Control Strategies *Dr. Martin Ufert*
Charging Infrastructure *Dr. Sven Klausner*

Traffic Safety and Vehicle Automation
Prof. Dr. Thoralf Knote
thoralf.knote@ivi.fraunhofer.de | Phone +49 351 4640-628
Vehicle Control and Sensor Systems *Dr. Sebastian Wagner, Felix Keppler*
Vehicle and Road Safety *Dr. Christian Erbsmehl*

Strategy and Optimization
Dr. Kamen Danowski
kamen.danowski@ivi.fraunhofer.de | Phone +49 351 4640-660
Disposition *Dr. Kamen Danowski* | Digital Business Processes *André Rauschert* | Logistics *Denise Holfeld*
Fraunhofer Center for the Security of Socio-Technical Systems (Fraunhofer SIRIOS)

Cognitive and Cooperating Systems
N. N.
Cooperative Systems *Dr. Thomas Otto*

Application Center

Connected Mobility and Infrastructure
Prof. Dr. Gordon Elger
gordon.elger@ivi.fraunhofer.de | Phone +49 841 9348-2840
Highly Automated Flying *Henri Meeß* | Networked Systems *Prof. Dr. Andreas Festag*
Autonomous Systems *Prof. Dr. Klaus Kefferpütz*

In Profile

At Fraunhofer IVI's three locations Dresden, Ingolstadt and Berlin, approximately 150 researchers develop technologies and concepts in the fields of mobility, energy and security – from forward-looking research to practical application. The institute cooperates closely with TU Dresden, TU Bergakademie Freiberg and TH Ingolstadt.

For more than 20 years, Fraunhofer IVI has been developing innovations for the intelligent planning, coordination and management of mobility, shaping the digital transformation of public transport with reliable information and assistance systems, platform solutions for mobility data and services as well as electronic ticketing.

Projects investigating autonomous systems are gaining in importance, especially in heavy goods transport and agriculture. Besides innovative charging technologies, research and development work in the field of electromobility includes, for instance, solutions for remote battery diagnosis. The Fraunhofer Application Center »Connected Mobility and Infrastructure« at the TH Ingolstadt focuses on topics of automated and cooperative driving.

In the light of future technological and societal changes, special attention is devoted to security-related topics, covering aspects of civil hazard prevention, the functional safety of vehicle technologies, and developments in the fields of vehicle and road safety as well as accident research. Since 2021, the institute has also been involved in the newly founded Fraunhofer Center for the Security of Socio-Technical Systems (Fraunhofer SIRIOS) in Berlin.

Intelligent Transport and Mobility Systems

- Mobility services and data
- Ticketing and fares
- Transport planning
- Autonomous driving and cooperative driving maneuvers
- Urban Air Mobility

Vehicle and Propulsion Technologies

- Propulsion technologies
- Multi-axle steering systems and lane guidance
- Mobile work machines
- Thermal management

Vehicle and Road Safety

- Functional safety
- Analyses of accident data
- Traffic psychology

Energy Systems

- Autonomous utility systems
- Stationary energy storage systems

Electromobility

- Battery development and recycling
- Charging technologies
- Electric buses and electric commercial vehicles
- Fuel cells / hydrogen technologies

Process Data Analysis

- Transport ecology
- Logistics
- Digital business processes

Civil Protection

- Planning and operation command
- Infrastructure management
- Risk assessment

Facilities and Large Equipment

- Technical center with a vehicle hall and an adjacent test track
- Test vehicles and demonstrators
- Measurement technology
- Test rigs
- Software for simulation, Big Data, 3D construction and GIS

The complete list of facilities and large equipment is available on the website:
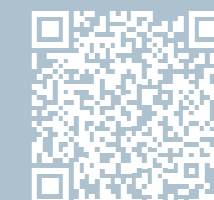
Economic Development

Financial Development
in € million

	2015	2016	2017	2018	2019	2020	2021	2022

Operating Budget

Industrial revenues	37 %
EU	3 %
Basic financing	10 %
Miscellaneous	4 %
Public sector	46 %

Employees
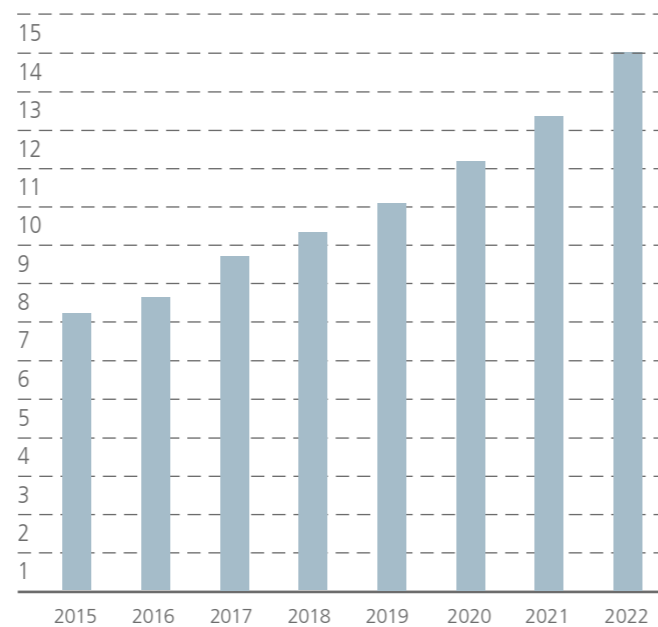
Employees	163
Trainees	6
Student assistants	81
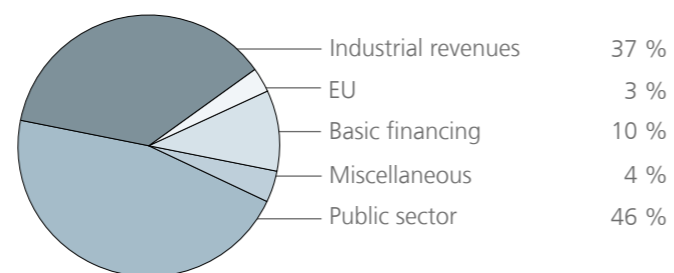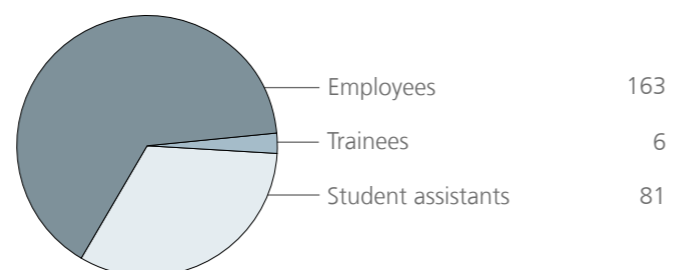
Advisory Board

Members

Prof. Dr. Thomas Brandmeier,
Scientific Director, Institute of Safety in Future Mobility (ISAFE),
Technische Hochschule Ingolstadt (THI)

Dr. Babett Gläser,
Head of Research Department, Saxon State Ministry for
Science, Culture and Tourism (SMWK)

Mario Herber,
Senior Chief Superintendent, Head of Department »Central
Services«, Dresden Police Department

MinR Hans-Peter Hiepe,
Head of Division »Innovation Support; Structural
Strengthening«, Federal Ministry of Education and Research
(BMBF)

Stefan A. Lang,
Director Advance Development,
Sensor-Technik Wiedemann (STW) GmbH

Katja Müller,
Head of HR Transformation,
Lausitz Energie Bergbau AG (LEAG)

Sonja Penzel,
President, Saxon State Office of Criminal Investigation (LKA)

Prof. Dr. Peter Pickel,
Deputy Director / Manager External Relations,
John Deere GmbH & Co. KG

Nils Schmidt,
Head of Yunex Traffic Germany

Dr. Marzena Schöne,
Head of Division »Digital Transformation in Higher Education,
Scientific Libraries«, Saxon State Ministry for Science, Culture
and Tourism (SMWK)

Dr. Katharina Seifert,
Head of Group Engineering Strategy and China,
Volkswagen AG

Lars Seiffert,
Board of Operations and Human Resources,
Dresdner Verkehrsbetriebe (DVB) AG

Chairman

Nils Schmidt,
Head of Yunex Traffic Germany

Mobility and Digital Services

The level of interconnection and digitalization in complex transport systems is increasing rapidly. With the help of information and communication technologies, it is possible to organize traffic more efficiently, establish new mobility services and integrate traffic participants more actively. For over 20 years, Fraunhofer IVI has successfully operated in the field of mobility and digital services. The department's work is based on an in-depth collaboration with a multitude of partners such as transport companies and associations as well as industry and public institutions.

The two working groups »Data Systems and Travel Assistance« and »Ticketing and Fares« successfully realize projects in a large variety of research topics, acting in interdisciplinary teams with a broad range of skills and on the basis of experience and know-how gained in practical project work. The staff includes computer scientists, information, transportation and automation engineers.

Range of Services

- Data spaces and platforms for data on transportation and mobility
- Information and navigation applications for conventional and alternative mobility services, as well as for electromobility
- Fare calculator for conventional, electronic and mobile ticketing
- Specific programming language for fares, including development and testing tools
- Fare modeling and simulation
- Software solutions for mobile applications including applications for frontend, backend and the cloud
- Utilization of semantic technologies for data processing and service integration

More information

Head of Department

Dr. Torsten Gründel
torsten.gruendel@
ivi.fraunhofer.de
Phone +49 351 4640-664

Data Spaces for Mobility Data

The Mobility Data Space is Germany's central data ecosystem for the mobility sector. It unites enterprises, organizations and institutions with the aim of exploiting their shared data to facilitate tomorrow's mobility.

The Mobility Data Space (MDS) offers new technological solutions for exploiting sensitive mobility data in a trustworthy manner. This way, it is possible for the first time to provide heretofore unused data for a more environmentally and user-friendly, safe and fair mobility. MDS connects existing data platforms such as the Mobilithek, the HERE platform and the CARUSO data place to enable standardized access to large data catalogs. Based on the open, decentralized system architecture provided by the International Data Spaces Association, and in cooperation with the Fraunhofer Institutes AISEC, FIT, IAIS, IML and ISST, Fraunhofer IVI developed the technical platform and hosted the data space in its set-up phase.

The political relevance of MDS is anchored in the current Federal Government's coalition agreement. On behalf of the Federal Ministry for Digital and Transport (BMDV), the National Academy of Science and Engineering (acatech) and further stakeholders, such as Mercedes, BMW, Volkswagen and Deutsche Bahn, founded DRM Datenraum Mobilität (DRM Data Space Mobility) GmbH, a sponsoring company that has been hosting the German section of MDS since 2022. In addition, the BMDV operates the Mobilithek platform (formerly MDM), which offers a standardized central access point to traffic and mobility data. In collaboration with T-Systems, Fraunhofer IVI is also working on improving the Mobilithek, extending it by data space concepts so that it can be integrated into MDS.

Fraunhofer IVI also supports the implementation of the aforementioned concepts and technologies on a European level: Within the Gaia-X 4 AMS, Gaia-X 4 ROMS and Gaia-X 4 PLC projects, which are part of the Gaia-X 4 Future Mobility project family, MDS constitutes the »data ecosystem layer« of the Gaia-X system architecture. Additional activities in this field are currently being carried out by the institute and its partners within the scope of PrepDspace4Mobility. This EU project aims at creating the »Common European Mobility Data Space« as mandated by the European Commission's data strategy.

mobility-data-space.de | mobility-dataspace.eu

Contact

Sebastian Pretzsch
sebastian.pretzsch@
ivi.fraunhofer.de
Phone +49 351 4640-689

Vehicle Systems

Digital Transformation of Farming: Cognitive Agriculture

With the aim of enabling farmers to achieve high productivity in accordance with quality and resource efficiency in a digital world, interdisciplinary cognitive solutions for smart farming applications were created within the COGNAC project. By developing the CERES field robot, Fraunhofer IVI has made a valuable contribution to the project goals.

The Department »Vehicle Systems« focuses on novel concepts and technologies for commercial and special-purpose vehicles. This includes overall vehicle design, construction of components and partial solutions, innovative drive systems as well as methods for the energy-efficient operation of both main engine and auxiliaries.

The department contributes their expertise in diverse areas ranging from the development of concepts to the detailed simulation and dimensioning of vehicle systems, and the assembly, set-up and testing of prototypes. This also includes different charging technologies for private and public transport.

More information

Head of Department

Dr. Frank Steinert
frank.steinert@
ivi.fraunhofer.de
Phone +49 351 4640-846

Range of Services

- Design and dimensioning of electric powertrains in commercial and special-purpose vehicles
- Functional safety of commercial vehicles (ISO 26262)
- Electrification and automation of agricultural machinery
- Fast-charging concepts for electric vehicles
- Development of multi-modal energy supply concepts (trams, buses, stationary)
- Modeling and diagnosis of batteries and fuel cells
- Vehicle systems monitoring
- Development of operating strategies for commercial vehicles

Within the Fraunhofer »Cognitive Agriculture« (COGNAC) Lighthouse Project, strategies and technologies for the digital transformation of agriculture were created. During the three-year project term, eight Fraunhofer institutes worked on finding interdisciplinary solutions for digital agricultural use cases, data spaces and novel sensor systems.

In order to accelerate the automation of field work, Fraunhofer IVI and their partners developed the full-electric, autonomous CERES field robot (»Cognitive Electrical Robot Environment System«). Its system architecture follows a modular approach and consists of a platform providing basic functionalities, to which different modules can be connected. For the concrete use case of weed removal in sugar beet fields, the following modules are employed:

- Automated solution for charging the field robot's energy storage unit to allow 24/7 operation
- Modular »Navigationsbox« (navigation box) containing sensors and data processing systems for locating, environment perception and plant row detection
- helyOS® control tower software
- Electrified hoeing tool for weed removal
- Selective weed detection with the help of the RGBN camera contained in the »Smart Vision Box«
- Data compression and connection to ADS (»Agricultural Data Space«)

At the smart farming project's final event on September 29, 2022 in Dresden, CERES was introduced during a live presentation for invited experts from agriculture, science and industry, as well as other guests.

