



**Fraunhofer**

IIS

FRAUNHOFER INSTITUTE FOR INTEGRATED CIRCUITS IIS



**HIGHLIGHTS**  
**2013**  
ANNUAL REPORT

## PROFILE

### FRAUNHOFER INSTITUTE FOR INTEGRATED CIRCUITS IIS

The Fraunhofer-Gesellschaft is the leading organization for applied research in Europe. Its research activities are conducted by 67 institutes and research units at locations throughout Germany. The Fraunhofer-Gesellschaft employs a staff of more than 23,000, who work with an annual research budget totaling 2 billion euros.

Founded in 1985, Fraunhofer Institute for Integrated Circuits IIS in Erlangen, Germany, ranks first among the Fraunhofer Institutes concerning headcount and revenues. With the creation of mp3 and the co-development of AAC, Fraunhofer IIS has reached worldwide recognition.

In close cooperation with partners and clients the Institute provides research and development services in the following areas: Audio & Multimedia, Imaging Systems, Energy Management, IC Design and Design Automation, Communication Systems, Positioning, Medical Technology, Sensor Systems, Safety and Security Technology, Supply Chain Management and Non-destructive Testing.

About 780 employees conduct contract research for industry, the service sector and public authorities. Fraunhofer IIS with its headquarters in Erlangen, Germany, has further branches in Nuremberg, Fuerth, Wuerzburg, Ilmenau, Dresden, Bamberg, Deggendorf and Coburg. The budget of 102 million euros is mainly financed by projects. Less than 25 percent of the budget is subsidized by federal and state funds.

For further information, please visit: [www.iis.fraunhofer.de/en](http://www.iis.fraunhofer.de/en)

**COVER** *X-ray image of a car with XXL computed tomography, see highlight topic page 32 et seqq.*

**HIGHLIGHTS**  
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ANNUAL REPORT



**"WE DO THE RIGHT THINGS.  
WE DO THINGS RIGHT."**

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*Excerpt from the Fraunhofer IIS guiding principles*

# WE INVEST ON YOUR BEHALF

Ladies and gentlemen,

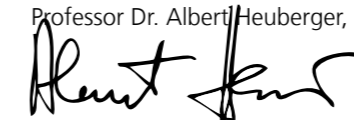
“We do the right things” and “We do things right” are two central mission statements we adopted as part of our 2013 guiding principles. In other words, we always aim to find the best solutions for you, our customers, and we take as our benchmark satisfied customers who are convinced by our solutions.

Besides a creative and entrepreneurially minded employee base, another prerequisite for obtaining sustainable and technologically ambitious results is to have an excellent infrastructure. Our successful business strategy has allowed us to make substantial investments during the past year that will enable us to continue to live up to our promise of “doing the right things” and “doing them right”. In the spring we opened our L.I.N.K. Test and Demonstration Center at our Nordostpark location in Nuremberg. By bringing together positioning, identification, navigation and communication technologies under one roof, it provides the ideal combination of technological environment and realistic, application-oriented test conditions in which to develop new technologies and services. In Fuerth, we opened a new building for the Development Center for X-ray Technology featuring numerous laboratories and state-of-the-art infrastructure. The facility, which houses some 200 staff, develops promising technologies for non-destructive material characterization. Our newly established application centers, one for wireless sensor technology at the Coburg University of Applied Sciences and Arts and one for CT in Metrology at the Deggendorf Institute of Technology DIT, act as a bridge to higher education institutions that have always taken an application-oriented approach in their work. Last but not least, our Fraunhofer Working Group on Supply Chain Services cofounded the Center for Aging-Adequate Services (ZAD) with the Friedrich-Alexander-Universität Erlangen-Nürnberg. The ZAD’s work includes developing strategies for ensuring workforces remain innovative despite demographic change, and for ways to optimize products and services for the 50+ target group.

Dear readers, we thank you for placing your trust in us throughout the past year. Through this annual report we hope to assure you that your confidence and support are our motivation to do things even better. We look forward to working with you again!

With best wishes,

Professor Dr. Albert Heuberger, Executive Director of Fraunhofer IIS





# THE GLOBAL FRAUNHOFER NETWORK



LOCAL PRESENCE,  
GLOBAL REACH



# FRAUNHOFER IN GERMANY

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

At present, the Fraunhofer-Gesellschaft maintains 67 institutes and research units. The majority of the more than 23,000 staff are qualified scientists and engineers, who work with an annual research budget of 2 billion euros. Of this sum, more than 1.7 billion euros is generated through contract research. More than 70 percent of the Fraunhofer-Gesellschaft's contract research revenue is derived from contracts with industry and from publicly financed research projects. Almost 30 percent is contributed by the German federal and Länder governments in the form of base funding, enabling the institutes to work ahead on solutions to problems that will not become acutely relevant to industry and society until five or ten years from now.

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

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

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

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

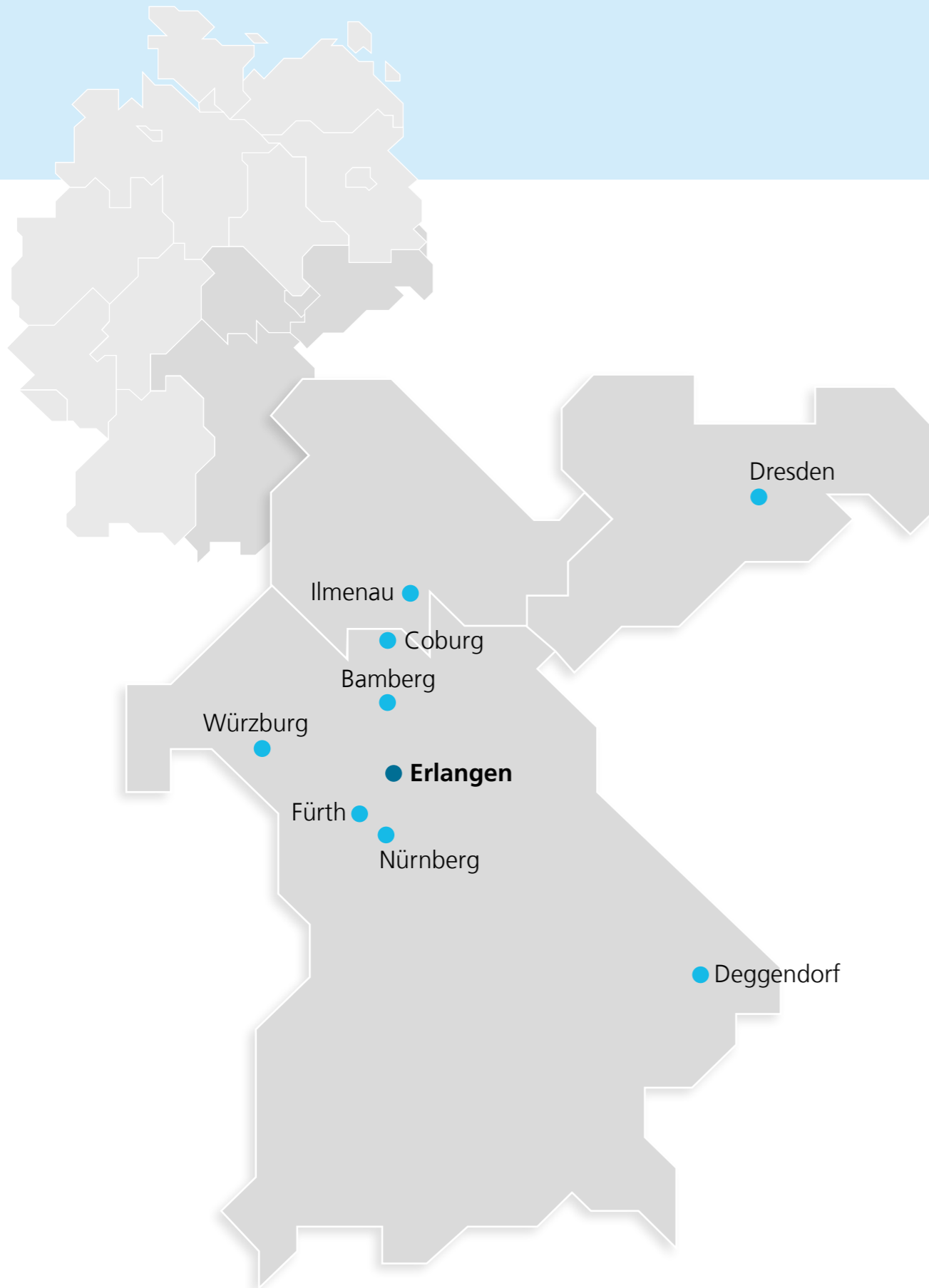
[www.fraunhofer.de/en.html](http://www.fraunhofer.de/en.html)



# RESEARCH OF PRACTICAL UTILITY

# FRAUNHOFER IIS IN PROFILE

The Fraunhofer Institute for Integrated Circuits IIS is the largest Fraunhofer Institute, employing some 780 staff working on a research budget of more than 100 million euros. The institute currently has several locations throughout Bavaria, Saxony and Thuringia. It has bundled its research into fields of expertise in order to provide customers with comprehensive solutions from a single source. The following chart shows which fields of research are represented at which locations.



Distribution of research fields across locations

	Erlangen	Nürnberg	Fürth	Ilmenau	Würzburg	Dresden	Bamberg	Coburg	Deggendorf
Non-destructive Testing			●		●				●
Imaging Systems	●								
Communication Systems	●	●		●				●	
Sensor Systems	●	●				●		●	
IC Design and Design Automation	●					●			
Medical Technology	●							●	
Positioning	●	●					●	●	
Supply Chain Management		●					●		
Audio & Multimedia	●								
Energy Management	●	●				●			
Safety and Security Technology	●	●	●	●	●			●	

# THE IIS AS A PARTNER

We offer the following on a contractual basis:

RESEARCH AND DEVELOPMENT SERVICES

LICENSING OF TECHNOLOGIES AND SYSTEMS

CONSULTING AND PROJECT SUPPORT

MARKET STUDIES

## Research dedicated to the future – and your company's success

In conjunction with a network of international partners, Fraunhofer IIS conducts top-level research for the immediate benefit of industry and the greater good of society. The innovative and practical technology solutions we develop for our clients are instrumental in increasing the competitiveness not only of the Nuremberg metropolitan region, where we are based, but also of Germany and Europe as a whole.

## We do the right things

As an institution devoted to applied research, we are at the forefront of technological innovation, striving to be a catalyst for tomorrow's technologies and applications. We understand our industrial and public-sector clients' needs and drive technology forward.

Drawing on our expertise and experience, we create sustainable, technologically ambitious solutions which help both our clients and our institute remain competitive in the national and international markets. The results of our research help in meeting the challenges that societies face today.

In order to facilitate practically oriented education for young people, we also contribute insights to the curricula of higher education institutions.

## We do things right

In our research, we use state-of-the-art methods and knowledge and collaborate with selected partners to complement our research expertise.

Our central aim is to identify and provide the solution that best meets client requirements. Our staff is the cornerstone of the institute's success. It is their creativity and entrepreneurial spirit that is the basis for productive work within the framework of the Fraunhofer model. We continually improve our processes and protect our knowledge through patents, ensuring dependable relationships with our clients and partners.

# FRAUNHOFER IIS – DEDICATED TO YOUR FUTURE!

# ORGANIZATION CHART

**ER | Headquarters Erlangen**

Am Wolfsmantel 33  
91058 Erlangen  
Phone +49 9131 776-0

**N | Location Nürnberg**

Nordostpark 93  
90411 Nürnberg  
Phone +49 911 58061-9190

**FÜ | Location Fürth**

Flugplatzstraße 75  
90768 Fürth  
Phone +49 911 58061-7500

**DD | Design Automation**

**Division EAS**  
Zeunerstraße 38  
01069 Dresden  
Phone +49 351 4640-701

**WÜ | Project Group**

**NanoCT Systems**  
Campus Hubland Nord  
Josef-Martin-Weg 63  
97074 Würzburg  
Phone +49 931 84246

**IL | Project Group**

**Wireless Distribution  
Systems/Digital Broadcasting**  
Helmholtzplatz 2  
98693 Ilmenau  
Phone +49 3677 69-4280

**BA | Project Group**

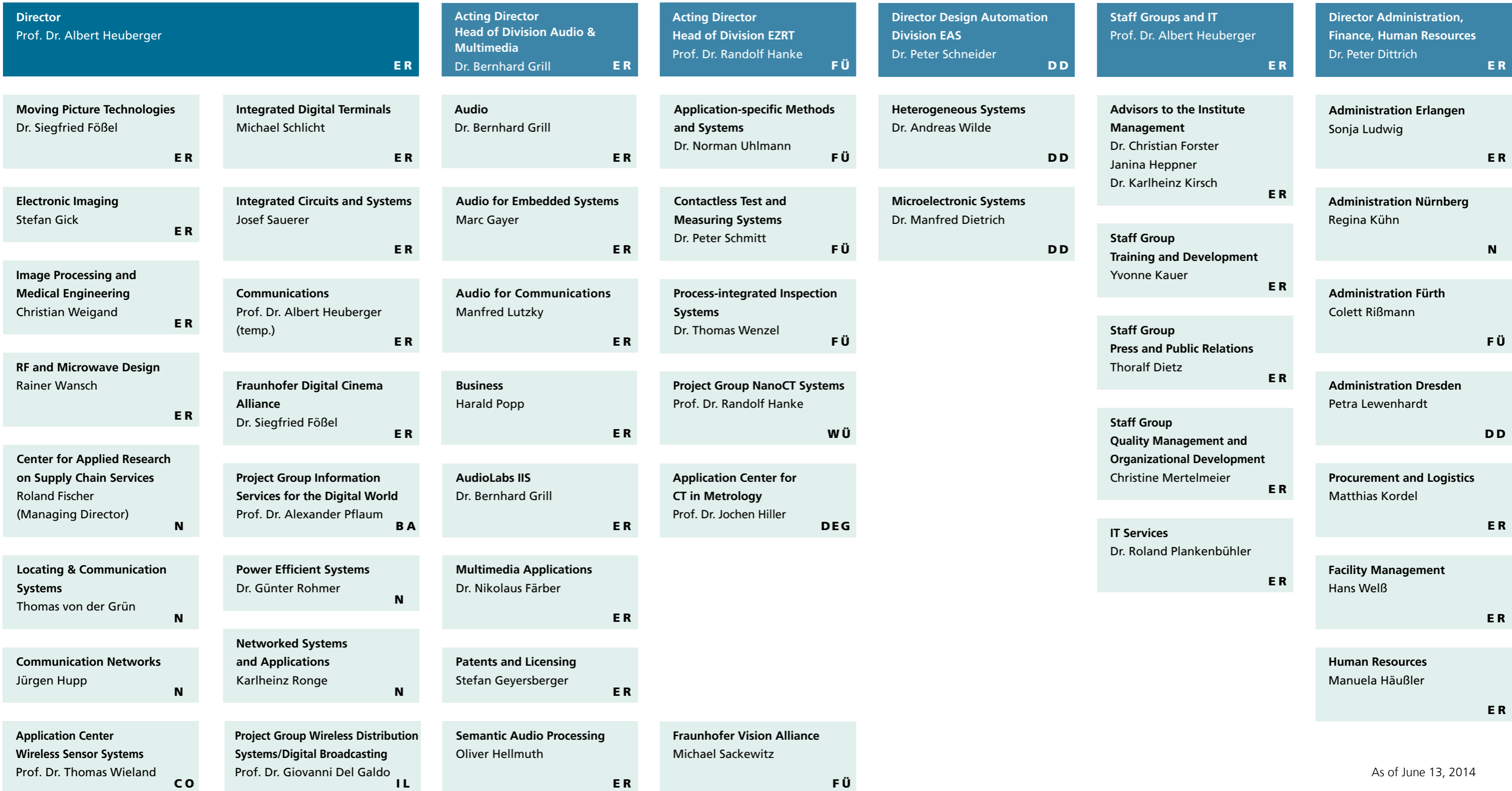
**Information Services for  
the Digital World**  
Feldkirchenstraße 21  
96052 Bamberg  
Phone +49 951 863-1771

**DEG | Application Center**

**for CT in Metrology**  
Edlmairstraße 6 and 8  
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Phone +49 991 3615-0

**CO | Application Center**

**Wireless Sensor Systems**  
Am Hofbräuhaus 1  
96450 Coburg  
Phone +49 9561 317-674

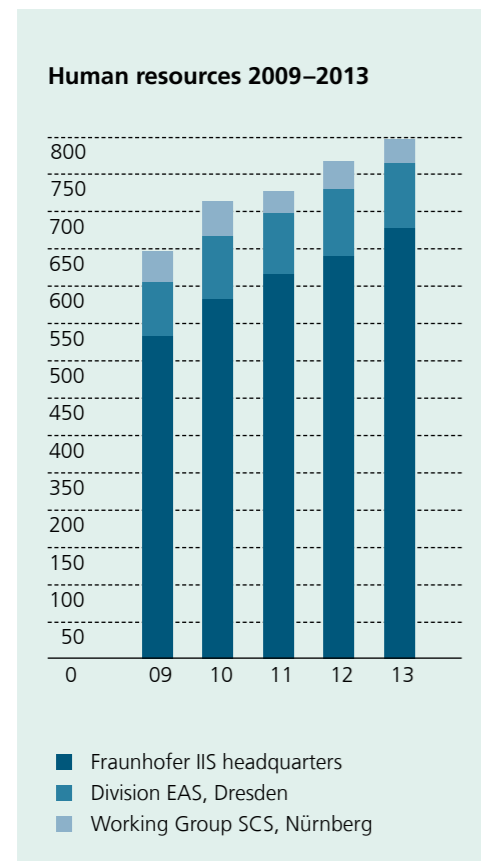


# KEY FIGURES

In boardrooms across Germany, the mood brightened considerably during the fiscal year 2013 – as was also borne out by the Ifo Business Climate Index in the last quarter of the year. Optimistic corporate expectations are at their highest level since the spring of 2011, with this optimism extending across all industries. In addition, the Index went up for the third time in a row, which is generally indicative of an economic turnaround.

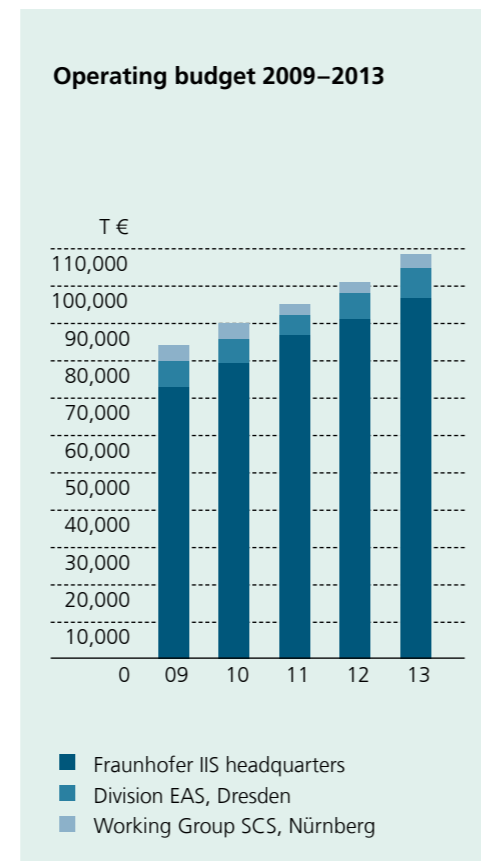
## Human resources

In light of the German economy's buoyancy, Fraunhofer IIS is facing stiff competition when it comes to attracting highly qualified applicants. These challenges call for new ideas in HR marketing and recruitment strategies. Irrespective of this, during the previous fiscal year Fraunhofer IIS recorded moderate growth at its locations in Erlangen, Nuremberg, Fuerth, Dresden, Ilmenau, Wuerzburg, Bamberg, Coburg and Deggendorf.