The prototype shows how field work in row crops can be automated. In the future, autonomous field robots are supposed to handle a majority of agricultural tasks. These robots are able to work both alone and in cooperating swarms, and they symbolize another step taken towards high-level automation in agriculture.
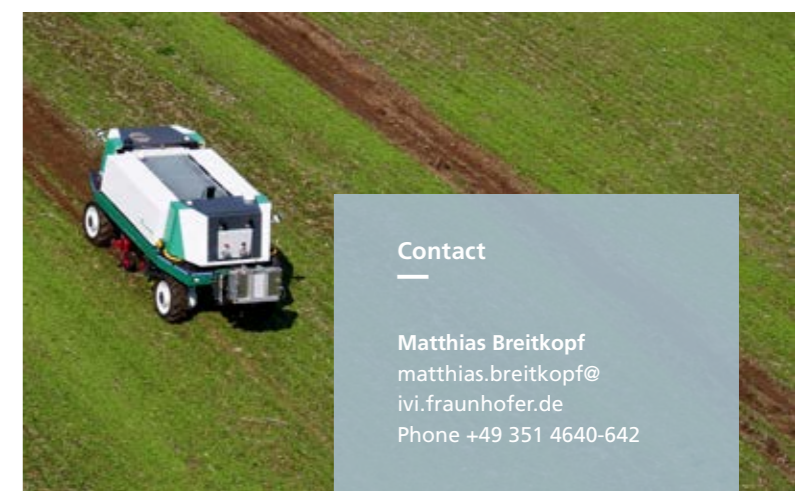
Contact

Matthias Breitkopf
matthias.breitkopf@
ivi.fraunhofer.de
Phone +49 351 4640-642

Traffic Safety
and Vehicle Automation

Ultra-long vehicles can help increase efficiency in the traffic sector, but their operation requires special infrastructure features. Steering systems designed at Fraunhofer IVI improve the maneuverability of these vehicles and simultaneously create broader application options for them.

Automation in the fields of transportation and agriculture is a future-oriented topic. Applications for automation in non-public areas are an important migration path for which the department developed the helyOS® management system. helyOS® is capable of coordinating driving tasks, allocating resources to them, and calculating paths.

Highly automated autonomous vehicles set entirely new standards in terms of establishing and proving their safety. The department carries out accident analyses and traffic observation campaigns that provide a basis for driving and testing scenarios used in the development and approval of functions for automated driving.

More information
—

Head of Department
—

Prof. Dr. Thoralf Knote
thoralf.knote@
ivi.fraunhofer.de
Phone +49 351 4640-628

Range of Services

- Innovative steering systems for extremely long road vehicles with multiple steered axles
- Control center for autonomous driving in non-public areas
- Fully automated maneuver planning for road-bound transport vehicles
- Analyses, surveys and development work in the field of vehicle and road safety
- Traffic psychology – analyses of the experience and behavior of various groups of traffic participants
- Modeling and testing of driving scenarios with the help of motion platforms
- Implementation concepts for electric buses and hydrogen fuel cell buses
- Charging infrastructure for bus depots and logistics yards

Making Accidents Tangible: Fraunhofer IVI Accident Prevention School (FAPS)

—

At Fraunhofer IVI, accident researchers, engineers and psychologists collaborate to develop future methods for accident prevention. They combine engineered solutions with data analyses and approaches from psychology that place the individual at the center, focusing on the increased risk of accidents involving vulnerable road users.

Current numbers show that children and adolescents often become involved in accidents while on foot or riding a bike. Of those accidents, ca. 50 percent were caused by other, motorized traffic participants, and not by the children and adolescents themselves. Therefore, it is crucial to raise awareness among these road users of the possible misconduct of others, as it can save lives.

Fraunhofer IVI Accident Prevention School (FAPS) is a project that aims at improving the road safety of students aged 13 to 16 by closing the current road safety training gap in this age group. For their accident prevention work at schools, FAPS instructors make use of the accident data bases of official authorities. Based on the geographical locations of the participating schools, they extract corresponding data and provide it for the project work. The teenagers then work on tablet computers using the FAPS software tool and analyze real accident data from police data bases. They gain an insight into anonymized accident descriptions and a majority of the associated accident parameters. With the help of this information, they analyze the specific causes and characteristics of accidents involving pedestrians and cyclists, as well as accident hot spots in their school's immediate surroundings.

As an expansion of this approach, a VR experience module was created between 2021 and 2022. This module complements the FAPS accident prevention training by allowing the users to adopt an interactive perspective within a virtual space via 3D glasses. Statistical accident analyses were carried out based on 145,000 accidents involving pedestrians and cyclists from an official accident data base with the aim of identifying especially critical and frequently recurring situations and recreate them in virtual reality. This is the only way to safely gain experience in the context of traffic accidents, and to adopt the perspectives of different accident participants. It is possible and advisable to adapt the concept for additional user groups.

Contact

Nora Strauzenberg
nora.strauzenberg@
ivi.fraunhofer.de
Phone +49 351 4640-8759

Strategy
and Optimization

Predictive Maintenance Planning
for Infrastructure Systems

Within the scope of the European Shift2Rail Joint Undertaking, a framework supporting infrastructure managers in predictive maintenance planning was developed. Due to the fact that the information available for maintenance planning tasks is often incomplete, robust planning tools based on data analysis and prognoses are essential.

The Department »Strategy and Optimization« consists of three working groups and offers a wide array of services in the areas of security, business process analysis, logistics planning and infrastructure management. The interdisciplinary team includes computer scientists, geoscientists as well as mathematicians with both professional expertise and practical knowledge.

Their application-oriented research and development projects are focused on decision support for optimized planning and control of resources. The core competencies of the department comprise developing novel optimization processes and algorithms as well as designing and implementing complex systems. In the age of digitalization, it is not only the controllability of data that counts but also the creation of data value as a business benefit.

Range of Services

- Systems for operational and tactical mission control for firefighters, rescue services, emergency services, police, and specialized units
- Analyses and risk assessment in hazard prevention: planning of fire safety requirements and rescue service zones, optimization of site concepts
- Robust distributed systems using analysis tools from data mining, machine learning and natural language processing on the basis of big/smart data
- Data-driven process optimization using AI methods
- Predictive and prescriptive analyses for decision support systems
- Condition-based maintenance planning

More information

Head of Department

Dr. Kamen Danowski
kamen.danowski@
ivi.fraunhofer.de
Phone +49 351 4640-660

The guidelines developed within the Shift2Rail Joint Undertaking support infrastructure operators in categorizing specific planning tasks and transferring them into formal optimization problems so that they can be solved with the help of algorithms. The focus in this context is operative, tactical as well as strategic planning, with the timescale and level of detail increasing along the abovementioned levels. Concrete tools for all three levels were developed.

The operative planning level includes the concrete scheduling of maintenance tasks within available time slots and the allocation of resources such as machines and staff. The measures to be carried out are known, but the time required for the individual tasks is unknown. Data analyses can provide reference points in this area.

On the tactical planning level, specifications are made about which maintenance tasks need to be scheduled within which time windows and on which route sections. Here, uncertainty in terms of the individual components' state evolution plays a major role. With the help of data analyses, it is possible to predict the deterioration of railway tracks, which can then be taken into account during the planning phase.

In the context of strategic planning, the level of uncertainty further increases due to long time scales of 5 to 20 years.

A simulation-based approach is well-suited for evaluating long-term effects. The state of the railway tracks as it evolves over time is simulated under different constraints while taking into account both deterioration and improvement through maintenance activities planned on a tactical level.

Complex data analyses are not only required for making prognoses about future developments, but also for generating missing information from historical data. These analyses are partly based on classical statistics, and – due to the multitude of parameters – partly on learning algorithms.
.
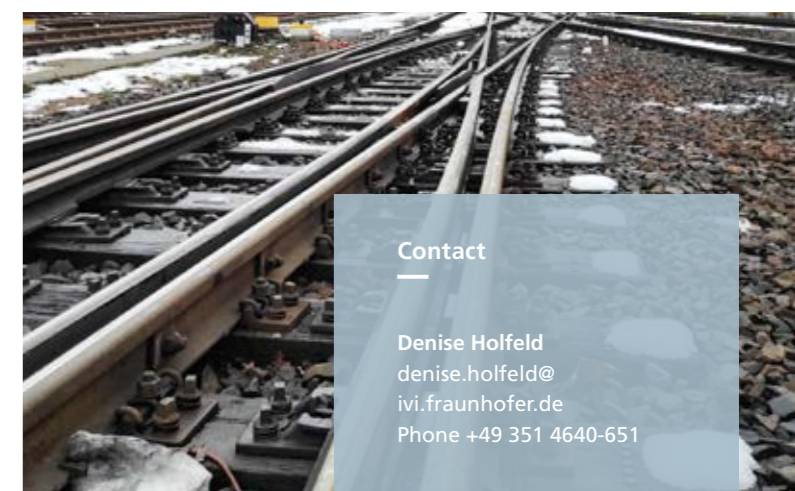
Contact

Denise Holfeld
denise.holfeld@
ivi.fraunhofer.de
Phone +49 351 4640-651

Cognitive and Cooperating Systems

The »Cognitive and Cooperating Systems« department investigates anticipatory connected and automated driving under consideration of all road users as well as the transport infrastructure. Special emphasis is put on the cooperation between the involved players, focusing on the reliable exchange of information and messages.

Detecting, learning and anticipating traffic scenarios can be achieved with the help of cognitive systems. For tackling current transportation challenges, these systems offer novel methods and algorithms that serve to effectively support and manage automated and connected driving in urban areas – one example being the so-called smart intersection.

More information

Group Manager

Dr. Thomas Otto
thomas.otto@
ivi.fraunhofer.de
Phone +49 351 4640-813

Range of Services

- Concept, test and supply of cooperative and cognitive system solutions for connected and automated driving
- Implementation of hybrid cloud systems, C-ITS backend systems, as well as management systems for connected infrastructures
- Development of algorithms and communication protocols for innovative transport applications and services
- Design and implementation of hybrid simulation environments
- Infrastructure object detection to provide traffic-relevant dynamic objects and scenarios
- Equipment of test vehicles for automated and connected driving including visualization of applications
- Planning, realization and assessment of test drives and communication tests (laboratory, closed test area as well as the public digital test bed Dresden)

# Multimodal – Intelligent – Sustainable – Digital: Frankfurt MIND(+)

By introducing cooperative C-ITS services in the field of future public transport, the innovative Frankfurt MIND(+) implementation project lays the groundwork for smart and sustainable mobility options in the city of Frankfurt am Main.

The transformation of transportation has become a ubiquitous concept. In this context, digitalization, electrification, and automation are seen as basic prerequisites for exploiting untapped potential. In order to preserve or even improve the usability of public transport in the future despite increasing passenger numbers, shorter cycles and more modern vehicles, comprehensive technological and professional problems need to be solved. Factors such as the stepwise conversion and discontinuation of analog radio frequencies used for radiocommunication or for prioritization of public transport vehicles at traffic lights must be considered in this process.

Mobility service providers are aware of their responsibilities and of the challenges ahead. For this reason, VGF (Verkehrsgesellschaft Frankfurt am Main) has initiated the Frankfurt MIND(+) project, which is being carried out together with Benz & Walter GmbH and Fraunhofer IVI. One of the research project's aims is to raise the acceleration of public transport in urban environments to a new level.

The basis for this is the gradual switching from today's analog radio technology to prioritization with the help of standardized and harmonized car2X communications via ETSI ITS 5G throughout Europe. The acceleration concept developed by Fraunhofer IVI was tested successfully together with their consortium partners. In a next step, the method will be piloted on a subway line on route segments outside of tunnels.

The implemented solution will provide a national and international blueprint and will be included in the instructions and recommendations given by the VDV (Association of German Transport Companies) as a committee of public transport providers, and by the FGSV (German Road and Transportation Research Association) as a committee of infrastructure operators. In addition, it will be submitted to the C-ROADS platform for the purpose of Europe-wide standardization and harmonization.
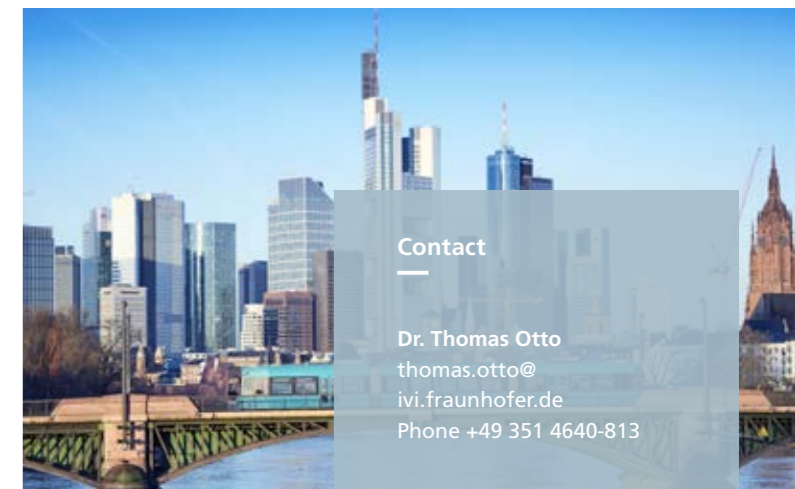
Contact

Dr. Thomas Otto
thomas.otto@
ivi.fraunhofer.de
Phone +49 351 4640-813

Connected Mobility and Infrastructure

The Fraunhofer Application Center »Connected Mobility and Infrastructure« at Technische Hochschule Ingolstadt (THI) focuses on current and future topics of automated and cooperative driving. By means of roadside protection systems and high-performance car-2-infrastructure communication, the safety risks of partially and fully automated traffic flows will be reduced, and overall traffic will become more efficient.

In the long term, the exploitation of mobility's third dimension – the airspace – will facilitate the shipping of goods as well as passenger transport. To achieve this, diverse competencies in the fields of sensor technology, communications and artificial intelligence are combined, fostering synergies with local industry and promoting close cooperation with the city of Ingolstadt and its partners.

Range of Services

- Testing of connected automated driving within the digital test bed Ingolstadt / Bavaria
- Backend and cloud applications for cooperative systems
- Infrastructure sensors and assistance
- Environment perception and maneuver control for autonomous drones
- High-precision locating for indoor and outdoor areas
- AI-based environment perception and driving functions
- V2X communications (ETSI ITS-G5, C-V2X, 5G), C-ITS facilities and applications
- Traffic monitoring, management and control
- Sensor monitoring, malfunction detection as well as sensor re-calibration and control

More information

—

Head of Application Center

—

Prof. Dr. Gordon Elger
gordon.elger@
ivi.fraunhofer.de
Phone +49 841 9348-2840

IN²Lab: Open Innovation Lab for Testing Automated Driving Functionalities

—

The IN²Lab (Ingolstadt Innovation Lab) research project aims to create a safety system for connected and automated driving. For this purpose, a digital test bed called »Erste Meile« (First Mile) is being set up in Ingolstadt. It will serve as the foundation for an open innovation lab that welcomes participation from academia, startups, and established companies alike.