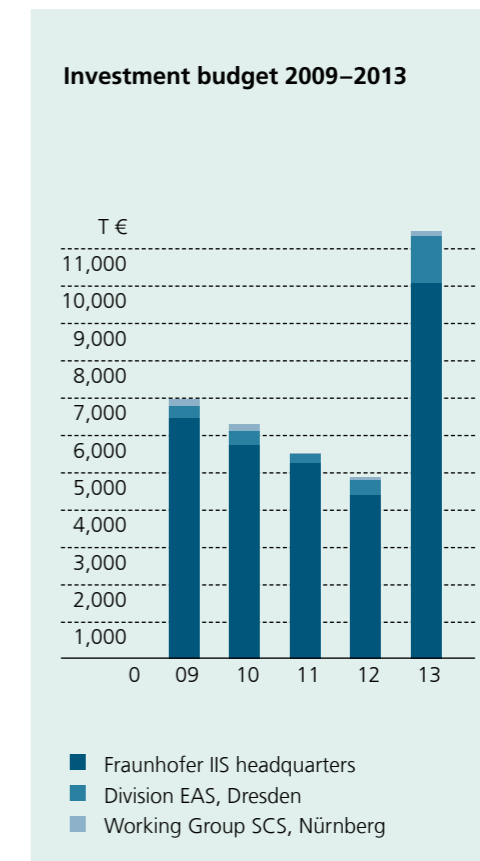
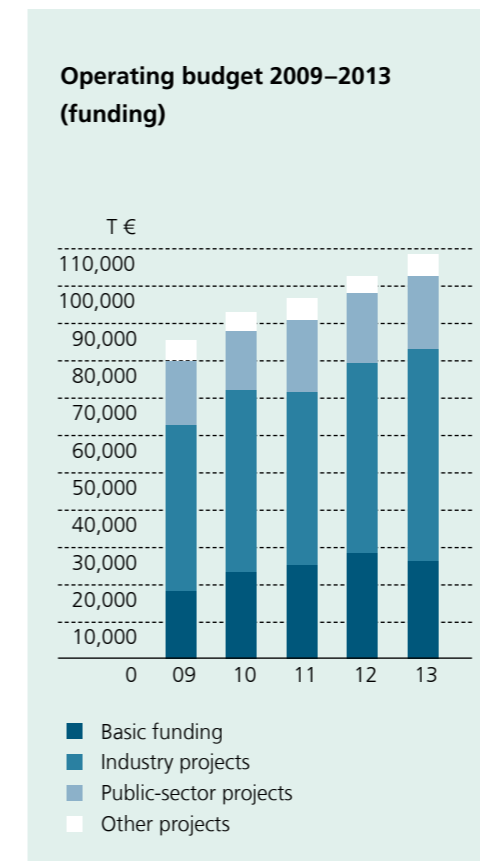
## Operating budget

Besides its current fields of research, Fraunhofer IIS is also working on a series of new areas that will benefit from the optimistic attitudes felt across the economy. Fraunhofer IIS finances its activities on the basis of the Fraunhofer model. Hence its operating budget for the fiscal year 2013 comprised base funding through the Fraunhofer-Gesellschaft (24 percent), revenues from commercial and industrial projects (53 percent), and project revenues from public funding and other sources (23 percent). Given the present volume of contracts, Fraunhofer IIS expects to balance its operating budget for 2014, as in previous years.



## Investment budget

Global competitiveness requires highly qualified staff as well as ongoing investment. In keeping with the institute's profile, the main items of expenditure are IT security, computers and software, including sophisticated design software, as well as high-performance network infrastructure. The institute's investment budget is supported by public funds as well as revenue from projects and licensing. The budget was significantly increased in 2013, partly because of the new building at the Fuerth location and also because of an internal investment program.



# ADVISORY BOARD



The Advisory Board supports the administrative bodies of the Fraunhofer-Gesellschaft and the institute directors, and helps to forge contacts with industry and related organizations.

## Members of the Fraunhofer IIS Advisory Board

Dr. Annerose Beck Saxon State Ministry for Higher Education, Research and the Arts	Energy and Technology
Jürgen Beuthner TechniSat Digital GmbH	Dr. Dietmar Schill (Head of Advisory Board) Sony Deutschland GmbH
Dr. Gerd Gruppe German Aerospace Center (DLR)	Prof. Dr. Dr. h.c. Jürgen Schüttler Faculty of Medicine, Friedrich-Alexander-Universität Erlangen-Nürnberg
Klaus Helmrich Siemens AG	Dr. Marc Steckling Astrium GmbH
Prof. Franz Kraus ARRI AG	Dr. Alexander Tettenborn Federal Ministry for Economic Affairs and Energy
Dr. Ulf Lange Federal Ministry of Education and Research	Dr. Keith Ulrich Athenga GmbH
Prof. Dr. habil. Marion Merklein Faculty of Technology, Friedrich-Alexander-Universität Erlangen-Nürnberg	Norbert Michael Weber Federal Ministry of Defence
Dr. Ronald Mertz Bavarian Ministry of Economic Affairs and Media,	Jürgen Weyer Freescale Halbleiter Deutschland GmbH
	Reiner Würz Continental Automotive GmbH

from left:  
 Prof. Dr. Jürgen Schüttler,  
 Reiner Würz,  
 Ronald Mertz,  
 Prof. Reimund Neugebauer  
 (President of the  
 Fraunhofer-Gesellschaft),  
 Dr. Keith Ulrich,  
 Prof. Dr. Albert Heuberger  
 (Executive Director,  
 Fraunhofer IIS),  
 Dr. Dietmar Schill,  
 Jürgen Weyer,  
 Dr. Marc Steckling,  
 Jörg Geiger (representing  
 Dr. Annerose Beck),  
 Prof. Franz Kraus



## GLOBAL HE-AAC AUDIO STANDARD FOR BROADCAST AND STREAMING

Fraunhofer IIS's development of the mp3 was a landmark in the evolution of digital audio and helped to make this exciting new technology accessible to a global audience. Now the next milestone is moving into view: the ability to stream content wherever, whenever, without the need to actually download it. Once again, Fraunhofer IIS is playing an integral role in developing the technology that will make it all possible.



*Fraunhofer IIS's HE-AAC software is part of the Android operating system and enables for e. g. playback of 5.1 surround sound.*



# BEHIND THE GOOD SOUND OF DAB+, YOUTUBE & CO

Today, the open MPEG standard High Efficiency Advanced Audio Coding (HE-AAC) is one of the most widely used audio coding processes in the world. In broadcasting and streaming alike, modern systems rely on HE-AAC to transfer media content, and there are currently more than six billion devices capable of playing audio content coded using HE-AAC. Behind HE-AAC's success story is the efficiency of the coding process. Impressively, this codec requires just a third of the data rate of comparable techniques while offering the same or even better quality. Fraunhofer IIS is now in the process of developing new audio technologies designed to promote the use of HE-AAC worldwide. Cingo, for example, allows movies and music coded for instance with HE-AAC to be played back in high quality surround sound. Dialogue Enhancement gives greater clarity to speech content in TV broadcasts, while xHE-AAC can improve audio quality at very low data rates. At the same time, Fraunhofer IIS is focusing on the development of the next generation of MPEG audio.

Today, the ISO MPEG standard HE-AAC is one of the most widely used audio coding techniques in the world. There is probably no cell phone or PC that doesn't incorporate HE-AAC technology – and the same applies to TVs and set-top boxes. All in all, the codec can be found in more than six billion devices. Most multimedia applications also use HE-AAC to transmit audio data efficiently.

HE-AAC coding can be found in places from DAB+ radio to YouTube. HE-AAC is to broadcasting and streaming what mp3 is to personal entertainment: a worldwide standard without which modern consumer electronics and media networks as we know them would not exist.

## Ultimate coding efficiency

HE-AAC's leading market position owes much to its high efficiency. Broadcast and mobile networks have limited capacity – and the number of smartphone users and online streaming services keeps on growing.

Users of download services in Germany already stream 20 percent of their music. This content must be streamed efficiently if the worldwide network is not to collapse under the pressure of the quantities of music and video being streamed at any given moment. HE-AAC is the preferred option for the coding of audio signals since it delivers premium sound quality at just a third of the data rate required by other audio codecs.

HE-AAC also supports all the common channel configurations, from mono to 7.1 surround sound. This means it is possible to transmit audio files in excellent quality without putting too much strain on the networks.

## Worldwide streaming and broadcasting with HE-AAC

Thanks to its unique combination of properties, HE-AAC has become the codec of choice for streaming services including Amazon VoD, China Mobile, BBC iPlayer, Google Play, and YouTube. HE-AAC's efficiency saves streaming service providers money because many of them are charged according to data volume. The more efficient the coding process, the lower the volume of transmitted data – and the costs involved. Customers with mobile phone contracts that specify certain data usage limits can also save money with HE-AAC, or else use this capacity to listen to more music for the same price.

HE-AAC is also invaluable for broadcasting. The vast majority of modern digital radio standards employ the codec, including DAB+ and Digital Radio Mondiale DRM. HE-AAC also enjoys a worldwide presence in the realm of digital television – it is specified for the transmission of TV sound in stereo as well as in surround in South America and in many countries across Europe, Asia and Africa.

## Combining different technologies

HE-AAC encompasses several technologies. The basis is the AAC codec, which was developed and standardized as the successor to mp3. Apple's online music store iTunes is the most prominent user of the AAC codec. AAC offers premium sound quality at near-transparent levels – which means that even experts can't tell the difference between the original and the encoded version. Typical bit rates for AAC are between 128 and 256 kbit/s for stereo signals and between 256 and 320 kbit/s for 5.1 surround sound.

For HE-AAC and HE-AACv2, AAC was combined with the Spectral Band Replication (SBR) and Parametric Stereo (PS) technologies. In the HE-AAC codec, AAC is employed to encode the lower range of the frequency spectrum while SBR assumes responsibility for the upper part. SBR is a parametric approach. The relationship of the lower part to the upper part of the frequency spectrum is analyzed in the encoder and stored by means of additional data that describe the relationship. The decoder can then combine the lower part of the spectrum and the additional data to recreate the signal. HE-AACv2 makes additional use of parametric stereo. This technology employs a mono downmix when encoding stereo signals, and records the parameters that describe the original stereo signal. The decoder then uses these parameters to reconstruct the original stereo signal from the mono signal. This means stereo data can be stored in good sound quality at bit rates of 32 to 96 kbit/s. 5.1 surround sound requires bit rates of 96 to 256 kbit/s.

## Made in Erlangen

Fraunhofer IIS played a significant role in the development and MPEG standardization of HE-AAC. Today the institute is particularly active in promoting the codec and its wider usage. This emphasis has resulted in Fraunhofer IIS's HE-AAC software being integrated into the Android operating system so that the codec can be incorporated into Android devices to deliver the best possible quality. In 2013, the institute helped Google

to introduce the audio codec to the Google Play Store, where it is used to transmit surround sound in movies.

In addition to these activities, Fraunhofer IIS also works on technologies to complement the codec. Cingo was launched in 2013 and allows surround sound to be reproduced via stereo headphones or mobile devices' integrated stereo speakers. Cingo also improves general audio quality when playing stereo content on tablets or smartphones. Google was the first customer to incorporate Cingo in its Nexus tablet and smartphone range, whilst Korean mobile network provider SK Broadband makes use of Cingo as part of a video service for Android devices.