The IN²Lab project partners are pursuing a vision for future mobility in which automated vehicles can navigate highways and urban roads into automated parking garages. To achieve this, they are setting up the »Erste Meile« (First Mile) test bed in Ingolstadt. It connects the A9 Autobahn with the new IN-Campus technology park and features roadside infrastructure such as sensors, communication modules, IT systems and a control station, the so-called »Mission Control«. The project is funded by the Bavarian Ministry of Economy, Regional Development, and Energy, and carried out by Audi AG, Blickfeld GmbH, Continental AG, Technische Hochschule Ingolstadt, and Fraunhofer IVI's application center in Ingolstadt.

The core idea of IN²Lab is to create a safety system that uses sensors to capture the surrounding environment and constitutes a redundant data source in addition to the vehicles' own sensors. The system aggregates environmental data and monitors the automated vehicles present within the test bed. This approach enables testing of automated vehicles under real-life conditions in an urban traffic area in the future.

Cameras and high-performance RADAR and LiDAR systems from the automotive sector, adapted to the requirements of infrastructure operation, are used as sensors. A hierarchical concept including a local object detection and classification system as well as decentralized data fusion processes enables efficient sensor data processing within the overall system.

Data transmission within the infrastructure is based on fast fiber-optic connections using the SENSORIS standard. Vehicle-to-infrastructure communication is realized via Cellular-V2X. It relies on the latest generation of V2X communications and on specifications for sensor data exchange that are currently under development. The »Mission Control« tracks objects along the test bed and provides feedback to the test vehicles. The safety system allows carrying out a diverse range of tests under real traffic conditions, such as scenarios including bicyclists, buses and bus stops, traffic circles, and many more.

Contact

—

Prof. Dr. Andreas Festag
andreas.festag@
ivi.fraunhofer.de
Phone +49 172 179 2911

Fraunhofer SIRIOS

Fraunhofer Center for the Security of Socio-Technical Systems

Extreme weather events, terrorist attacks or riots at major events – public safety faces major challenges. Due to multiple interdependencies between humans, technology and infrastructure, security-related scenarios are becoming increasingly complex and difficult to manage. Fraunhofer SIRIOS pools the expertise of several Fraunhofer institutes in order to study and simulate these interdependencies.

The Fraunhofer Center for the Security of Socio-Technical Systems (Fraunhofer SIRIOS) makes complex security scenarios tangible and controllable in order to increase security and resilience in society.

With initial funding from the German Federal Government and the State of Berlin, the newly founded institution will use the coming four years to build a research, testing and training environment for safety authorities, rescue service providers and critical infrastructure operators. This environment, which is unique in Europe, serves to simulate scenarios, to experience them virtually and to test them in real life.

Located at the site of Fraunhofer FOKUS in Berlin, an increasing number of researchers from the Fraunhofer Institutes EMI, FOKUS, IOSB and IVI will carry out joint projects. Fraunhofer IVI researchers contribute their long-standing expertise gained from cooperating with end users in the fields of firefighting, rescue services, civil protection and police.

Incidents within socio-technical systems can have severe and wide-scale effects, for example, regarding the supply of power, internet connectivity, telecommunications, water and logistics. Existing security solutions often only cover a few of these aspects. With the help of new, comprehensive simulation systems, Fraunhofer SIRIOS researchers are going to study these interdependencies in order to be well-prepared in case of crisis. To achieve this aim, the institution pools the expertise of the four Fraunhofer Institutes EMI, FOKUS, IOSB and IVI.
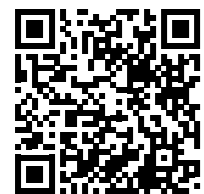
After an extensive preparation period, Fraunhofer SIRIOS was launched in 2022. By securing its initial funding, establishing important contacts in science, administration and industry, and by hiring about 20 new employees, the center has laid solid foundations and reached a critical mass in terms of staff to efficiently carry out project work. Both junior scientists and experienced researchers from natural sciences, engineering, as well as social sciences and the arts are working together in four pilot projects to create new models and simulations for natural and anthropogenic crisis scenarios. To cover the cross-sectional »system architecture« task, an expert position will be created in 2023 with the aim of guaranteeing the interoperability of the solutions from the start.

The research work focuses on five application areas for simulations of urban infrastructure systems:

- Digitalization of security and protection of critical infrastructures
- Education, communication and operational management
- Virtual planning and supervision of major events
- Participation, risk and crisis communication
- Visualization and hybrid test environments

In these fields, key research priorities are set and technologies are jointly developed and tested.

Range of Services

- Simulation of complex socio-technical security scenarios
- Visualization and analysis of deployment scenarios
- Development of courses of action and defense strategies
- Provider-independent environments for development and testing
- Support in the planning of new security solutions
- Simulation-based seminars and training
- Design and execution of simulation games and virtual stress tests
- Interdepartmental large-scale emergency demos
- Development of workshop and networking formats
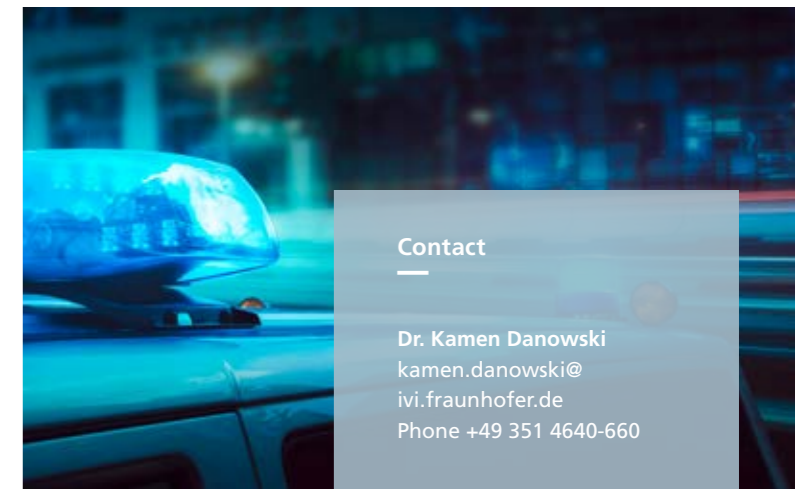
More information

Managing Director Fraunhofer SIRIOS

Daniel Hiller
daniel.hiller@
sirios.fraunhofer.de
Phone +49 30 3463-7810

Contact

Dr. Kamen Danowski
kamen.danowski@
ivi.fraunhofer.de
Phone +49 351 4640-660

Strategic Development

SteigtUM – Electrified Micromobility for Cities

The desire for individuality in urban traffic often leads to high emission levels and tense parking situations. To counteract these effects, the SteigtUM project, funded by the Federal Ministry for Education and Research (BMBF), aims to develop a mobility system with flexible and safe small electric vehicles that are suitable for everyday use. The renting and charging infrastructure with automated rental and return features, and a universal user interface will be part of the system.

As a result, new types of micromobility for urban areas will be put to practical use in Freiberg, Saxony. The vehicles will be seamlessly integrated with the infrastructure, their interface allowing easy use of the system via smartphones.

Currently, the first components have entered the prototype manufacturing stage, among them a cargo bike and the so-called CityBox, a combined bicycle shed and charging station. The system will be tested under real-life conditions until mid-2024. TU Bergakademie Freiberg is heading the trial run, and additional partners are apromace data systems GmbH, Projektionisten GmbH, TU Carolo-Wilhelmina zu Braunschweig, TU Chemnitz and Fraunhofer IVI.

Next to the system's functionality, its acceptance and user-friendliness are key aspects of the project. For this reason, Fraunhofer IVI focused their work, among other topics, on integrated product design as a way of shaping a market-relevant use-case that raises user acceptance. The designs take into account both user-centered demands and ergonomic requirements.

SteigtUM increases flexibility in the field of public transport vehicles and allows individual, emission-free mobility in urban areas – a cost-efficient and easily available alternative to private cars for a broad user group.

Contact

Prof. Dr. Jana Kertzscher
jana.kertzscher@
ivi.fraunhofer.de
Phone +49 3731 392926

Tiny House for Civil Protection – Modular Housing

Offering fast support and providing temporary shelters for uninjured persons in the event of a major disaster are some of the main tasks of civil protection.

On behalf of the German Federal Office of Civil Protection and Disaster Assistance (BBK), the »Tiny-Haus Zivilschutz« pilot study (»Tiny House for Civil Protection«) analyzed the conditions under which mobile, self-sustaining housing units are suitable for civil protection cases in central Europe. The investigations included a broad spectrum of solutions ranging from steel scaffolding tents, which are lightweight and easy-to-store but susceptible to bad weather conditions, to robust container solutions, which can be prefabricated but are rather bulky. As a next step, solution proposals for mobile and modular micro-accommodation units were derived from the findings.

The supply technologies (heat, power and water) were dimensioned and balanced with a view to the ideal of self-sustainability. In this context, given economical constraints did not only have an influence on the mobile micro-houses' level of equipment, but also on their level of self-sustainability.

A PV system with battery storage provides electrical energy. Thermal energy is supplied by flexibly using combustion waste heat and electrical heating options via buffer storages.

Connectivity to existing external supply networks is also intended. In the case of energy shortages, it will be possible to self-generate a rudimentary amount of energy.

All building technology components are located in a central module containing the kitchen and washroom. Two lateral modules provide living and sleeping space. Compared to a container housing unit, the transport volume is reduced by ca. 40 percent while the living space is increased to ca. 150 percent.
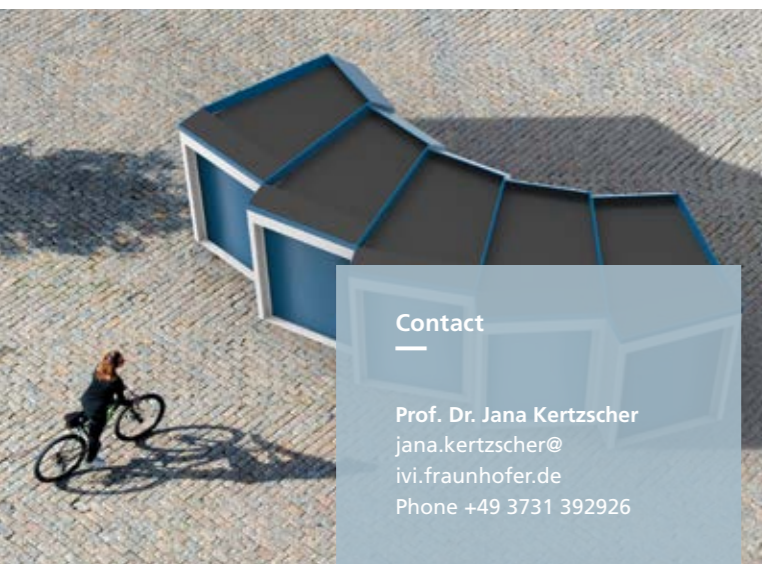
Contact

Ernst-Eckart Schulze
ernst-eckart.schulze@
ivi.fraunhofer.de
Phone +49 351 4640-643

E-Mobility:
Printed Circuit Boards Under 1000 Volt

Dr. Kerstin Franke
—

Application Center
»Connected Mobility and
Infrastructure«

kerstin.franke@
ivi.fraunhofer.de

Phone +49 173 4631647

As a result of drive electrification, higher power levels must be provided in vehicles. This means that the internal control devices, such as DC-DC converters, propulsion system power electronics or battery monitoring devices, including their circuit boards and materials, must also be able to meet the increased requirements needed for higher voltage levels.

This thesis is based on comprehensive reliability studies of printed circuit boards (PCBs) and their included materials exposed to moisture and DC voltages of up to 1000 V. Their aim was to analyze the behavior of PCBs and their included materials under these new voltage demands, developing lifetime models, and deriving criteria for material selection and usage.

In the process, a novel electrochemical phenomenon was discovered, the so-called anodic migration phenomenon (AMP). It is characterized by a semiconducting structure resembling dendrites that forms at the beginning of the anodic circuit path and spreads in the direction of the cathode. In most cases, this structure develops within the solder resist and at the solder resist-base material border, but it can also be observed in the base material itself. If the AMP should bridge the distance between two circuit paths, the result could be a short-circuit and possibly failure of the overall system.

The dissertation focused on investigating the influence of the solder resist – its properties as well as its ingredients – and the PCB design and operating parameters on the AMP.

The investigations resulted in proof that thicker solder resist layers absorb more moisture than thinner layers, which causes the AMP to be more pronounced. As a consequence, affected components will fail earlier due to AMP. This is a counterargument to the current practice that tends towards applying thicker insulating solder resist layers to high-voltage components in order to prevent potential defects in the coating.

Through the targeted variation of the solder resist ingredients, such as filler materials, dispersing agents and accelerator substances, individual factors with a major impact on AMP growth were identified. Additionally, it became clear that AMP formation is influenced by the electric field strength and voltage levels. A formal lifetime model was developed based on these findings.

Solving a Routing Problem in Railway Infrastructure Maintenance

Dr. Franziska Theurich
—

Department
»Strategy and
Optimization«

franziska.theurich@
ivi.fraunhofer.de
Phone +49 351 4640-658

An important aspect in railway maintenance management is scheduling short-term corrective maintenance activities. In this process, travel expenses need to be considered as well as costs caused by bad track conditions. Modeling the resulting scheduling problem as a Vehicle Routing Problem with additional time-dependent costs offers a promising solution approach.

In railway infrastructure maintenance planning, it is often necessary to schedule corrective maintenance jobs on very short notice for unexpected failures in the track network. These jobs are geographically distributed throughout the railway net. Depending on the severity of the failure, it may be necessary to reduce the top speed on that track section in order to minimize safety risks and avoid rapid deterioration. In the case of fatal failures, it might even be necessary to close down an entire track section. This has a negative impact on railway traffic, for which the responsible maintenance company has to pay penalty fees until the tracks are repaired and all restrictions have been lifted.

Therefore, corrective maintenance jobs must be scheduled so that the costs are kept to a minimum. This refers both to the costs of travel between the individual service locations and to the costs for railway traffic restrictions that must be paid in the form of penalty fees for each maintenance day. In this dissertation, the new »Vehicle Routing Problem with Customer Costs« (VRPCC) was modeled for the scheduling of maintenance jobs.