Fraunhofer IIS's Dialogue Enhancement technology is also an ideal addition to the HE-AAC codec. People with impaired hearing often struggle to follow the speech content in TV series, films or shows, which can be overlaid with excessive sound effects or background music. Dialogue Enhancement allows TV viewers to adjust the audio settings to suit their individual needs, either by increasing the volume of voice content or by reducing the level of background noise. In such applications, the data rates required are only marginally increased, while the technology remains compatible with end devices already available on the market.



### Looking ahead: xHE-AAC and MPEG-H audio

HE-AAC, Cingo and Dialogue Enhancement are just steps along the road in the ongoing development of audio signal processing, and the next generation of technology is already on the way.

In 2012, xHE-AAC was standardized and became the newest member of the AAC family. This codec combines AAC, SBR and PS with a technology that is specialized in coding speech and music at extremely low data rates. As a result, the xHE-AAC codec is capable of storing audio signals from a data rate of just 8 kbit/s per channel – achieving the same quality for both speech and music. This makes xHE-AAC the first universal codec to combine speech and audio encoding technologies so as to enable all signal types to be stored in good quality at extremely low data rates. In the fall of 2013, this unique method of operation prompted Digital Radio Mondiale's standardization committee to opt for xHE-AAC as its new audio codec for the transmission of programs.

While current generations of AAC technology have firmly established themselves on the market – or are well on the way to doing so – Fraunhofer researchers are already developing the next generation of MPEG standards. The new MPEG-H standard promises a variety of new audio features: from 3D sound to interactive audio objects, it will provide everything a broadcaster or content provider could wish of a modern audio codec, both now and into the future. Again, Fraunhofer IIS is playing a crucial role, with its concept for the technology which was selected as the reference model for the forthcoming MPEG-H standard.

With these new developments, Fraunhofer IIS is continuing its tradition of audio technology success. The foundation is laid for sustainable growth – guaranteeing that you will continue to see the “Made in Erlangen” label on technologies for TVs, smartphones and other devices over the years to come.

1 Fraunhofer IIS's audio codecs can be found everywhere, from music production to playback on end devices.

### AUDIO TECHNOLOGY MADE IN ERLANGEN

**AAC-LC (Advanced Audio Coding Low Complexity):** Excellent audio quality for mono, stereo and multi-channel sound (up to 48 channels). Used in music and video download services such as Apple iTunes as well as in TV systems. Typical bit rates: 128–256 kbit/s (stereo), 256–320 kbit/s (5.1 surround sound).

**HE-AAC (High Efficiency Advanced Audio Coding):** High audio quality for mono, stereo and multi-channel sound (including 7.1) at low data rates. Ideal for any channel with limited transmission capacity and de facto standard for streaming applications. Typical bit rates: 32–96 kbit/s (stereo), 96–256 kbit/s (5.1 surround sound).

**xHE-AAC® (Extended High Efficiency Advanced Audio Coding):** The first audio codec to integrate speech and music coding, enabling good audio quality at extremely low data rates. Suitable for any application that combines speech and music, e.g. radio. Typical bit rates: 16 kbit/s (stereo), 96–256 kbit/s (5.1 surround sound).

**Dialogue Enhancement:** Allows TV viewers to adjust the audio mix in line with their individual preferences, the listening environment and their hearing acuity.

**Cingo®:** Improves reproduction of stereo sound and enables surround sound on mobile devices.

**MPEG-H:** Future MPEG audio standard for enhanced interactivity and 3D sound.

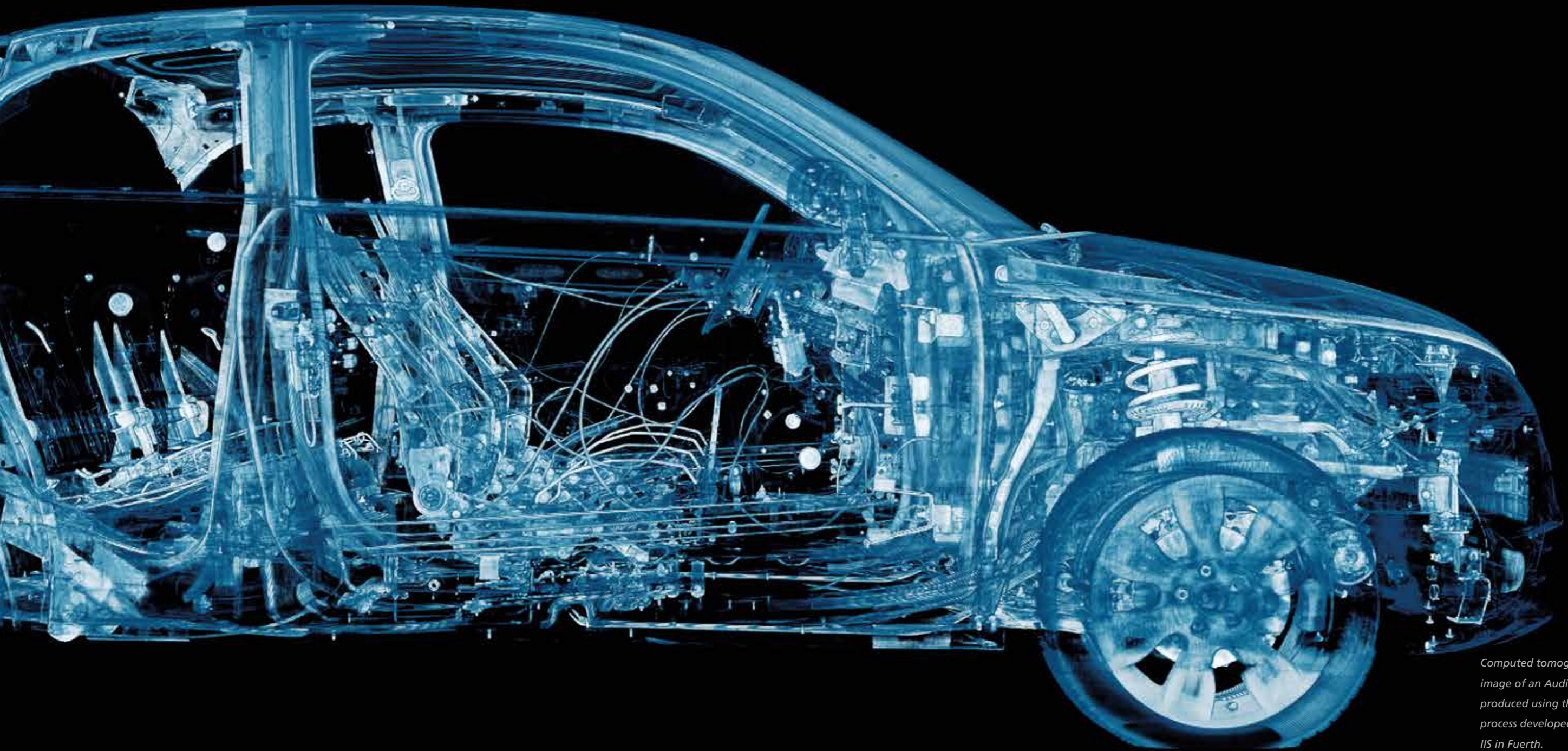
### CONTACT

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## COMPUTED TOMOGRAPHY GOES LARGE, EXTRA-LARGE, XXL

Until now, it was only possible to obtain computed tomography X-ray images of large, thick-walled objects such as cars, freight containers and aircraft components using a destructive process in which the objects first had to be broken down into smaller parts. Fraunhofer researchers in Fuerth have developed a new solution: the world's first XXL computed tomography system.



*Computed tomography image of an Audi A1, produced using the new process developed by the IIS in Fuerth.*

# AN INSIDE VIEW OF VERY LARGE OBJECTS

The LINAC test center in Fuerth is housed in an outsized building covering a surface area of 400 square meters and rising to a height of 14 meters in order to accommodate the two eight-meter-tall scaffolding towers containing the beam source and detectors. Using this linear accelerator (LINAC), the scientists working in the X-ray center can examine entire cars, shipping containers, or rotor blades in their final configuration, and analyze their characteristics in minute detail, down to sub-millimeter resolution. The objects are imaged slice by slice and can be viewed in three dimensions, either in their entirety or by focusing on specific parts. XXL computed tomography can be used for test and measurement purposes in numerous sectors of industry. Some 190 people currently work in the Development Center for X-ray Technology, which includes the LINAC test center.

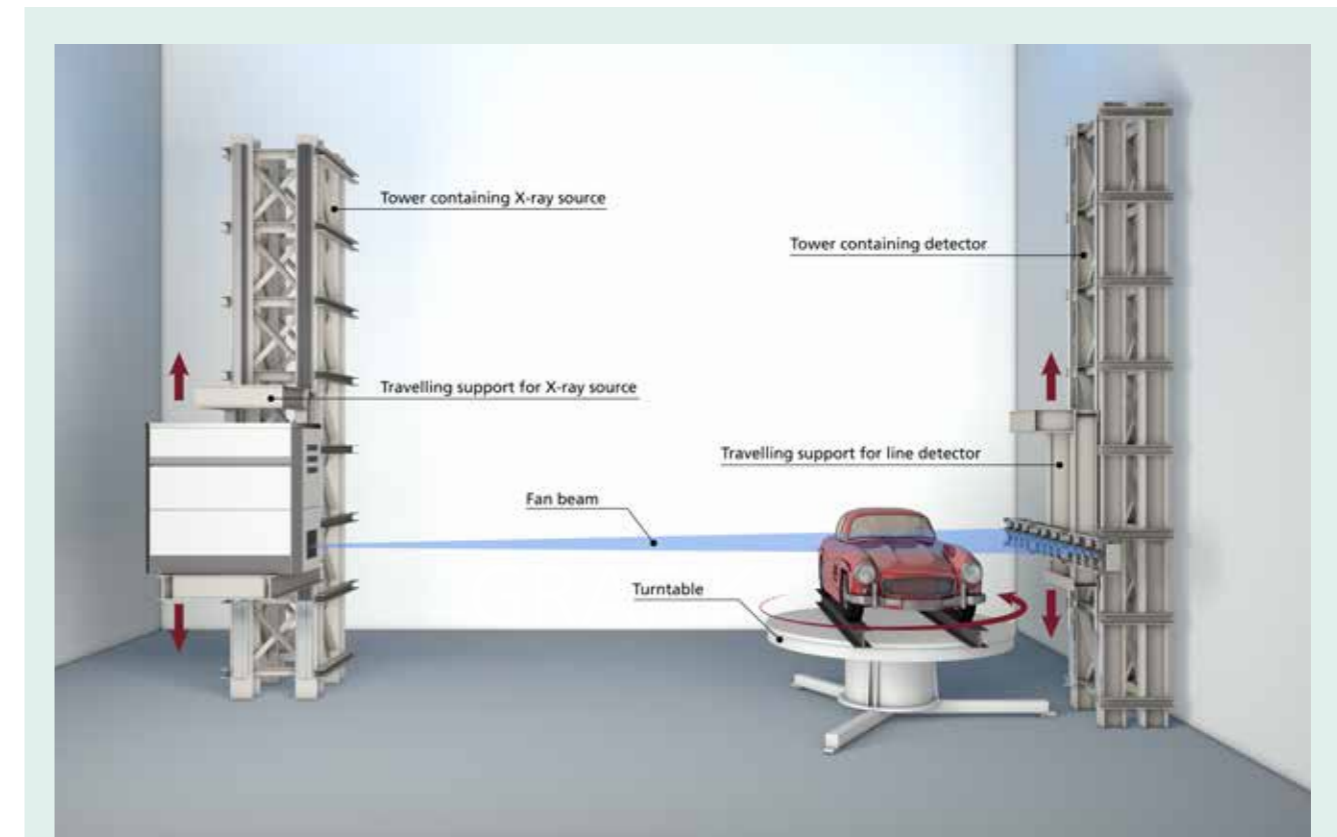
“Keep going – just a bit more – that’s it, stop!” calls out Dr. Michael Böhnel while giving hand signals to the crane operator, who, as instructed, slowly lowers the car suspended on the overhead travelling crane. The car is gently placed on the giant turntable with millimeter-scale precision in exactly the right spot. Once in place, no further movement of the car is allowed, even by a single millimeter, otherwise the X-ray images will not be accurate. Böhnel takes a final look to check that everything is in order, and then hits the start button that initiates the security procedure. A piercing alarm rings through the building and all the warning lights start to flash. The scientists present in the LINAC test center proceed to the exit, and a laser scanner installed in the safety vestibule counts the number of people leaving the building to make sure that nobody remains inside. If this check is OK, the security system gives the go-ahead and the plant manager locks the test facility. From now on, nobody is allowed to enter the building, which is encased in three-meter-thick protective concrete walls. The researchers take up their positions in the control center – a spacious office immediately adjacent to the test center – from which they can safely observe everything that is happening during the tests. Data captured by the cameras inside the test hall are displayed in real time on a wall of monitors, enabling the slightest anomaly to be detected immediately. Böhnel takes one last look at the data and then initiates the measurement process. All the team has to do now is wait for the results.