Due to the new time-dependent term within the objective function, solving the VRPCC proved difficult. For this reason, the development of a special branch-and-bound algorithm was at the core of the thesis. Using this method, the solution area is gradually sectioned into smaller and smaller solution sets. With the help of low boundaries that estimate the objective function value of the best solution contained, the solution area to be investigated is reduced. In order to define better boundaries, a permutation model was used as a development basis for the VRPCC algorithm. This way, it is also possible to directly compute the time needed for the maintenance jobs. Additional heuristics and local-search methods were also created within the scope of the thesis to facilitate the transfer to practical application.

Improvement of Transient Thermal Analysis for Power Electronics and Optoelectronics
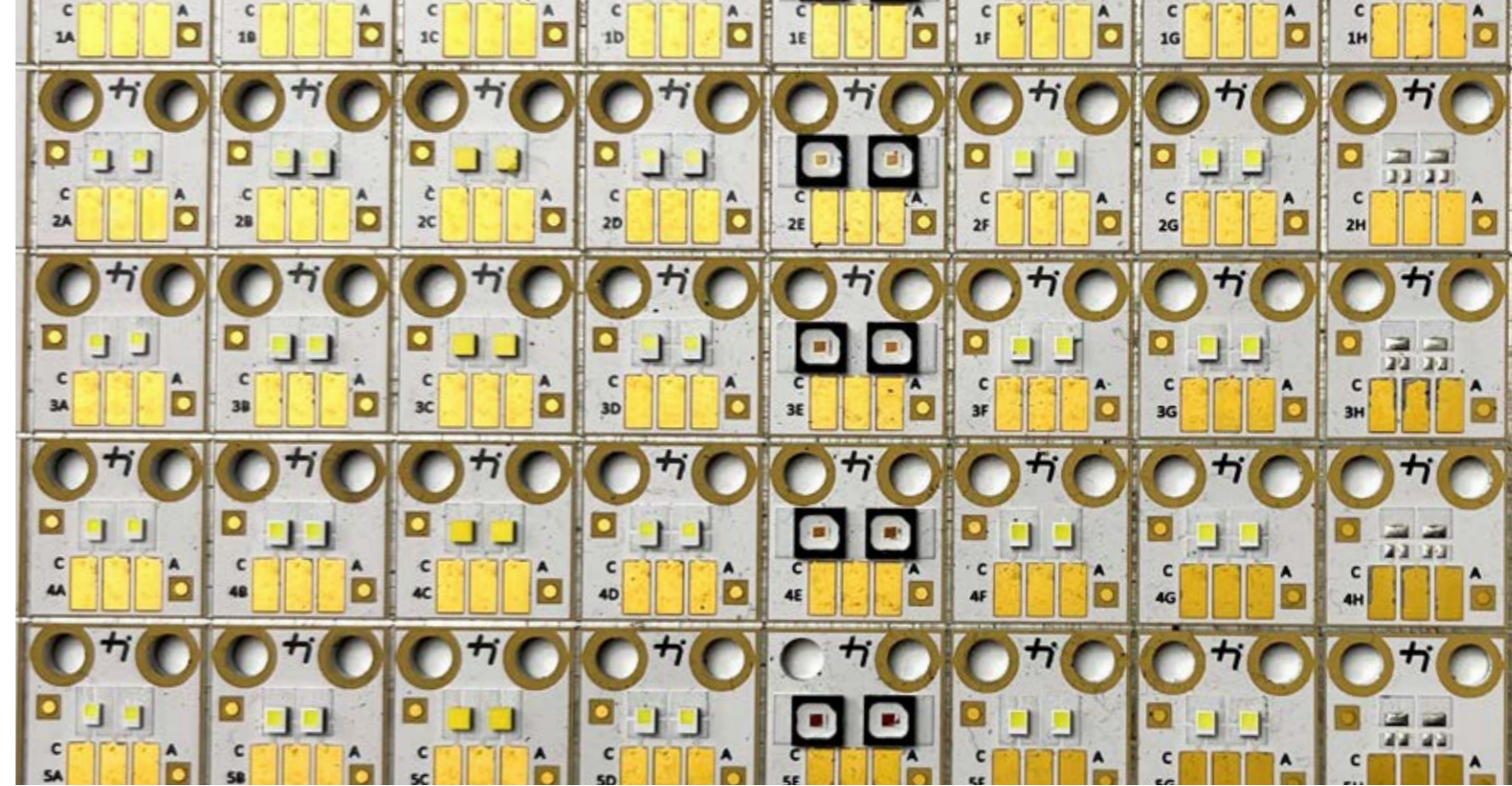
Dr. Maximilian Schmid
—

Application Center
»Connected Mobility and
Infrastructure«

maximilian.schmid@
ivi.fraunhofer.de
Phone +49 173 2045349

The transient thermal analysis method (TTA) offers great potential for detecting thermally relevant defects in power electronics and optoelectronics independently of the specimen's material and geometry. Long measurement periods and a lack in automation make its application difficult. This thesis offers improvements to successfully balance out these disadvantages.

Recent innovations in power electronics and optoelectronics include wide-bandgap semiconductors, Ag and Cu sintering, and optimized miniaturization. As a result, waste heat dissipation is increasingly coming into focus. Inadequate heat dissipation results in higher working temperatures and, in turn, in shorter lifetimes and poorer efficiency. Production defects and aging-related damages can be responsible for that phenomenon. Therefore, thermal assessment is crucial, both in production lines and during the development and quality control stages.

X-raying has become the established method for detecting voids and uncovered areas in the solder joint. However, x-ray testing is unsuitable for ruptures in solder joints, sintered compounds and organic materials such as adhesives and thermal interface materials (TIMs). Applying Scanning Acoustic Microscopy (SAM) allows the detection of defects in the aforementioned cases, but the measuring specimens must be submerged in water for SAM. In addition, there are strong limitations in terms of the specimens' geometry. A third testing method is TTA, which was the focus of this thesis. In contrast to x-ray and SAM, TTA is not an imaging technique. Instead, a specimen's thermal properties are evaluated ranging from semiconductor to heat sink, independent of material type and geometry.

TTA has the highest potential for defect detection, but it is limited by long measuring periods and a lack in automation. Therefore, the thesis aimed at optimizing the TTA method in terms of these two parameters.

To reduce the required time for measuring, the Deterministic Pulse Algorithm (Deterministischer Puls Algorithmus, DPA) was developed and patented. Implementation of DPA allows to reduce the measuring period by up to 95.9 percent while maintaining the signal quality. For the guaranteed flexible contacting of components via spring contact pins, a new heating/measuring source for transistors was created. Two automated test stands were set up based on DPA and the heating/measuring source respectively and tests were carried out.

Design and Evaluation of a Platform for Documenting Media Literacy Acquisition in Secondary Education

Susanna Kunzmann
—

Department
»Strategy and
Optimization«

susanna.kunzmann@
ivi.fraunhofer.de
Phone +49 351 4640-8767

The digital transformation has fundamentally changed the requirements for the working world and research. Anyone wanting to keep up with the rapid pace of digitalization must continuously educate themselves and become acquainted with new technologies. Professionals and researchers who can reflect actively, and who are creative and skilled in the use of digital tools are in high demand everywhere. In addition to IT education, the acquisition of media literacy must become a standard subject in the school system, so that young people are prepared for these changed conditions in the best possible way.

Within the scope of the present Master's thesis, a digital media passport was created for use in schools during the orientation stage (5th grade). It comprises 19 interactive modules that teach media literacy in different fields in a playful way. The tasks and subjects reflect the competence framework set by the Kultusministerkonferenz (conference of German ministers for education and cultural affairs), which provides a reference for the acquisition of media literacy within the German school system. Within the media passport, learning to interact appropriately on the internet and reflecting on one's own behavior in terms of media use plays an important role in addition to acquiring classic IT skills, such as working with computers, search engines, passwords, and different software applications. Different didactic approaches are chosen to sustain the students' motivation during their work on the digital media passport. Short quizzes and puzzles, integrated video clips and a range of interactive elements serve to connect theoretical knowledge with practical application.

To guarantee the permanent documentation of the knowledge gained, the Digi4Docs web platform was created. This platform allows students and teachers the process-based completion of tasks. First, the students finish the individual interactive modules and then they submit them digitally via the platform to their teachers for evaluation. The teachers confirm the successful completion of the respective modules and the students' acquisition of the associated skills. When all modules have been completed, participants receive an automatically generated certificate listing the skills acquired. The Digi4Docs web platform and the digital media passport program were tested in cooperation with a regional secondary school. The digital and interactive elements met with particularly great approval.

Self-Supervised Deep Learning for Visual Odometry and Monocular Depth Estimation on Absolute Scale
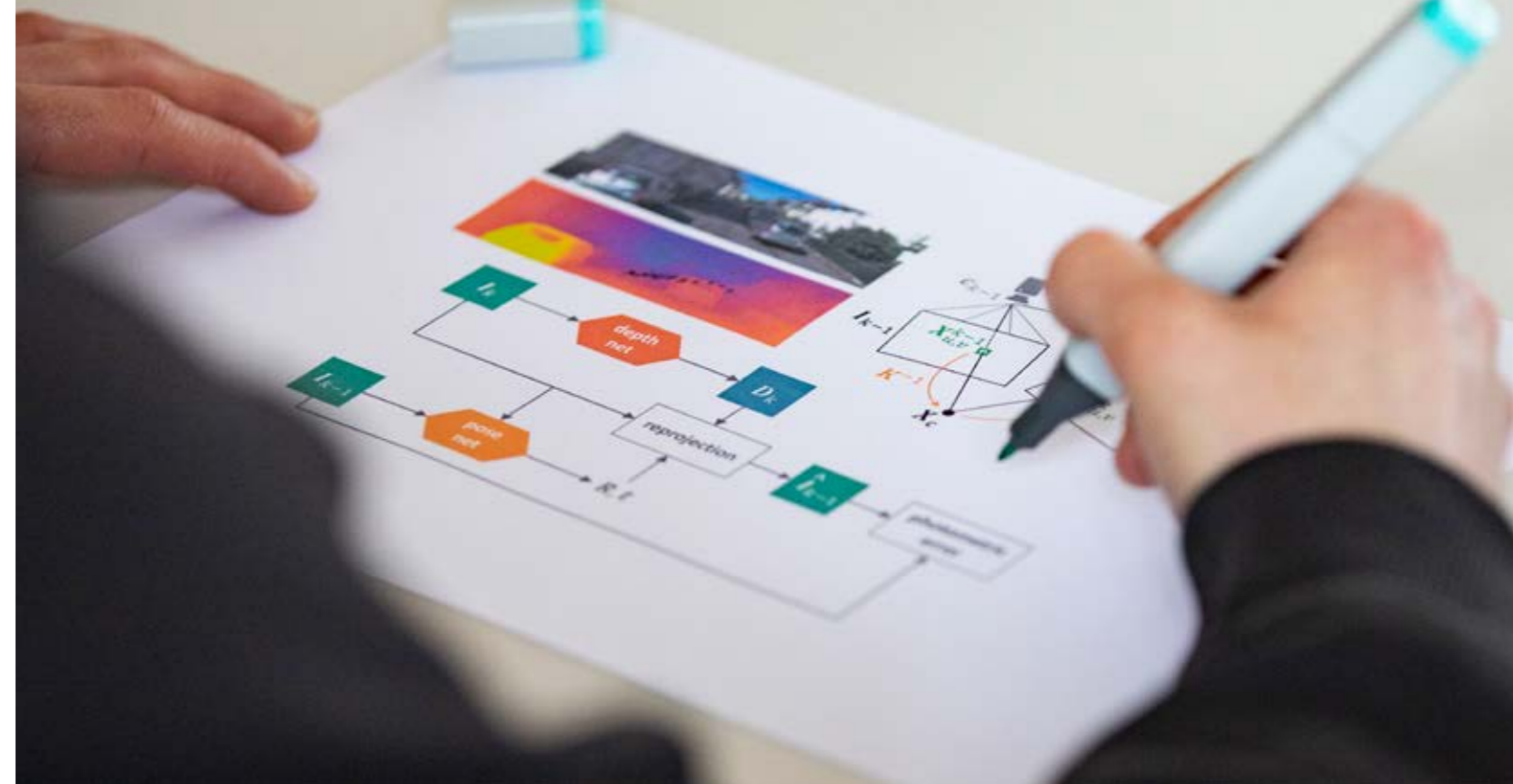
Markus Gross
—

Application Center
»Connected Mobility and
Infrastructure«

markus.gross@
ivi.fraunhofer.de
Phone +49 1520 2830347

Mobile systems such as autonomous vehicles often use digital cameras for environment perception. The 2D images captured by those cameras allow reconstruction of the 3D surroundings on an absolute scale only if supplemented by additional range sensors. To counteract the disadvantages of these sensor systems, inertial measuring units and Deep Learning approaches were used in this thesis to transfer camera-based 3D environment perception to an absolute scale.

The Master's thesis addresses the field of camera-based environment perception for mobile systems. A particular emphasis was placed on the topic of monocular depth estimation, which reconstructs 3D environment information based on 2D images from a single camera. To achieve this, current research uses self-supervised Deep Learning, which is a subfield of Artificial Intelligence. In addition to monocular depth estimation, this approach also allows calculation of the so-called visual odometry, which tracks a mobile system's movement through space. Since the depth and odometry are estimated solely based on 2D images, reconstructing the absolute (real) scale of the environment is mathematically impossible. This phenomenon is called scale ambiguity.

The use of distance sensors is a suitable solution to this problem because they allow reconstruction of the real scale of the observed environment. However, the implementation of these sensors is usually cost-intensive, requires extra installation space and calibration, and a subsequent data fusion process is needed to merge all sensor data.

To counteract these disadvantages, depth estimation on an absolute scale was accomplished with the help of inertial measuring units (IMUs), which are ubiquitous in most mobile systems due to their diverse applications. The results show that information generated by IMUs can be used within a self-supervised learning approach to perform visual odometry and monocular depth estimation on an absolute scale. This means that the use of range sensors is unnecessary. In the next step, the knowledge gained will be transferred from the context of autonomous driving to the field of autonomous flight. The Fraunhofer ALBACOPTER® Lighthouse Project offers an excellent framework for this undertaking.

Highlights

January 25, 2022 | »GAIA-X 4 Future Mobility« project family kicked off

The »GAIA-X 4 Future Mobility« project family was kicked off in a virtual event in January. Coordinated by the DLR Institute for AI Safety and Security, 80 partners are currently carrying out basic research within five projects in the fields of intelligent traffic infrastructure systems, vehicle technology design and industrial applications. Together with other Fraunhofer institutes, Fraunhofer IVI is actively involved in creating the future Gaia-X data ecosystem on the basis of different use cases for automated and networked mobility services.