## A center of excellence like no other

The tests performed here are not limited to a single component – they provide data on an entire vehicle. “With our XXL CT technology, we can perform X-ray measurements of structures with a height to up to 4.60 meters and a diameter of up to 3.20 meters. This opens up a whole array of new possibilities,” says Dr. Stefan Kasperl, the manager in charge of the XXL computed tomography project.

Since May 2013, Fraunhofer researchers have had access to this extra-large facility for performing their work. The new international center of excellence established at Fuerth-Atzenhof provides resources for industrial-scale X-ray and computed tomography. The adjacent LINAC test center has a surface area of around 400 square meters and is as tall as a large apartment building; it provides space for the realization of big ideas and is the only center of its kind in Europe.

The work performed here involves the non-destructive testing of large objects, such as road vehicles, aircraft components, and loaded shipping containers, by means of X-ray techniques. The important point is that these tests are non-destructive, whereas up to now the only way to X-ray large, thick-walled objects necessitated their division into smaller parts, and therefore their destruction. Consequently, the new facility not only helps to save time and costs but also, unlike traditional methods, allows quality testing of objects that previously could only be tested to a limited extent or not at all.

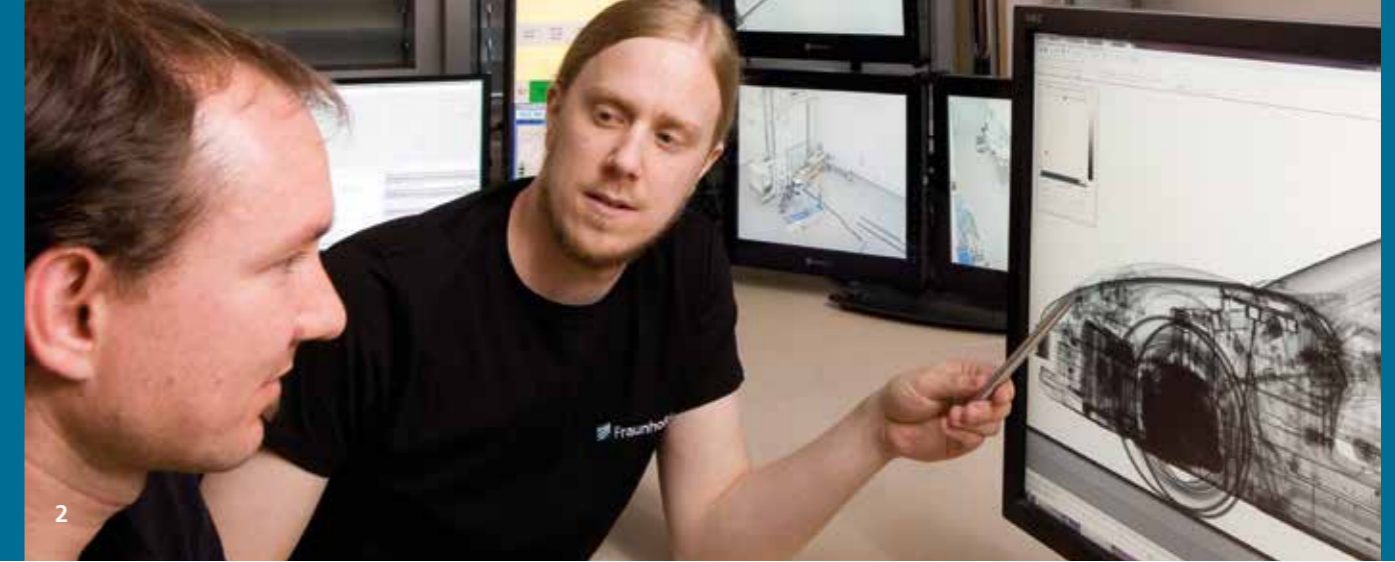
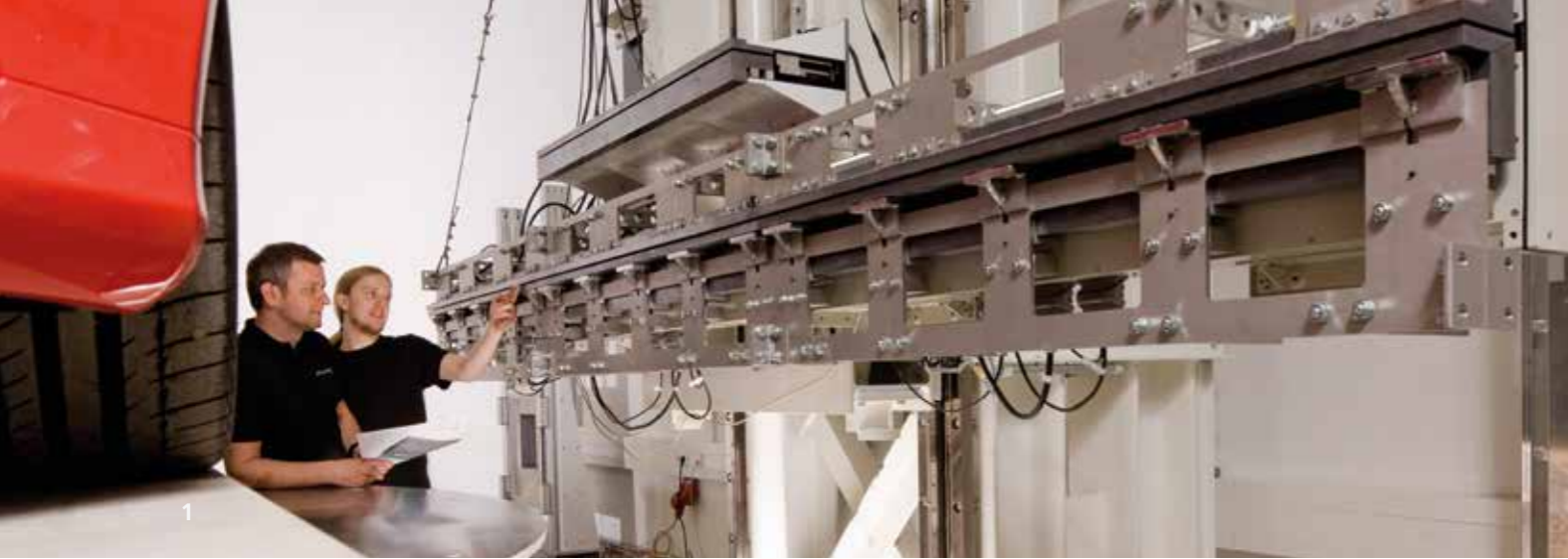


## The LINAC (linear accelerator) test center

The installations under the roof of the 14-meter-high test center include two scaffolding towers, each eight meters tall, a turntable with a diameter of three meters, an X-ray source with a mass of three metric tons, and a detector measuring four meters in length.

The test objects are placed on a turntable by means of a travelling crane and automatically X-rayed in three dimensions as they rotate through 360 degrees around their axis. The X-ray energy input can be varied to suit the material, size and wall thickness of the object, up to a maximum of nine mega electron volts (MeV), an energy level twenty times superior to that produced by conventional industrial X-ray systems. The resulting image data are reconstructed and visualized using a software system developed in-house. The object can then be examined slice by slice and viewed in three dimensions, either in its entirety or focusing on specific parts. In this way it is possible to detect, characterize and evaluate design or construction errors, defective materials, and other anomalies in inaccessible places that are normally hidden from view.

If the object under test is too large to be imaged as a single item, separate images of smaller sections are recorded, which are then spliced together in a subsequent processing stage.



### Possible applications in many sectors of industry

The imaging of large objects, which often have very thick walls that are difficult to penetrate with X-rays, requires correspondingly high X-ray energy levels. To meet this requirement, the test center in Fuerth-Atzenhof is equipped with a linear accelerator designed by Siemens specifically for this CT scanner.

This new inspection technique offers advantages to users in many sectors of industry. Applications range from the strength testing of aircraft wings to quality control and fault analysis in the automotive sector and even the detection of hazardous materials or smuggled goods in sea freight containers. Indeed, X-ray testing may soon become a standard requirement in the latter case. After the 9/11 attacks in 2001, the U.S. government promulgated a series of security measures including amendments to the Safe Port Act, which followed on from House Resolution No. 1 that was adopted in 2007. This new legislation, which will soon go into effect, requires that all shipping containers imported into the United States must undergo X-ray inspection at the port of departure. A reliable, multi-slice X-ray security inspection system can save a lot of time and money.

### Reliable test results on combinations of materials

Another application of significant interest is the imaging of objects whose characterization is rendered difficult by the use of extremely dense materials or combinations of materials, such as a mix of carbon-fiber-reinforced polymer and heavier metal components. In such cases, high-energy X-ray tomography can produce very reliable test results even for combinations of materials of different densities.

Despite the huge size of the test objects, the images produced by the system are always reliable: "With an effective resolution of below 0.8 millimeters when scanning large objects, we are able to detect even minuscule defects. And we are already working on enhancements that will double the level of detail,"

reports Nils Reims, research associate in the Laboratory Systems group.

In brief, the technique works in the following manner. The object under test is placed on a turntable with a diameter of three meters. In each measurement cycle, the synchronized beam source and detector travel up and down the towers once, scanning the object line by line to produce individual projections. Then the object is repositioned by rotating the turntable and scanned again. The result of these separate measurement cycles is a complete set of projections recorded from different beam directions. The computer software then reconstructs these image data to create a three-dimensional dataset.

### Even bigger future plans

The next stage of the researchers' plans is to develop an alternative scanning process for test and measurement applications that will be familiar to anyone who has ever undergone a medical CT scan. Here, instead of rotating the patient, it is the X-ray tube and detector that rotate around the patient. The aim is to transfer this operating principle to the XXL CT project – by building a ten-meter high, donut-shaped scanner in which the X-ray source and detector can be rotated around even wider and longer objects. And even once this goal has been achieved, the project is by no means over, as Michael Schmitt, a member of the Software Systems team, explains: "We still have plenty of other ideas to explore, which only exist in our imagination at present." So the researchers will continue to enhance their system, motivated by the thought that in five years' time their XXL research project may well become an industrial standard.

1 The line detector that forms part of the XXL computed tomography system.

2 Fraunhofer researchers Dr. Michael Böhnel (left) and Nils Reims studying the X-ray images of an electric sports car.

### THREE QUESTIONS FOR DR. MICHAEL BÖHNEL

Dr. Michael Böhnel works in the Application-specific Methods and Systems department of the Development Center for X-ray Technology at Fraunhofer IIS.

#### What excites your interest in X-ray technology?

The XXL research project is a daring initiative by Fraunhofer to create a novel solution that far surpasses the dimensions of any other previous X-ray inspection system. Everything we're doing today and plan to do in the future means venturing into unknown territory – and we've only just begun to explore all the possibilities. It's really exciting to be able to generate three-dimensional images of such large and complex objects. Being able to work on this type of scientific and technological challenge is a rare and exceptional privilege.

#### What does being a Fraunhofer researcher mean to you?

Above all, working for Fraunhofer gives me more creative freedom. We're encouraged to try out new ideas, however wild they might seem, with the support of a strong team of similarly minded researchers. Another attractive point for me is that every day's work is different. I receive customer requests on a daily basis, which each time are associated with new challenges. So I'm never bored and continually learn new things.

#### What were the best moments in your work to date?

One of my most memorable experiences was seeing the first two-dimensional images produced by an X-ray artist on the basis of data generated by our system, shortly after it was placed in service. The radiographs were so beautiful, so full of artistic detail, that I was truly impressed. And I have to mention viewing the results of the first CT scans of large objects using our system; that was a demonstration that exceeded our expectations.

### XXL COMPUTED TOMOGRAPHY AT A GLANCE

#### Applications

- Fault analysis: shrinkage gaps, pores, cracks and delaminated areas above a size of 0.4 mm
- Materials analysis: fiber orientation and position in composite materials, porosity and density distribution
- Pre- and post-assembly quality control: correct and complete assembly of components, wiring configuration and the integrity of welded, glued and plug-in connections
- Safety inspection: presence of foreign bodies, illicit goods and hazardous materials
- Sorting: waste destined for the separation and recovery of raw materials

#### Relevant sectors of industry

- Automotive: entire vehicles, body parts and engine components
- Security: air freight and maritime shipping containers
- Aerospace: aircraft fuselages, carbon-fiber composite materials, airfoils
- Energy: wind turbine airfoils, engine turbine blades, power generating units
- Waste management / recycling: trash containers, waste sorting facilities
- Transportation: commercial vehicle components, single cylinder heads, hydraulic systems

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## KEEPING OUR ROADS SAFE WITH COOPERATIVE SYSTEMS

We're all familiar with the idea of cars that brake automatically when they detect an obstacle or else warn the driver – assistance systems that rely on cameras or radar. But what if a pedestrian who is out of sight of the camera suddenly walks out onto the road? Often, there isn't sufficient time left to react.



*The Ko-TAG system detects pedestrians before drivers can even see them. (prototype display)*

# THE FUTURE OF ROAD TRAFFIC

Ko-TAG is a cooperative system that establishes road users' position via radio – meaning that it “sees” them before they get into trouble and can react quickly to prevent an accident. Pedestrians and cyclists carry small transmitters that “cooperate” with in-vehicle radio receivers, allowing their movements to be tracked. The system detects situations in which a road user might be at risk and either warns the driver or initiates an automatic braking action. Ko-TAG is the first assistance system to work cooperatively. By extending the field of view, it can spot hidden road users before they come to any harm.

It's a sunny day in September and the small town is bustling with weekend traffic. Suddenly a toddler on a bobby-car emerges from between two parked cars – straight into the path of an oncoming vehicle. In fractions of a second, the car has braked to a halt and disaster is averted as the child is safely scooped up by his mother. Traffic resumes. It's late morning and many are on their way to the big shopping mall. Nothing impedes their progress as the traffic lights at the main intersection wait to let the queue of cars past before changing to red.

*“Ko-TAG brings a whole new perspective to road safety.”*

Dr. Ralph Hasshofer, BMW Group Research and Technology GmbH

Another day and there's another potentially dangerous situation. A car wants to turn right just as a cyclist comes racing up into his blind spot. The car immediately comes to a stop, momentarily startling the cyclist before they move on with a nod of the head.

What is this? A computer game, perhaps, or some sort of science-fiction scenario? In fact, it's a vision of the future that has already been realized – and on September 18 and 19 in Aschaffenburg, researchers and manufacturers demonstrated that it works, too. The final demonstration of the Ko-TAG project offered 200 experts from research, business, politics, administration and the media the chance to see the “intersection of the future” for themselves. This presentation formed the finale to four years of research within the Ko-FAS initiative (see p. 43).

*“Ko-FAS will enable us to prevent accidents that used to be inevitable.”*

Stefan Zecha, Continental Safety Engineering International

Fraunhofer IIS's contribution to this initiative has been Ko-TAG, a cooperative tracking technology for driver assistance systems. The institute supplies key components for the tracking units and mobile transponders. Ko-TAG enhances the visibility of vulnerable road users. A radio system detects pedestrians and cyclists before drivers see them and can warn drivers or initiate an automatic braking action in dangerous situations. This is ideal when road users are hidden behind parked cars, stopped buses, trees or simply because visibility is poor. These sorts of obstacles often leave drivers with insufficient time to react to avoid a collision. Transmitters in cars scan their environment and identify and locate pedestrians and cyclists. They can also detect movement and assess whether there is a danger of collision. These radio tracking systems are equally effective when pedestrians and cyclists are out of sight or hidden behind an object. To make this possible, vulnerable road users are provided with active transponders. These transponders can be attached to clothing, school bags, cycle helmets, Zimmer frames or cell phones.

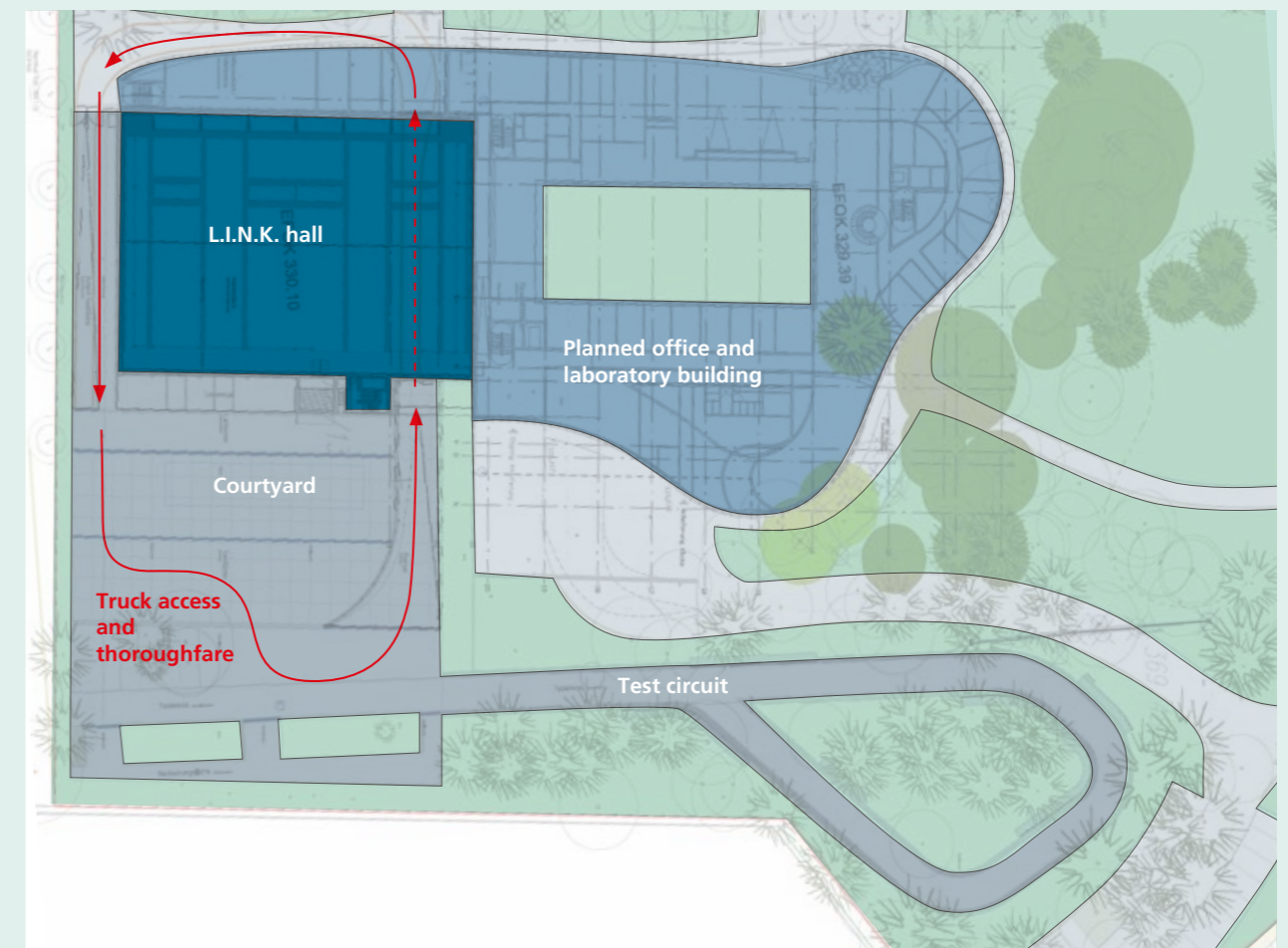
Ko-FAS also yielded insights concerning critical situations involving vehicles and the systems that control traffic flow. The real step forward in the

Ko-TAG subproject, however, is that it offers a driver assistance system that, for the first time, protects all road users and not just car drivers.