February 16, 2022 | Launch of the »5Going« project

Within the »5Going« project, an »Open Innovation Lab« will be created for operating 5G technologies in the traffic sector. The aim is to significantly increase the safety and sustainability of road traffic as a whole by employing intelligent 5G-based networks, camera and lidar systems, as well as cloud solutions. The kick-off meeting for the project was hosted by the TH Ingolstadt. Fraunhofer IVI is involved via its »Connected Mobility and Infrastructure« application center and will coordinate several work packages in the fields of infrastructure development and road safety.

February 24-25, 2022 | New iECO Lighthouse Project starts off

During the opening event of GAIA-X's »Innovative and practical applications and data spaces in the Gaia-X digital ecosystem« funding competition, the 11 winning consortia were presented with their funding agreements. On behalf of the iECO consortium, Michael Brenner (RIB) and André Rauschert (Fraunhofer IVI) officially accepted the funding agreements from Dr. Franziska Brantner, Parliamentary State Secretary of the German Federal Ministry for Economic Affairs and Climate Action (BMWK).

March 2, 2022 | 5G standalone innovation

As part of the 5G Lab Germany Research Field Lausitz (5GFOLA) research project, a pioneering step towards the implementation of 5G features was taken at the test track of Fraunhofer IVI.

With the installation of the 5G standalone network – consisting of a high-performance 5G infrastructure and an Edge Cloud – partially and highly automated driving can be developed, tested and evaluated through cooperation, networking and infrastructure-based assistance and control.

May 4, 2022 | Groundbreaking ceremony for »TELEWERK – Teleworkshops for Rural Regions«

In the immediate vicinity of the Mittweida university campus, a future-oriented living lab for innovation-based regional development with a total of 173 square meters of usable space will be built: the »TELEWERK«. As part of the simul+ initiative, Fraunhofer IVI and the consortium leader Mittweida University of Applied Sciences bundle their competences in this joint infrastructure. The complex will also incorporate Fraunhofer IVI's »AMSEL« project on self-sufficient micro-settlement for energy-conscious living.

May 17, 2022 | Ingolstadt digital test bed starts with the »First Mile«

With a ceremony at Technische Hochschule Ingolstadt, the so-called »First Mile« of the digital test bed Ingolstadt for cooperative, connected and automated driving was opened. It is the connection of the future »IN-Campus« technology park with the 140-kilometer-long Digital Test Field Autobahn A9. The Fraunhofer Application Center »Connected Mobility and Infrastructure« is involved in the research work at the Digital Test Field Ingolstadt with the projects »In²Lab« and »5GoIng«.

May 19, 2022 | Field robot event in Köllitsch

The topic of robotics is gaining increasing importance for plant cultivation. The Köllitsch Teaching and Research Farm therefore hosted the 2022 field robot event, presenting a large variety of technical solutions and research approaches. In addition to expert presentations and field demonstrations, the event mainly focused on facilitating the exchange between practitioners, scientists and representatives from industry. Visitors could learn about solutions in the field of »digital farming« at various exhibition stands.

May 25, 2022 | Festive inauguration of Fraunhofer SIRIOS

The newly founded Fraunhofer Center for the Security of Socio-Technical Systems SIRIOS was officially opened in Berlin's FUTURIUM with around 100 guests and high-ranking representatives from politics, security authorities, industry and research. Within a cooperation across the four Fraunhofer institutes EMI, FOKUS, IOSB and IVI, the aim of the center is to comprehensively simulate complex security scenarios such as a flash flood or a terrorist attack.

June 16, 2022 | Meeting of the Advisory Board

For the first time, the meeting of the Fraunhofer IVI Advisory Board did not take place as usually at the institute's Dresden site. Instead, it was held at lake Bergheide in the Lusatian Lake District. On a beautiful early summer day, the distinguished guests from the business and political sectors learned about current research topics and visited the floating autartec® house as a symbol for new lifestyles with largely self-sufficient solar-electric and thermal supply.

July 6, 2022 | Design Conference of the Fraunhofer Network »Science, Art and Design«

The Fraunhofer Network »Science, Art and Design« initiated a new conference and exhibition format for the exchange of internal design projects with external design practice and design research, inviting employees of the Fraunhofer-Gesellschaft, partners from the national university landscape, artists as well as other interested parties. The conference also informed about the successful launch of the DesignLab based at Fraunhofer IVI, an initiative of the Fraunhofer Institutes IWU, IWS and IVI as well as Technische Universität Dresden.

July 8, 2022 | »LAURIN« project kick-off

Following the handover of the funding agreement in June, the kick-off event for the »LAURIN« project took place in July as part of the »Modernity Fund – Digitization and Data-Based Innovations for Mobility 4.0 and Services of General Interest in the Lignite Mining Areas« funded by the German Federal Ministry for Digital and Transport (BMDV). Together with representatives of BMDV, the project sponsor VDI/VDE as well as the project partners, the goals for testing of cooperative and automated driving maneuvers as well as the swarm automation of the target platforms were discussed.

September 9, 2022 | Armin Schuster visits Fraunhofer IVI

The Saxon State Minister of the Interior, Armin Schuster, visited Fraunhofer IVI together with the Saxon Chief of Police, Jörg Kubiessa, and other high-ranking guests.

The two-hour meeting was dedicated to an intensive exchange on current security-related topics and the continuous expansion of the cooperation.

September 20, 2022 | ON/OFF Road Safety

When driving a car on rural roads in summer and encountering a combine harvester, it is often necessary to stop and maneuver so that the extra-wide agricultural machine can pass your own vehicle without causing an accident. Such scenarios were the topic of the ON/OFF Road Safety event within the »LANDNETZ« project. Scientists from TU Dresden and Fraunhofer IVI demonstrated a potential accident scenario on site and showed how accidents can be avoided through appropriate communication between agricultural machinery and passenger cars.

September 23, 2022 | Test and pilot track for connected and automated driving opened

After four years of construction, Saxony's Minister of Economic Affairs, Labor and Transport Martin Dulig officially opened the upgraded B 170 highway between the Dresden-Südvorstadt freeway junction and Bannewitz to traffic. This also created a test and pilot route for connected and automated driving. Fraunhofer IVI presented its comprehensive activities of the »C-Roads Germany – Urban Nodes« project for the Europe-wide harmonization of the new C-ITS services in the field of connected driving.

September 28, 2022 | »AuRa« project grant notification handed over

At a handing over celebration at the German Federal Ministry for Digital and Transport (BMDV), Fraunhofer IVI and Droniq GmbH received their »AuRa« project grant notifications from Federal Minister for Digital and Transport, Dr. Volker Wissing.

The project had been kicked off in August and aims at creating foundations for automated risk assessment for scheduled drone flights.

September 29, 2022 | Final event of the Fraunhofer »COGNAC« Lighthouse Project

Over the past four years, Fraunhofer IVI worked together with seven other Fraunhofer institutes in the Fraunhofer »Cognitive Agriculture (COGNAC)« Lighthouse Project. Under the consortium leadership of Fraunhofer IESE, they jointly investigated the challenges and the state of the art in agriculture and developed solution modules in the areas of sensor technology, robotics, automation, digital data space, and cognitive services. The project results were presented to an audience of experts at the final event in Dresden.

October 13-14, 2022 | Interim evaluation of the Fraunhofer »ALBACOPTER®« Lighthouse Project

On the occasion of the interim evaluation of the ALBACOPTER® project, Fraunhofer IVI invited the project partners, members of the Fraunhofer-Gesellschaft headquarters as well as the advisory board with representatives from industry and science to Dresden. The six institutes involved in the project provided information on their progress to date in the subprojects »Experimental Aircraft«, »Autonomous Flying«, »Materials and Structures«, »Energy and Propulsion« and »Digital Twin« and gave an outlook on the further development steps.
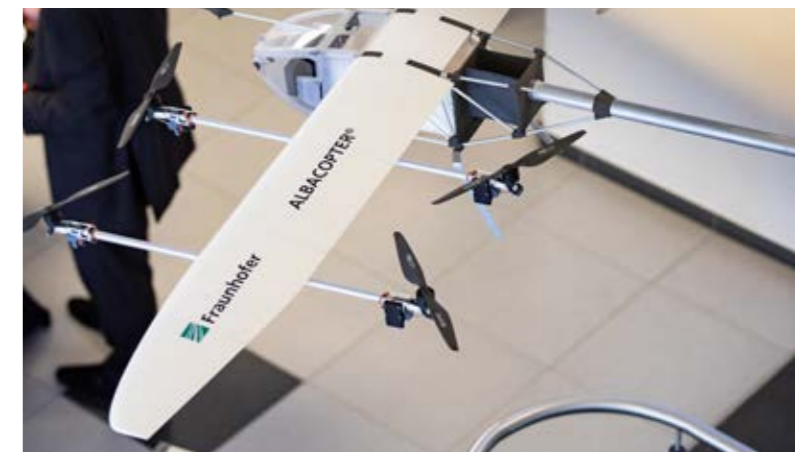
October 17, 2022 | Fraunhofer IVI as national relay within the European Road Safety Charter

The European Road Safety Charter (ERSC) led by the EU Commission is the largest road safety platform in civil society. The annual National Relay Meeting took place in Brussels in October, facilitating the exchange on the newest research results and measures in the field of road safety. The event also included a ceremony during which the »Excellence in Road Safety Awards« for outstanding projects in road safety work were given out.

November 10, 2022 | »Science sofa« of the Fraunhofer-Zukunftsstiftung visits the institute

On World Science Day, the Fraunhofer-Zukunftsstiftung visited Fraunhofer IVI on the occasion of the »Science For Good« crowdfunding competition 2022.

They brought the science sofa – a livestream event format in which researchers were interviewed on the project »YES! – Your e-bike and pedelec safety«, answering questions from the online audience.

November 22, 2022 | Book »Art and Science by Fraunhofer« published

The book, published in November, shows how seemingly contradictory things can be mutually dependent and mutually stimulating. Examples of different artistic genres illustrate this "harmony of opposites" and reinterpret scientific findings for a broad audience. With the publication of this third volume, the German edition of the Fraunhofer book series dedicated to design, architecture and art in a research context has been completed.

November 3, 2022 | Autonomous field robot CERES presented at the »Fokusreise Strukturwandel«

As part of the »Fokusreise Strukturwandel« (focus journey on structural change) by the President of the Fraunhofer-Gesellschaft scientists from the regionally anchored institutes demonstrated pioneering solution approaches that are suitable for providing a contribution towards future viability and innovative strength in regions affected by structural change. One of the projects presented at the Domäne Schickelsheim in the Helmstedter Revier was Fraunhofer IVI's electrically operated and autonomous field robot CERES.

December 13, 2022 | Final event of the Lausitz Research Field

On a beautiful winter day, the final event of the »5G Lab Germany Lausitz Research Field« (5GFoLa) project, funded by the German Federal Ministry for Digital and Transport (BMDV), was held. 5GFoLa focused on the current challenges in the introduction of the new mobile communications generation 5G. The aim of the project, coordinated by TU Dresden, was to establish Lusatia as a cross-state 5G model region for researching and testing corresponding technologies and applications for automated construction, driving and flying.

November 9-10, 2022 | Kick-off meeting of the »SOTERIA« project

Within the »SOTERIA« project, smart solutions for road safety of vulnerable road users and for new forms of mobility will be developed together with scientists, traffic data providers and traffic organizations over the next 3.5 years. Fraunhofer IVI is developing the psychological framework for age-appropriate traffic education programs as well as models for predicting accident risks of individual forms of mobility with different infrastructures.

Trade Fairs

Fraunhofer IVI researchers at Hannover Messe.

May 20 – June 2, 2022 | Hannover Messe
Hannover

In the context of connected and automated driving, many inner-city areas will be safeguarded in the future by sensors installed in the infrastructure. The reliable perception of road users under difficult weather conditions is one of the challenges that can only be met with cooperating and networked sensor systems.

At the joint booth of Bayern Innovativ, Fraunhofer IVI together with partners presented the KonSensData project (Cooperating Sensors for Data). In this project of the Fraunhofer Cluster of Excellence Cognitive Internet Technologies CCIT, a hardware solution consisting of radar and infrared camera in combination with data fusion is currently being developed to detect different classes of road users in a flexible, data-protection-compliant and, above all robust manner and to transmit the data to other road users. The Fraunhofer Application Center »Connected Mobility and Infrastructure« based in Ingolstadt is taking a leading role in the research work. Together with the Technische Hochschule Ingolstadt (THI), the institute contributes to research in the field of mobility in Bavaria.

July 5-6, 2022 | Additive Manufacturing Forum
Berlin

Under the motto »Industrial 3D printing on the rise«, Fraunhofer IVI presented itself at the 6th Additive Manufacturing Forum 2022, the leading conference for additive manufacturing with trade exhibition, in Berlin. The institute presented the AMCOCS project – a platform for digital testing and certification procedures in additive manufacturing.

In order to be allowed to use such a process, providing proof of strength is a necessary prerequisite. Currently, only very time-consuming and cost-intensive quality assurance processes exist for this area, which represent a high hurdle for the wide-spread use of this methodology. AMCOCS aims to accelerate the test and certification process by developing a digital, self-learning testing and certification platform. This will bundle data from the production phases of additive manufacturing, post-processing and material parameter determination. As part of this project, AMCOCS will be piloted with use cases from the aerospace industry. Complex algorithms can be used to derive predictions about the strength of the objects to be printed. In the future, it should be possible to make reliable statements about the strength of the objects to be printed in advance, i.e. before printing. The material parameters determined on this basis will enable the user to carry out a professional design.

September 20-23, 2002 | InnoTrans
Berlin

At the leading international trade fair for transport technology, renowned exhibitors presented their solutions and technologies in the fields of railway technology, railway infrastructure, public transport, interiors and tunnel construction. At the Hübner Group booth, Fraunhofer IVI introduced an innovative steering system for long articulated buses developed in cooperation with Hübner and Mobil Elektronik. The system comprises six steerable axles and complex control software. Through the interaction of both components, buses with multiple axles are able to navigate tight traffic routes precisely and safely.

The exhibition team at InnoTrans 2022.