## L.I.N.K. test center with test circuit for car-to-x road testing

Projects such as Ko-TAG have access to a test circuit at Fraunhofer IIS in Nuremberg. This track is almost seven meters across and around 100 meters long. It is partially surrounded by trees. The adjoining courtyard can be used for installations such as smart traffic light control systems. The entire site offers the opportunity to test the latest sensor technologies at the development stage.

The circuit is located on a 10,000 square meter site and forms part of the L.I.N.K. test and application center for localization technologies, identification, navigation and embedded communication. Here researchers model true-to-life scenarios for testing and demonstration purposes. Customers and partners have the chance to test new technologies under realistic conditions. Start-ups in particular can make the most of the excellent environment this provides for developing products, technologies and services (see p. 65).





## COOPERATION GETS RESULTS

“If we want to protect vulnerable road users, cars need to be able to spot them even when they can’t physically be seen,” says head of department Thomas von der Grün of Fraunhofer IIS. “Ko-TAG had a complex job to do, making the challenges sizeable. On the one hand, partners from research and industry had to work together and develop a sensor module that would work in a car and could be integrated into an existing car system. On the other hand, the project called for employees from a wide range of disciplines to work together effectively.”

The Wireless Locating and Communication Systems department was responsible for developing the tracking components that determine pedestrians’ position. Meanwhile, experts from High-frequency Technology developed the antenna that receives the signal in-vehicle. Finally, the department for Power Efficient Systems developed the movement classification system that determines whether a road user is moving or at a standstill, and in what direction they are moving.

### Identifying dangerous situations

“It’s important that warnings are restricted to real emergencies to avoid overwhelming drivers,” stresses Marc Faßbinder. This means it is up to the software to decide whether the situation is critical on the basis of road users’ movements. The system uses static behavioral modeling to boost its ability to assess pedestrians’ movements. This technique constructs a model based on the observation of how pedestrians have moved in the past and uses it to calculate the probability of a pedestrian moving onward in a given way. Certain patterns of behavior can be observed before a given movement is initiated. This makes it possible to calculate the probability of a given event occurring, say a pedestrian suddenly walking out into the road. For instance, there is a correlation between speed of movement and change of direction; the faster a person is walking, the less likely they are to abruptly change direction.

Jasper Jahn adds: “To assess the movements, we drew on and developed a technique from the Image Processing and Medical Engineering department. These sorts of in-house synergies are what set Fraunhofer apart. It all goes to show that when researchers from a variety of disciplines work together, they can come up with ideas that a specialist in a single area would never be able to reproduce.”

Thomas von der Grün echoes the sentiment: “Throughout the four years of the project, we collaborated successfully together, and the final presentation was proof that the system is helpful in critical situations on the road and works reliably. One way to improve the Ko-TAG system would be to combine it directly with other sensor systems in the vehicle such as the information obtained from camera systems. This new car-to-x tracking technology is still at the development stage, however, and is not yet mature enough for everyday application. Discussions are already underway as to how to achieve that. In the future, cooperative communication will have an important role to play in road safety.”

## Ko-TAG – ACTIVE TRANSPONDER TECHNOLOGY

In the collaborative Ko-TAG project, scientists conducted research into cooperative wireless sensor technologies. The focus lay on protecting vulnerable road users and vehicle-to-vehicle safety. Fraunhofer IIS was partnered by BMW Group Research and Technology GmbH, Continental Safety Engineering International GmbH, Daimler AG, the Technische Universität München, the Steinbeis Innovation Center Embedded Design and Networking and the Fraunhofer Heinrich Hertz Institute. Ko-TAG is one of three Ko-FAS subprojects.

[www.iis.fraunhofer.de/kotage](http://www.iis.fraunhofer.de/kotage)

## Ko-FAS – COOPERATIVE SENSOR SYSTEM AND COOPERATIVE PERCEPTION RESEARCH INITIATIVE FOR PREVENTIVE SAFETY ON THE ROADS

Ko-FAS is one of the big national collaborative projects dealing with road safety. Project partners received 14.9 million euros in funding from the Federal Ministry for Economic Affairs and Energy, while partners from industry contributed a further 8.7 million euros. 17 partners have been involved in the project since September 2009. Ko-FAS aims to make a substantive contribution to improving safety on the roads.

[www.ko-fas.de](http://www.ko-fas.de)

1 *Test scenario: the car brakes in good time as the dummy suddenly emerges from behind a trailer.*

## Ko-TAG: TECHNOLOGIES AT A GLANCE

*Tracking components: the tracking components are capable of determining positions to within a few centimeters. The system comprises a group antenna as well as functions to calculate trajectory (TU München) and angle of approach.*

[www.iis.fraunhofer.de/kotage](http://www.iis.fraunhofer.de/kotage)

*Antenna design: in the Ko-TAG project, researchers use a roughly 30 x 10 cm antenna array containing six reception antenna components.*

[www.iis.fraunhofer.de/antennas](http://www.iis.fraunhofer.de/antennas)

*Movement classification and inertial sensors: Fraunhofer IIS’s algorithm works out whether a given road user is walking, stationary or riding a bike, as well as the direction in which they are moving. This classification is facilitated by an inertial sensor system.*

[www.iis.fraunhofer.de/classification](http://www.iis.fraunhofer.de/classification)

[www.iis.fraunhofer.de/inertiale](http://www.iis.fraunhofer.de/inertiale)

*System integration: Fraunhofer IIS assumed responsibility for the integration of the tracking and communication components. The integrated system was fitted into the bumper bars of existing test vehicles.*

[www.iis.fraunhofer.de/embedded](http://www.iis.fraunhofer.de/embedded)

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## A WHOLE NEW DIMENSION FOR MAGNETIC FIELD MEASUREMENT

Hall sensors offer a completely contactless and wear-free solution for determining the position of machine parts and products within a magnetic field. That being said, there are two characteristics of conventional Hall sensors that pose problems for their industrial application; they are disrupted by external magnetic fields, and are susceptible to fluctuations in temperature, which alter the position values. HallinOne® balances out both these application weaknesses and enables robust and cost-effective solutions.

Layout of a HallinOne® sensor  
developed at Fraunhofer IIS

# PRECISE, ROBUST, VERSATILE – IT'S HALLINONE®

“Eureka!” Dr. Hans-Peter Hohe and his team of researchers thought to themselves when their 3D measurement solution resolved both weaknesses in Hall sensor design. The new HallinOne® sensor they came up with was able to record a magnet’s position not only on a single plane, but also within three-dimensional space. This finally made reliance on stable temperatures and external magnetic fields a thing of the past. The jury for the Joseph von Fraunhofer prize was equally impressed by this world first – so much so that they awarded the scientists the 2013 prize for their unique development.

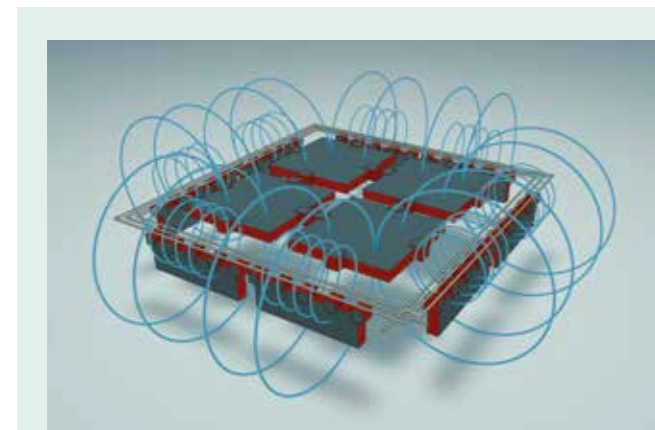
## Measuring magnetic fields spatially

Modern cars contain some 100 sensors that measure the position of safety belt buckles and door locks, register pedal positions, or are used for ABS and engine control. While they are cost-effective and robust, these conventional sensors generally measure only the magnitude of the magnetic field perpendicular to the chip surface. This is often good enough, but precision is limited and the magnetic field measurement is also susceptible to interference. Furthermore, conventional Hall sensors generally only measure the magnetic field at a single point, and do not measure its gradient. Hans-Peter Hohe and his team were not satisfied with these limitations. They wanted a precise, three-dimensional position measuring system that had all the advantages of magnetic field sensors but could also work under all conditions without being affected by external magnetic fields. They started by focusing on the sensor element itself, and how to make it suitable for multi-

ple applications. Once they began collaborating with Seuffer GmbH in 2000, their focus shifted to use of the technology in washing machines. The challenge was to improve the smooth running of conventional washing machines, which often move in undesired ways due to bulky items of washing or oversized loads. To guarantee that machines run smoothly, scientists had to develop a way for washers to immediately identify when they are out of balance and be able to correct the imbalance themselves – which they did. The new sensor also weighs the laundry, making poor washing performance as a result of overloading a thing of the past.