September 28-29, 2022 | CAR 2 CAR Forum
Dresden

The »CAR 2 CAR Forum«, a two-day international conference organized by the CAR-2-CAR Communication Consortium (C2C-CC), was held on September 28 and 29 in Dresden. The C2C-CC aims being one of the earliest contributors to the vision zero goal and to efficient mobility by using intelligent, connected and cooperative transport systems (C-ITS).

At the event, Fraunhofer IVI representatives introduced their solutions for connected and assisted connected driving. Their main focus was on the digital C-ROADS – Urban Nodes pilot test bed in Dresden. Several services developed within the scope of this project were presented at the forum, including a GLOSA (Green Light Optimal Speed Advisory) service and an EVA (Emergency Vehicle Approaching) service. Another highlight showcased at the conference was the »Smart Intersection« system developed by the Fraunhofer Cluster of Excellence Cognitive Internet Technologies CCIT. The smart intersection uses infrastructure to capture all aspects of complex traffic situations and gives assistance to automated vehicles via networking. This way, cooperative mobility solutions help improve the flow of traffic, and they also make a significant contribution to increasing the safety of all traffic participants.

The exhibition stand at the CAR 2 CAR Forum in Dresden.

October 13-15, 2022 | FLORIAN
Dresden

At the FLORIAN, the trade fair for Fire Brigades, Civil Protection and Disaster Control in Dresden, Fraunhofer IVI once again presented solutions in the field of civil protection and security. The technologies introduced at the fair effectively support complex strategic and operational-tactical decisions in risk prevention.

November 8-10, 2022 | International Cycling Safety Conference
Dresden

Together with the project partner Wildstyle Network, Fraunhofer IVI presented the PAPS-XR (»Public Accident Prevention School with eXtended Reality«) project and the associated VR module at the 10th International Cycling Safety Conference (ICSC) from November 8 to 10. The ICSC is a forum for researchers and experts whose scientific and practical activities are aimed at making cycling safer, and thus to ultimately increase the share of bicycle traffic.

The Fraunhofer IVI exhibition stand at the ICSC 2022.

November 14-15, 2022 | State Prevention Day
Chemnitz

The 6th Saxon State Prevention Day took place in Chemnitz from November 14 to 15, 2022. Nora Strauzenberg and Vanessa Hilse represented Fraunhofer IVI with the interactive accident prevention program FAPS (»Fraunhofer IVI Accident Prevention School«) and its further development PAPS-XR (»Public Accident Prevention School with eXtended Reality«) in cooperation with Wildstyle Network. Using tablets and virtual reality, children and adolescents can adopt a change of perspective between motorized traffic and vulnerable road users.

Presentation of the interactive accident prevention program.

Life at Work and Beyond

Now that COVID-related restrictions have been lifted and social distancing is coming to an end, life has returned to our institute this year. After months, colleagues are meeting in person and no longer just virtually, the hallways and rooms have started to fill up again and various occasions have brought back the institute's sense of community. Even if the pandemic has managed to prove how well we stick together in extreme times, there's nothing like a real-life chat in the coffee kitchen or a round of foosball in the meeting room. We're taking some of the benefits we've gained from these two years – such as digital organization and participation – with us to strengthen the links between the Dresden institute and our two branches, keeping them up to date. The following pages paint a picture of this diverse and multi-layered year 2022 as seen through the eyes of our staff.

Since more and more colleagues want to make use of mobile work options, we at the IT department are facing many new challenges. Receiving a heartfelt thanks on »System Administrator Appreciation Day« really made our day.«

Despite several day care strikes this past year, I managed to juggle caregiving and work – thanks to the well-equipped parent-child office here at the institute.«

With so many of our research activities related to agriculture, we got a lot of fresh air and sun again this year.«

I always enjoy taking part in the annual works outing. Going for a hike together, I get the chance to talk to fellow workers from other departments. That creates a sense of community. It also helps me connect with new colleagues and get to know the area better.«

We all had a great time at the team outing in the city. The game sent us all around Dresden on a scavenger hunt. We learned a lot about the area and each other and are really looking forward to the next time.«

It has become quite a tradition for our »motIVIert« team to participate in the REWE Team Challenge run. We even made it to 15th place this time, which made us really proud.«
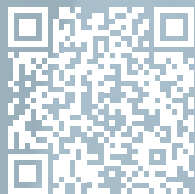
Contact

—

**Fraunhofer Institute for Transportation
and Infrastructure Systems IVI**

Zeunerstrasse 38
01069 Dresden
Phone +49 351 4640-800
Fax +49 351 4640-803

www.ivi.fraunhofer.de/en

Editorial Notes

Academic
Output

———

- Publications
- Teaching Engagements
- Final Theses
- Public Body Membership
- Patents
- Certificates
- Trademarks
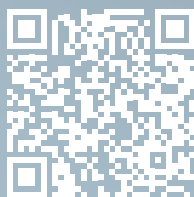
Publications

Agrawal, S.; Song, R.; Kohli, A.; Korb, A.; Andre, M.; Holzinger, E.; Elger, G.: **Concept of Smart Infrastructure for Connected Vehicle Assist and Traffic Flow Optimization.** 8th International Conference on Vehicle Technology and Intelligent Transport Systems VEHITS, online event, April 27-29, 2022, presentation: S. Agrawal
In: Proceedings. Ploeg, J.; Helfert, M.; Berns, K.; Gusikhin, O. (eds.), Sétubal, Portugal, SciTePress, 2022, p. 418-424, ISBN: 978-989-758-573-9, DOI: 10.5220/0011068800003191

Auerswald, R.; Lorenz, S.: **How Data Spaces Will Shape Future Data Ecosystems for Scenario-Based Testing.** ASAM International Conference 2022, hybrid event, Dresden, November 29-30, 2022, presentation: R. Auerswald

Bhogaraju, S. K.; Schmid, M.; Liu, E; Saccon, R.; Elger, G.; Klassen, H.; Müller, K.; Pirzer, G.: **Low Cost Copper Based Sintered Interconnect Material for Optoelectronics Packaging.** 72nd Electronic Components Technology Conference ECTC, San Diego, CA, USA, May 31 - June 3, 2022, presentation: G. Elger
In: Proceedings. Piscataway, NJ, USA, IEEE, p. 1720-1725, ISBN: 978-1-6654-7943-1, DOI: 10.1109/ECTC51906.2022.00270

Burse, B.; Doycheva, K.; Aicher, A.; Walther, C.: **Evaluation of Low-Cost Microcontroller-Based Electronic Systems for Simple Sensor Node Applications.** 2022 European Conference on Computing in Construction EC3, Ixia, Rhodos, Greece, July 24-26, 2022, presentation: B. Burse
In: Proceedings. Tagliabue, L. C.; Chassiakos, A.; Hall, D. M. et al. (eds.), Turin, Italy, University of Turin, 2022, p. 324-331, DOI: 10.35490/EC3.2022.191

Chanove, A.; Pohle, M.; Urban, M.; Mallada, J. L.: **An Extrapolation Method on European Accident Data Based on Weighting and Data Harmonization.** 8th Road Safety and Simulation International Conference RSS, June 8-10, 2022, Athens, Greece, presentation: A. Chanove
In: Proceedings. https://www.nrso.ntua.gr/rss2022/proceedings/, 7 pp.

Delooz, Q.; Willecke, A.; Garlichs, K.; Hagau, A.-C.; Wolf, L.; Vinel, A.; Festag, A.: **Analysis and Evaluation of Information Redundancy Mitigation for V2X Collective Perception.**
In: IEEE Access, vol. 10, 2022, Piscataway, NJ, USA, p. 47076-47093, ISSN: 2169-3536, DOI: 10.1109/ACCESS.2022.3170029

Drees, H.; Pretzsch, S.; Heinke, B.; Wang, D.; Schlueter Langdon, C.: **Data Space Mesh: Interoperability of Mobility Data Spaces.** 14th ITS European Congress, Toulouse, France, May 30 - June 1, 2022, presentation: H. Drees

Festag, A.: Vehicle-2-X: **From Driver Information to Support of Automated Driving Functions.** Cooperative Interacting Vehicles Summer School 2022, Lake Tahoe, CA, USA, July 31 - August 3, 2022

Gay, M.; Grimm, J.; Otto, T.; Partzsch, I.; Gersdorf, D.; Gierisch, F.; Löwe, S.; Schütze, M.: **Nutzung der C2X-basierten ÖV-Priorisierung an signalisierten Knotenpunkten.** Bremen, Fachverlag NW, 2022, Berichte der Bundesanstalt für Straßenwesen BASt, series Verkehrstechnik, V-353, ISBN: 978-3-95606-646-7

Gläser, U.; Morgado J.; Holfeld, D.: **Strategical and Tactical Asset Management for the North Line in Portugal.** Transport Research Arena TRA, Lisbon, Portugal, November 14-17, 2022, poster presentation

Gläser, U.: **Forschung zur Instandhaltungsplanung in IN2SMART2.** Discussion forum of the Predictive Maintenance working group at DZSF (German Centre for Rail Traffic Research): »Systematisierung der Instandhaltungsplanung«, Bonn, July 7, 2022

Hausmann, P.; Meeß, H.; Elger, G.: **Image Segmentation Based Emergency Landing for Autonomous and Automated Unmanned Aerial Vehicles.** 33rd Congress of the International Council of the Aeronautical Sciences ICAS, Stockholm, Sweden, September 4-9, 2022, presentation: H. Meeß
In: Proceedings. International Council of the Aeronautical Sciences ICAS, 11 pp., ISSN: 2958-4647, https://www.icas.org/ICAS_ARCHIVE/ICAS2022/icas2022_materials. html

Hecker, A.; Striller, B.; Boye, F.: **Aspects on Applying and Operating Campus Networks in Agriculture.** International Conference on Agricultural Engineering AgEng – Land.Technik 2022, Berlin, November 22-23, 2022, presentation: A. Hecker
In: Proceedings. VDI Wissensforum GmbH (ed.), Düsseldorf, VDI Verlag, 2022, VDI-Berichte, vol. 2406, p. 411-418, ISBN: 978-3-18-092406-9

Hermann, J.; Schmid, M.; Elger, G.: **Crack Growth Prediction in High-Power LEDs from TTA, SAM and Simulated Data.** 28th International Workshop on Thermal Investigations of ICs and Systems THERMINIC, Dublin, Ireland, September 28-30, 2022, presentation: J. Hermann
In: Proceedings. Piscataway, NJ, USA, IEEE, 6 pp., ISBN: 978-1-6654-9229-4, DOI: 10.1109/THERMINIC57263.2022.9950673

Schmid, M.; Hermann, J.; Liu, E.; Elger, G.: **Correlation of Scanning Acoustic Microscopy and Transient Thermal Analysis to Identify Crack Growth in Solder Joints.** 21st IEEE Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems iTherm, May 31 - June 3, 2022, San Diego, CA, USA, presentation: J. Hermann
In: Proceedings. Piscataway, NJ, USA, IEEE, 6 S., ISBN: 978-1-6654-8503-6, DOI: 10.1109/iTherm54085.2022.9899664

Keppler, F.; Kramer, M.; Koch, O.; Wagner, S.; Janschek, K.: **Prioritized Planning for Spatiotemporal Trajectory Coordination of Articulated Vehicles and Co-Simulation with ROS, Docker and Gazebo.** International Symposium on System Integration SII 2022, online event, January 9-12, 2022, presentation: F. Keppler
In: Proceedings. Piscataway, NJ, USA, IEEE, p. 279-284, ISBN: 978-1-6654-4540-5, DOI: 10.1109/SII52469.2022.9708754

Keppler, F.; Dunkelberg, N.; Wagner, S.; Janschek, K.: **Efficient Multi-Robot Path Planning for Autonomous Weed Control on Complex Field Configurations.** International Conference on Agricultural Engineering Land.Technik 2022, online event, February 25, 2022, presentation: N. Dunkelberg
In: Proceedings. Düsseldorf, VDI-Verlag, 2022, VDI-Berichte, vol. 2395, p. 79-86, ISBN: 978-3-18092395-6, DOI: 10.51202/9783181023952-79

Keppler, F.; Schönnagel, A.; Wagner, S.; Janschek, K.: **Genetic Algorithm-Based Kinodynamic Velocity Planning for Prioritized Multi-Robot Coordination.** Joint 12th International Conference on Soft Computing and Intelligent Systems SCIS and 23rd International Symposium on Advanced Intelligent Systems ISIS 2022, Ise-Shima, Mie, Japan, November 29 - December 2, 2022, presentation: F. Keppler
In: Proceedings. Piscataway, NJ, USA, IEEE, 6 pp., ISBN: 978-1-6654-9924-8, DOI: 10.1109/SCISISIS55246.2022.10002059

Klöppel-Gersdorf, M.; Otto, T.: **A Framework for Robust Remote Driving Strategy Selection.** 8th International Conference on Vehicle Technology and Intelligent Transport Systems VEHITS, online event, April 27-29, 2022, presentation: M. Klöppel-Gersdorf
In: Proceedings. Ploeg, J.; Helfert, M.; Berns, K.; Gusikhin, O. (eds.), Sétubal, SciTePress, 2022, p. 418-424, ISBN: 978-989-758-573-9, DOI: 10.5220/0011088900003191

Kramer, M.; Keppler, F.; Janschek, K.: **Verteilte Simulationsumgebung zur Erprobung koordinierter Fahrmanöver automatisierter Fahrzeuge.** VDI Mechatronik 2022, Darmstadt, March 22-24, 2022, presentation: M. Kramer
In: Proceedings. Bertram, T.; Corves, B. Janschek, K.; Rinderknecht, S. (eds.), TU Darmstadt, 2022, p. 25-30, Proceedings DOI: 10.26083/tuprints-00020963

Kreißig, I.; Springer, S.; Willner, R.; Keil, W.: **A Cyclist Warning System to Enhance Traffic Safety – Development, Implementation and Evaluation in a Bicycle Simulator.** 10th Annual International Cycling Safety Conference ICSC, Dresden, November 8-10, 2022, poster presentation
In: Proceedings. Petzoldt, T.; Gerike, R.; Anke, J. et al. (eds.), TU Dresden, p. 156-158, Proceedings DOI: 10.25368/2022.368 (extended abstract)

Lehmann, T.; Weiß, F.: **Aging Diagnostics of Lithium-Ion Batteries Using Artificial Intelligence and Real Vehicle Data.** 14. Internationale Konferenz für elektrische Fahrzeugantriebe und E-Mobilität E-MOTIVE, Wolfsburg, September 21-22, 2022, presentation: T. Lehmann
In: Proceedings. Frankfurt am Main, Forschungsvereinigung Antriebstechnik e. V., 2022, p. 195-203

Liers, H.; Ziegler, J.; Chanove, A.; Pohle, M.: **Objective Assessment of Database Quality for Use in the Automotive Research and Development Process.** Berlin, Forschungsvereinigung Automobiltechnik e.V., 2021, FAT-Schriftenreihe, vol. 343, ISSN: 2192-7863

Liu, E.; Bhogaraju, S. K.; Elger, G.: **Investigation of Stress Relaxation in SAC305 with Micro-Raman Spectroscopy.**
In: Microelectronics Reliability, 2022, vol. 138, Amsterdam, Elsevier, article no. 114664, ISSN: 1872-941X, DOI: 10.1016/j.microrel.2022.114664

Liu, E.; Bhogaraju, S. K.; Lux, K.; Elger, G.: **Investigation of Stress Generated by Interconnection Processes with Micro-Raman Spectroscopy (µRS).** 72nd Electronic Components Technology Conference ECTC, San Diego, CA, USA, May 31 - June 3, 2022, presentation: G. Elger
In: Proceedings. Piscataway, NJ, USA, IEEE, p. 739-745, ISBN: 978-1-6654-7943-1, DOI: 10.1109/ECTC51906.2022.00123

Lobo, S.; Festag, A.; Facchi, C.: **Enhancing the Safety of Vulnerable Road Users: Messaging Protocols for V2X Communication.** 96th Vehicular Technology Conference VTC2022-Fall, hybrid event, London, England / Beijing, China, September 26-29, 2022, presentation: S. Lobo
In: Proceedings. Piscataway, NJ, USA, IEEE, 7 pp., ISBN: 978-1-6654-5468-1, DOI: 10.1109/VTC2022-Fall57202.2022.10012775

Meeß, H.: **Stand der Arbeiten zum autonomen Fliegen.** Lange Nacht der Wissenschaften, Nuremberg, May 21, 2022

Meeß, H.: **Normierungs- und Zulassungsanforderungen für das KI-basierte hochautomatisierte Fliegen.** Roundtable Digitale Luftfahrt »Urban Air Mobility – von Gedankenspielen zur Umsetzung?«, hybrid event, Munich, September 20, 2022

Meeß, H.: **Normierungs- und Zulassungsanforderungen für das KI-basierte hochautomatisierte Fliegen.** KIANDI-Seminar, hybrid event, Bonn, November 8, 2022

Meeß, H.; Gerner, J.; Hein, D.; Schmidtner, S.; Elger, G.: **Real World Traffic Optimization by Reinforcement Learning: A Concept.** 6th International Workshop on Agent-Based Modelling of Urban Systems ABMUS 2022, online event, May 10, 2022, presentation: H. Meeß
In: Proceedings. Kieu, M. L.; van Dam, K. H.; Thompson, J. et al. (eds.), Figshare, 2022, p. 49-54, http://modelling-urban-systems.com/abmus2022/

Meeß, H.; Gerner, J.; Hein, D.; Schmidtner, S.; Elger, G.: **Reinforcement Learning for Traffic Signal Control Optimization: A Concept for Real-World Implementation.** 21st International Conference on Autonomous Agents and Multiagent Systems AAMAS 2022, online event, May 9-13, 2022, presentation: H. Meeß
In: Proceedings. Faliszewski, P.; Mascardi, V.; Pelachaud, C.; Taylor, M. E. (eds.), Richland, SC, USA, International Foundation for Autonomous Agents and Multiagent Systems IFAAMAS, 2022, p. 1699-1701, ISBN: 978-1-4503-9213-6 (extended abstract)

Mohan, N.; Langer, S.; Elger, G.: **Fluxfree Solder Paste and Process for Standard SMD Components.** 9th Electronics System-Integration Technology Conference ESTC, Sibiu, Romania, September 13-16, 2022, presentation: N. Mohan
In: Proceedings. Piscataway, NJ, USA, IEEE, p. 163-168, ISBN: 978-1-6654-8947-8, DOI: 10.1109/ESTC55720.2022.9939528

Mohan, N.; Saccon, R.; Bhogaraju, S. K.; Elger,G.: **Cu Particle Free Inks for Printed Electronics Application – Challenges and Solutions.** 9. GMM-Fachtagung Mikro-Nano-Integration MNI, November 21-22, 2022, Aachen, presentation: N. Mohan
In Proceedings. VDE/VDI-Gesellschaft Mikroelektronik, Mikrosystem- und Feinwerktechnik (ed.), Berlin, VDE-Verlag, GMM-Fachberichte, vol. 105, p. 21-25, ISBN: 978-3-8007-5991-0

Otto, T.: **Smarte Infrastruktur für automatisiert-assistiertes Fahren.** TAVF Up and Running, Hamburg, April 29, 2022

Otto, T.: **Kooperative intelligente Verkehrssysteme – C-ITS: Wie funktioniert zukünftig die Beschleunigung von Verkehrsteilnehmenden.** 12th OCA-Akademie »ÖPNV-Beschleunigung«, Berlin, November 10, 2022

Otto, T.; Klöppel-Gersdorf, M.; Partzsch, I.: **A Framework for Urban C-ITS GLOSA Evaluation.** 6th Conference on Sustainable Urban Mobility CSUM 2022, hybrid event, Skiathos, Greece, August 31 - September 2, 2022, presentation: T. Otto
In: Proceedings. Nathanail, E. G.; Gavanas, G. (eds.), Cham, Springer, 2023, Lecture Notes in Intelligent Transportation and Infrastructure, p. 382-392, ISBN: 978-3-031-23721-8, DOI: 10.1007/978-3-031-23721-8_33

Otto, T.; Holfeld, J.: **Teleoperiertes Fahren und Remote Control via 5G – Vision oder nahe Realität?** 17th VIMOS Symposium, Dresden, November 30 - December 1, 2022, presentation: T. Otto

Pandey, A.; Bhogaraju, S. K.; Lux, K.; Elger, G.: **Analysis of Stress in Spherically Bent Thinned Image Sensors.** 23rd International Conference on Thermal, Mechanical and Multi-Physics Simulation and Experiments in Microelectronics and Microsystems EuroSimE, April 25-27, 2022, St. Julian, Malta, presentation: A. Pandey
In: Proceedings. Piscataway, NJ, USA, IEEE, 5 pp., ISBN: 978-1-6654-5836-8, DOI: 10.1109/EuroSimE54907.2022.9758847

Partzsch, I.; Otto, T.; Kaufmann, F.: **MIND - Multimodal, intelligent, nachhaltig, digital – Die Beschleunigung des ÖV in Frankfurt von morgen.** 2nd Saxon Public Transport Symposium »Sustainable, atuomated, connected«, (2. Sächsisches ÖV-Symposium »Nachhaltig, automatisiert, vernetzt«), Leipzig, June 21-22, 2022, presentation: I. Partzsch

Pretzsch, S.; Drees, H.; Rittershaus, L.: **Chapter 21: Mobility Data Space.**
In: Designing Data Spaces. The Ecosystem Approach to Competitive Advantage. Otto, B.; ten Hompel, M.; Wrobel, S. (eds.), Cham, Springer, 2022, p. 343-361, ISBN: 978-3-030-93975-5, DOI: 10.1007/978-3-030-93975-5_21

Saccon, R.; Bhogaraju, S. K.; Elger, G.: **Cu Sintering for High Power Electronics Packaging – Challenges and Solutions.** 9th GMM Symposium Micro-Nano Integration (9. GMM-Fachtagung Mikro-Nano-Integration) MNI, November 21-22, 2022, Aachen, presentation: R. Saccon
In: Proceedings. VDE/VDI-Gesellschaft Mikroelektronik, Mikrosystem- und Feinwerktechnik (eds.), Berlin, VDE-Verlag, GMM-Fachberichte, 105, p. 26-31, ISBN: 978-3-8007-5991-0

Schmid, M.; Elger, G.: **TTA als Zuverlässigkeitsprüfung von SAC+ Loten.**
In: Productronic, issue 3, 2022, Heidelberg, Hüthig, p. 22-24, ISSN: 0930-1100, online: https://www.all-electronics.de/elektronik-fertigung/tta-als-zuverlaessigkeitspruefung-von-sac-loten-616.html

Schmid, M.; Hermann, J.; Bhogaraju K.; Elger, G.: **Reliability of SAC Solders Under Low and High Stress Conditions.** 9th Electronics System-Integration Technology Conference ESTC, Sibiu, Romania, September 13-16, 2022, presentation: G. Elger
In: Proceedings. Piscataway, NJ, USA, IEEE, p. 553-559, ISBN: 978-1-6654-8947-8, DOI: 10.1109/ESTC55720.2022.9939394

Schmid, M.; Zippelius, A.; Hanß, A.; Böckhorst, S.; Elger, G.: **Investigations on High-Power LEDs and Solder Interconnects in Automotive Applications: Part I – Initial Characterization.**
In: IEEE Transactions on Device and Materials Reliability, vol. 22, 2022, issue 2, Piscataway, NJ, USA, IEEE, p. 175-186, ISSN: 1558-2574, DOI: 10.1109/TDMR.2022.3152590

Schulze, E.-E.: **autartec®-Haus: Ausstellungspitch.** »Focus on Design in Fraunhofer Research« Expert Conference (Fachkonferenz »Design im Fokus Fraunhofer-Forschung«), Berlin, July 6, 2022

Schwan, H.; Pforr, J.; Elger, G.: **ZVS Class E2 Wireless Power Transfer System with Self-Resonant Transmission Coils for the Biomedical Application.** PCIM Europe, Nuremberg, May 10-12, 2022, presentation: H. Schwan
In: Proceedings. Stuttgart, Mesago Messe Frankfurt GmbH, 10 pp., ISBN: 978-3-8007-5822-7, DOI:10.30420/565822107

Schwan, H.; Schmid, M.; Elger, G.: **Laser Stimulated Transient Thermal Analysis of Semiconductors.** 28th International Workshop on Thermal Investigations of ICs and Systems THERMINIC, Dublin, Ireland, September 28-30, 2022, presentation: H. Schwan
In: Proceedings. Piscataway, NJ, USA, IEEE, 6 pp., ISBN: 978-1-6654-9229-4, DOI: 10.1109/THERMINIC57263.2022.9950672

Söffker, C.; Stephan, A.; Hüttig, F.; Klausner, S.; Weyers, C.; Berendes, E.: **GUW+: A Smart Grid for Public Transport in Urban Environments.** International Symposium on Power Electronics, Electrical Drives, Automation and Motion SPEEDAM, June 22-24, 2022, Sorrento, Italy, presentation: C. Söffker
In: Proceedings. Piscataway, NJ, USA, IEEE, p. 200-204, ISBN: 978-1-6654-8459-6, DOI: 10.1109/SPEEDAM53979.2022.9842260

Song, R.; Hegde, A.; Senel, N.; Knoll, A.; Festag, A.: **Edge-Aided Sensor Data Sharing in Vehicular Communication Networks.** 95th IEEE Vehicular Technology Conference VTC-Spring, Helsinki, Finland, June 19-22, 2022, presentation: R. Song
In: Proceedings. Piscataway, NJ, USA, IEEE, 7 pp., ISBN: 978-1-6654-8243-1, DOI: 10.1109/VTC2022-Spring54318.2022.9860849

Song, R.; Zhou, L.; Lakshminarasimhan, V.; Festag, A; Knoll, A.: **Federated Learning Framework Coping with Hierarchical Heterogeneity in Cooperative ITS.** 25th IEEE International Conference on Intelligent Transportation Systems ITSC, Macau, China, October 8-12, 2022, presentation: R. Song
In: Proceedings. Piscataway, NJ, USA, IEEE, p. 3502-3508, ISBN: 978-1-6654-6880-0, DOI: 10.1109/ITSC55140.2022.9922064

Streck, E.; Herschel, R.; Wallrath, P.; Sunderam, M.; Elger, G.: **Comparison of Two Different Radar Concepts for Pedestrian Protection on Bus Stops.** 11th International Conference on Sensor Networks SENSORNETS, online event, February 7-8, 2022, presentation: E. Streck
In: Proceedings. Prasad, R. V.; Pesch, D.; Ansari, N.; Benavente-Peces, C. (eds.), Sétubal, SciTePress, 2022, p. 89-96, ISBN: 978-989-758-551-7, DOI: 10.5220/0010777100003118

Tavakolibasti, M.; Meszmer, P.; Kettelgerdes, M.; Böttger, G.; Elger, G.; Erdoğan, H.; Seshaditya, A.; Wunderle, B.: **Structural-Thermal-Optical-Performance (STOP) Analysis of a Lens Stack for Realization of a Digital Twin of an automotive LiDAR.** 23rd International Conference on Thermal, Mechanical and Multi-Physics Simulation and Experiments in Microelectronics and Microsystems EuroSimE, April 25-27, 2022, St. Julian, Malta, presentation: M. Tavakolibasti
In: Proceedings. Piscataway, NJ, USA, IEEE, 7 pp., ISBN: 978-1-6654-5836-8, DOI: 10.1109/EuroSimE54907.2022.9758897

Ufert, M.; Jehle, C.: **Bewertungsmethodik zur Identifizierung kritischer Batteriebelastungen als Bestandteil einer skalierbaren Batteriediagnose-Plattform.** Rail.S/VDE Symposium 2022 »Electric Vehicle Drive Systems and Equipment« (»Elektrische Fahrzeugantriebe und -ausrüstungen«), Dresden, December 1-2, 2022, joint presentation

Zippelius, A.; Hanß, A.; Schmid, M.; Perez-Velazquez, J.; Elger, G.: **Reliability Analysis and Condition Monitoring of SAC+ Solder Joints under High Thermomechanical Stress Conditions Using Neuronal Networks.**
In: Microelectronics Reliability, 2022, vol. 129, Amsterdam, Elsevier, 10 pp., ISSN: 1872-941X, DOI: 10.1016/j.microrel.2021.114461

Zippelius, A.; Strobl, T.; Schmid, M.; Hermann, J.; Hoffmann, A.; Elger, G.: **Predicting Thermal Resistance of Solder Joints Based on Scanning Acoustic Microscopy Using Artificial Neural Networks.** 9th Electronics System-Integration Technology Conference ESTC, Sibiu, Romania, September 13-16, 2022, presentation: A. Zippelius
In: Proceedings. Piscataway, NJ, USA, IEEE, p. 566-575, ISBN: 978-1-6654-8947-8, DOI: 10.1109/ESTC55720.2022.9939465

Teaching Engagements

Bartholomäus, Ralf
Optimale Steuerung kontinuierlicher Prozesse. TU Dresden, Faculty of Electrical and Computer Engineering, Institute of Control Theory, SS 2022

Vernetzte Energiespeicher. TU Freiberg, Faculty of Mechanical, Process and Energy Engineering, Institute of Electrical Engineering, SS 2022

Elger, Gordon
Elektronische Bauelemente. TH Ingolstadt, Faculty of Electrical Engineering and Information Technology, WS 2021/22, WS 2022/23

Computer Aided Engineering. TH Ingolstadt, Faculty of Electrical Engineering and Information Technology, WS 2021/22, SS 2022, WS 2022/23

CAE für die Elektrotechnik. TH Ingolstadt, Faculty of Electrical Engineering and Information Technology, WS 2021/22, SS 2022, WS 2022/23

Electronics, Measurement and Systems. TH Ingolstadt, Faculty of Electrical Engineering and Information Technology, SS 2022

Festag, Andreas
Kommunikationssysteme. TH Ingolstadt, Faculty of Electrical Engineering and Information Technology, SS 2022

Projektmanagement. TH Ingolstadt, Faculty of Electrical Engineering and Information Technology, WS 2021/22, WS 2022/23

Car2X-Kommunikation. TH Ingolstadt, Faculty of Electrical Engineering and Information Technology, WS 2021/22, WS 2022/23

Einführung in die Car2X-Kommunikation. TH Ingolstadt, Faculty of Electrical Engineering and Information Technology, WS 2021/22, WS 2022/23

Software-Entwicklung für sicherheitskritische Systeme. TH Ingolstadt, Faculty of Electrical Engineering and Information Technology, WS 2021/22, WS 2022/23

Group project (Master Program Automatisiertes Fahren, International Automotive Engineering). TH Ingolstadt, Faculty of Electrical Engineering and Information Technology, WS 2021/22, SS 2022, WS 2022/23

V2X Services (Master of Applied Research). TH Ingolstadt, Faculty of Electrical Engineering and Information Technology, WS 2021/22, WS 2022/23

Kefferpütz, Klaus
Sensordaten- und Informationsfusion. TH Ingolstadt, Faculty of Electrical Engineering and Information Technology, WS 2022/23

Regelungstechnik 1. Hochschule Augsburg, Faculty of Mechanical and Process Engineering, WS 2022/23

Regelungstechnik 2. Hochschule Augsburg, Faculty of Mechanical and Process Engineering, WS 2022/23

Kertzscher, Jana
Einführung in die Elektrotechnik. TU Freiberg, Faculty of Mechanical, Process and Energy Engineering, Institute of Electrical Engineering, WS 2021/22

Elektrische Maschinen. TU Freiberg, Faculty of Mechanical, Process and Energy Engineering, Institute of Electrical Engineering, WS 2021/22

Einführung in die Elektromobilität. TU Freiberg, Faculty of Mechanical, Process and Energy Engineering, Institute of Electrical Engineering, WS 2021/22

Theorie elektrischer Maschinen. TU Freiberg, Faculty of Mechanical, Process and Energy Engineering, Institute of Electrical Engineering, WS 2021/22

Klingner, Matthias
Elektroenergiesysteme. TU Freiberg, Faculty of Mechanical, Process and Energy Engineering, Institute of Electrical Engineering, SS 2022

Knote, Thoralf
Straßenverkehrstechnik. TU Dresden, »Friedrich List« Faculty of Transport and Traffic Sciences, Institute of Transport Planning and Road Traffic, WS 2021/22

Fahrzeugsicherheit automatisierter Fahrzeuge. TU Dresden, »Friedrich List« Faculty of Transport and Traffic Sciences, Institute of Transport Planning and Road Traffic, SS 2022

Rauschert, André
Ideen-, Innovations- und Change Management. Gründungsmanagement. HS Mittweida (FH), Faculty Industrial Engineering/Media Faculty, WS 2021/22, SS 2022, WS 2022/23

Final Theses

Doctoral Candidates

Franke, Kerstin
Leiterplatten unter 1000 V Spannung: Einfluss des Lötstopplacks auf das unter Feuchte und hohen elektrischen Spannungen auftretende anodische Migrationsphänomen in der Leiterplatte. Universität Rostock and TU Dresden

Schmid, Maximilian
Weiterentwicklung der transienten thermischen Analysen für Leistungs-Halbleiter. TU Berlin

Theurich, Franziska
On a Vehicle Routing Problem with Customer Costs and Multi Depots. TU Dresden

Diploma Students

Blaschke, Edgar
Entwicklung eines generalisierten Lenkmoduls für hochautomatisierte Feldroboter. HTW Dresden

Heimhuber, Paul
Parametrierung und Evaluierung von Alterungsmodellen für NMC- und NCA-basierte Lithium-Ionen-Batterien. TU Dresden

Horn, Sten
Entwicklung eines Simulationsmodells zur dezentralen, regenerativen Energieversorgung vollelektrischer landwirtschaftlicher Fuhrparke. TU Dresden

Roedel, Levin
Stressfaktorbasiertes Alterungsmodell für Brennstoffzellen. TU Dresden

Schäfer, Johannes
Robustness analysis and further development of algorithms for cooperative disturbance handling of automated vehicles. TU Dresden

Schreiber, Tom Niclas
Entwicklung und Erprobung eines hochautomatisierten Industriemähers. HTW Dresden

Schwetzler, Paula
Erstellung eines Modells zur Abschätzung von durchschnittlich täglichen Verkehrsstärken (DTV) im Innerortsbereich anhand Infrastrukturdaten und Umfeldnutzung. TU Dresden

Trimeche, Amina
Echtzeitvisualisierung von Fahrzeugbewegungen überlanger Busse für einen Lenkungsprüfstand. HTW Dresden

Master Students

Cardona Torres, Camilo
Assessing cyclist safety using infrastructure parameters from OpenStreetMap: The case of Leipzig, Marseille and Edinburgh. TU Dresden and University of Twente

Gangadhari, Praveen Kumar
Implementation of Multi-Material Thermo-Mechanical Surrogate Models by Using Physics-Informed Neural Networks. TH Ingolstadt

Gross, Markus
Self-Supervised Deep Learning für visuelle Odometrie und monokulare Tiefenschätzung in absolutem Maßstab. Hochschule für Angewandte Wissenschaften München

Kühn, Stephan
Applicability of Optical Health Indicators for Condition Monitoring of Object Recognition Cameras in Automotive Applications. TH Ingolstadt

Kunzmann, Susanna
Konzeption und Evaluation einer Plattform zur Dokumentation erworbener Medienkompetenz in der Sekundarstufe. Internationale Hochschule Fernstudium

Lalkaka, Brandon
Integration eines Bearbeitungsgerätes in den Feldroboter CERES. Leibniz Universität Hannover

Lokeshwara, Shankar
Deep Learning Approaches for Defect Detection During Printed Circuit Board Inspection. FH Dortmund University of Applied Sciences and Arts

Mariyaklla, Chethan Lokesh
Simulation-based Performance Evaluation of Collective Perception Service with Cellular-V2X. TH Ingolstadt

Momberg, Marcel
Konzeptionierung und Aufbau eines In-Situ-Messstands für die Zuverlässigkeitsuntersuchung von Lötstellen. TH Ingolstadt

Mumtahana Mou, Rokeya
Packaging Induced Stress Investigation Using Micro-Raman Spectroscopy. Ruhr-Universität Bochum

Reuße, Richard
Prototypische Umsetzung einer Simulationssoftware zur Unterstützung bei der Planung von Fahrzeugstandorten und deren Validierung bei Feuerwehren im ländlichen Raum. HTW Dresden

Sfar, Mohamed
Experimentelle und simulative Untersuchung der Detektierbarkeit von Rissbildung mit der Time Domain Reflectometry-Methode in Mikrostripline-basierten HF-Anwendungen. TH Ingolstadt

Sözmen, Esra
Development of a Database Structure for Recording Aviation Incident and Accident Data. TU Dresden

Subbiah, Subash
Sensor Fusion of Infrared Camera and Radar Sensor for Object Detection and Tracking. TH Ingolstadt

Bachelor Students

Ciesielski, Kai
Möglichkeiten und Grenzen für die automatisierte Qualitätssicherung und Bereitstellung von Software am Beispiel einer iOS-Anwendung. Staatliche Studienakademie Dresden

Hermann, Joseph
Korrelation der mittels Akustikmikroskopie und Transienten Thermischen Analyse detektierten Rissbildung in Lötverbindungen mit Finite Element Simulation. TH Ingolstadt

Peuker, Jasper
Wirtschaftlichkeitsanalyse elektrischer Batteriegroßspeicher zur Teilnahme am Regelenergiemarkt und an den Arbitrargeschäften. TU Bergakademie Freiberg

Stadler, Andreas Franz
Konzeption, sicherheitstechnische Auslegung und simulative Absicherung der benötigten Heizleistung einer containerisierten PtG-Anlage. TH Ingolstadt

Straßer, Lucas
Optische Inspektion mittels kollaborierendem Roboter und Maschinellem Lernen. TH Ingolstadt

Wittmann, Michael
Development and Evaluation of a Time-To-Collision Based Collision Warning Application With ROS. TH Ingolstadt

Public Body Membership and Patents

Public Body Membership

Brausewetter, Patrick
– JUG Saxony e. V.

Danowski, Kamen
– Section »Civil Protection, Euroregion Elbe/Labe«

Elger, Gordon
– International Microelectronics and Packaging Society (IMAPS)

Erbsmehl, Christian T.
– EVU European Association for Accident Research and Analysis e. V.
– SafeTRANS e. V.

Festag, Andreas
– 5G Automotive Association e. V.
– ETSI European Telecommunications Standards Institute

Fichtl, Holger
– Agronym e. V.

Gründel, Torsten
– ASAM Association for Standardization of Automation and Measuring Systems e.V.
– Fraunhofer Traffic and Transportation Alliance
– Kontiki Working Group in Contactless Smart Card Systems for Electronic Ticketing e. V.
– UITP International Association of Public Transport

Hedel, Ralf
– Spokesperson of ECTRI Thematic Group »Security and Risk Analysis«

Kertzscher, Jana
– VDE Verband der Elektrotechnik Elektronik Informationstechnik e. V.

Klingner, Matthias
– Dresden-concept e. V.
– »Dresden – Stadt der Wissenschaften« Network
– Exzellenzstiftung Ingolstädter Wissenschaft – Ignaz Kögler
– Fraunhofer-Alumni e. V.
– Fraunhofer ICT Group
– Fraunhofer Network »Science, Art and Design«
– HYPOS – Hydrogen Power Storage & Solutions East Germany e.V.
– Steering committee of the Fraunhofer Traffic and Transportation Alliance

Otto, Thomas
– Road and Transportation Research Association (FGSV), Working Group 3.3.1 »Recommendation for the technology change to C-ITS at traffic lights« (Head of the Working group)
– Road and Transportation Research Association (FGSV), Working Group 3.2.1 »Sensor fusion and artificial intelligence for situation/event detection and prognosis«
– ECTRI Thematic Group »Mobility«
– ECTRI Thematic Group »Traffic Management & Modelling«

Pohle, Maria
– IRTAD International Road Traffic Accident Database

Rauschert, André
– Fraunhofer Big Data and Artificial Intelligence Alliance
– futureSAX Saxon transfer network
– VDMA Software and Digitalization, Expert Group »Machine Learning«

Ufert, Martin
– Fraunhofer Battery Alliance
– Fraunhofer Energy Alliance
– HZwo e. V.

Patents

Breitlauch, P.; Erbsmehl, C. T.: **Verfahren zum Modellieren einer Kollision zweier Objekte.** European patent application: EP 4 009 216, published 2022

Jehle, C.; Klausner, S.: **Vorrichtung zur Energieversorgung eines elektrischen Betriebsnetzes.** German patent application: DE10 2017 105 728 A1, published 2018, PCT application: WO2018/167286 A2, published 2018

Klausner, S.; Gamsizlar, Ö.: **Elektrische Kontaktanordnung.** German patent: DE 10 2009 023 072 B4, 2012

Klausner, S.; Kuitunen, S.: **Elektrisch beheizbarer Latentwärmespeicher mit kurzen Beladezeiten.** German patent application: DE 10 2016 004 248.6, published 2017, PCT application: WO 2017/174803 A9, published 2017

Klausner, S.; Vorwerk, T.; Seiler, C.: **Elektrische Kontakteinheit.** German patent: DE 10 2021 201 472 B4, 2022, PCT application: WO 2022/1752S6 A1, published 2022

Klausner, S.; Vorwerk, T.; Seiler, C.: **Unterflur-Kontaktsystem.** European patent application: EP 3 600 950 B1, 2022, US patent: US 11,502,456 B2, 2022, Japanese patent: JP 7252900 B2, 2023, European divisional application: EP 4 098 476 A1, 2022, US divisional application: US 2023/0008114 A1, 2023

Klingner, M.: **Leistungssteuereinrichtung und Verfahren zum Lastausgleich eines Netzes.** German patent application: DE 10 2011 114 344, 2011

Wagner, S.; Zipser, S.: **Verfahren zur automatischen oder teilautomatischen spurtreuen Mehrachslenkung eines Straßenfahrzeugs und Vorrichtung zur Durchführung des Verfahrens.** German patent: DE 10 2006 037 588 B4, 2011

Certificates

DIN EN ISO 9001:2015,
Sector »Development of vehicle and propulsion technology and transportation research and development«, Certificate registration no.: 44 100 190788

Trademarks (Word)

AutoTram®
DE 304 17 949.3, 2004

autartec®
DE 30 2012 021 316, 2012

Feldschwarm®
DE 30 2013 013 880, 2013

HORUS®
DE 30 2013 006 673.1, 2014

TruckTrix®
DE 30 2014 003 169.8, 2014

autarsia®
DE 30 2020 104 936, 2020

MobiKat®
DE 30 2020 112 519, 2021

ALBACOPTER®
DE 30 2021 105 494, 2021

helyOS®
DE 30 2021 107 776, 2021

Trademarks (Word / Figurative)

PKM®
DE 30 2019 108 863, 2019

PKM Produkteditor®
DE 30 2019 108 856, 2019

PKM® (EU, GB, CH)
DE 1593681, 2020

PKM Produkteditor® (EU, GB, CH)
DE 1 593 681, 2020