## Opening up a broad range of possibilities

Dr. Markus Stahl-Offergeld recalls how the new generation of Hall sensors came into being. “Initially, our idea was to increase the measuring precision of multiple individual sensors on a chip by interconnecting them. Then we arranged them



## How HallinOne® works

The Hall effect describes the production of a voltage difference caused by the Lorentz force across an electrical conductor, transverse to an electric current in the conductor and a magnetic field perpendicular to the current. This effect is used in the contactless measurement of object positions. HallinOne® not only measures perpendicular to the chip surface, as conventional Hall sensors do, but also measures magnetic fields aligned parallel to the chip surface. This enables 3D magnetic field measurement.



in such a way that they measured the magnetic field in three dimensions at a given point. And that’s where our pixel cells came from.” They had created HallinOne®, a product able to measure in three dimensions by recording all three spatial axes of a magnetic field. The system then uses this data to calculate the exact position of an object without disruptions through temperature fluctuations. The chip has a separate sensor for each of the three axes, which allows it to measure the magnetic field vector completely, in all directions. At the same time it digitizes the readings and sends them on to a computer or microcontroller. It is also possible to embed evaluation electronics and a coil for self-testing and calibration directly onto the sensor chip itself. Its gradient evaluation capability makes HallinOne® robust enough to withstand external magnetic fields. For all its complexity, HallinOne® can still be manufactured using commercially available standard type semiconductor process technology, which keeps costs low. What’s more, it is also possible to easily integrate custom electronics at any stage.

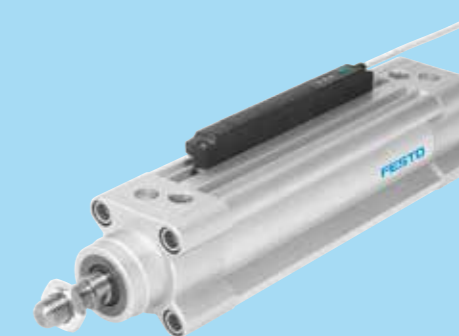
Because of these advantages, the technology is now being used successfully in many branches of industry. HallinOne® can be used wherever contactless methods are employed to measure changes in position. The system also benefits manufacturers of tractors and construction machines, as the fact that HallinOne® sensors are not compromised by dirt or temperature fluctuations makes them ideally suited to outdoor applications. “Conventional Hall sensors measure field strength,” explains engineer Michael Hackner, “which changes with fluctuations in temperature. HallinOne®, by contrast, measures the magnetic field vector and thus the direction of the magnetic field. Since the spatial profile of the magnetic field lines correlates to the geometry of the magnet regardless of temperature, the system produces measurements that are always stable.” Or, put another way: the system works whether it’s fitted on digger is shoveling snow in Siberia or sand in the Sahara.

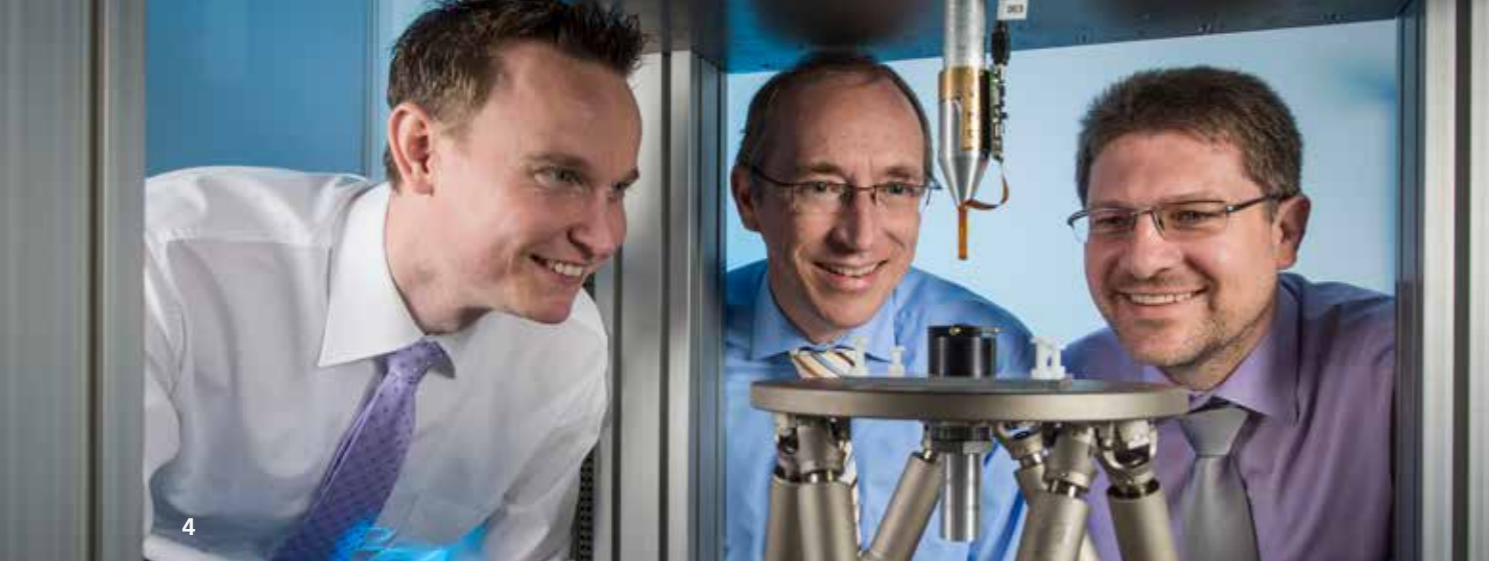
**1+2** There are countless fields of application, ranging from agriculture to construction.

**3** Cylinders used in automation technology make use of HallinOne® and its advantages.

## HALLINONE®: MANY DIFFERENT FIELDS OF APPLICATION

- Joysticks/position controllers for computers and machinery for industrial, construction, agricultural and automotive applications
- Measurement of energy consumption and energy saving potential in drive technologies and plumbing/electrical systems
- Multi-axis position detection for windows and doors
- Magnetic environment detection – e.g. in medical devices
- Single or multi-axis rotation angle measurement in chassis, steering and inspection systems





4

## AN INTERVIEW WITH DR. HANS-PETER HOHE

Hans-Peter Hohe and his team developed HallinOne® over a period of 15 years of research and development work. But they didn't stop there – the team is still expanding the sensor's capabilities.

### What drove you and your colleagues to continue working on HallinOne® over such a sustained period?

In the very beginning we were driven by our vision of using vertical Hall sensors to create the first magnetic field sensor able to be produced cost-effectively using standard CMOS technology but still able to measure the complete spatial magnetic field vector with its three components. We weren't aiming to develop the best 3D sensor, just to make the best 3D sensor on a standard-CMOS basis. Thus throughout the development process we were always firmly focused on the product's many possible applications. And we were certain about one thing: if our 3D sensor was to benefit numerous interesting applications, the sensor had to be significantly less expensive to produce than comparable solutions. Over the course of its development, more and more attractive features got added to the sensor, including a self-monitoring capability via an integrated coil and the possibility of developing more robust systems using gradient measurement.

### What were the key developmental stages for HallinOne®?

We passed the first key stage back in 2000, when we realized that our idea – our approach – for vertical Hall sensors would actually work. From then on we began working to implement a production-ready 3D magnetic field sensor able to be integrated into different applications. We were given another boost by a potential client, who expressed an interest even though the sensor's properties were still far from optimal at the time. This confirmed to us that our technology was urgently needed.

It wasn't easy to fund the development in the early years. However, thanks to outstanding teamwork we were still able to continuously make good progress. Another important milestone was the brainchild of Martin Schaller from Seuffer, who had the idea of using our 3D sensor for detecting imbalance in washing machines. This was the initial step on the way to the first series production of HallinOne® sensors, as we've been calling them since 2006. Through this pilot application, we were able to show that our HallinOne® sensors could easily be manufactured in series – which was extremely important for further marketing of the sensor. This eventually led to us sub-licensing our HallinOne® technology to Micronas, a company that has also just come on board the series production of HallinOne® sensors. Somewhat later we developed standardized products with ams AG that the company now produces and distributes under license. We are very pleased that our technology has come as far as it has, and managed to find its way into so many different applications and industries.

### What are you working on currently, and what will be possible in the future?

We are currently working on algorithms for multidimensional position calculation. This will make it possible to one day determine both the position and the orientation of a magnet using a HallinOne® sensor located nearby. Another avenue we are pursuing is the so-called magnetic 'color' camera. It is built around a flat array of 3D magnetic field sensors that can be used to control the quality of high-quality permanent magnets, or to analyze arcs. What's more, we believe that if these magnetic field cameras were to be embedded on a chip one day, they would also be able to determine the positions of multiple magnets at the same time. But that's just a distant vision at the moment.

## AN INTERVIEW WITH ANDREAS BUCHHOLZ

Andreas Buchholz is Head of Research and Development at Seuffer GmbH & Co. KG in Calw, Germany. Seuffer was one of the first companies to capitalize on HallinOne®'s potential. Seuffer is based in Baden-Württemberg and is an automotive and white goods supplier employing some 530 staff.

### How did the cooperation between Seuffer and Fraunhofer IIS progress?

We started having initial discussions with Fraunhofer IIS back in 2000. We firmed up our ideas four years later, when we discussed the first design sketch together. At the end of 2004, Fraunhofer IIS sent us the first rotation-angle magnetic field sensor, and a mere two years later Seuffer brought the first imbalance sensor for washing machines onto the market. By March 2009, we had already fitted over a million washers with the 3D sensor, and by the end of 2013, the total number of sensor units sold had topped four million.

### What advantages have you gained from working together?

Our close and collegial cooperation with Fraunhofer IIS goes beyond the usual customer-supplier relationship. The way our employees relate to one another on a technical as well as personal level generated unique approaches to the technology we were developing. In addition, Fraunhofer IIS is a reliable and flexible partner for the launch of ASICs in series production. In November 2008, this development secured us the Baden-Württemberg Innovation Award for outstanding contributions by SMEs to the development and application of new technologies. So besides the economic benefits that the cooperation brought us, it gave us yet another plus that we are particularly proud of.



5

### What does Seuffer use the HallinOne® sensor for?

As things stand it is primarily used in washing machines. A magnet is attached to the tub and the sensor to a fixed, unmoving part of the washing machine. Depending on how much washing is in the drum and how it is distributed during a spin cycle, the tub moves and therefore the magnet too. The sensor measures this movement, evaluates the data, and transmits it to the washing machine. If the drum is wobbling, it is stopped briefly and shaken around a bit in order to distribute the washing more evenly.

### Do you have further applications in mind?

At the moment we're also working on projects for determining the position of mechanical components in the automotive field, which involves complex controls or contactless position determination in complicated mechanical structures. The broad range of inquiries we receive from the car and commercial vehicle sector shows how universally applicable this technology is.

4 Winners of the Joseph von Fraunhofer Prize 2013:

Dr. Markus Stahl-Offergeld,  
Dr. Hans-Peter Hohe und  
Michael Hackner (from left).

5 Intelligent: HallinOne® ensures washing machines run smoothly.

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## CINEMA'S DIGITAL REVOLUTION

What makes movies so captivating is the amazingly high quality of the visual and acoustic experience. The impact of digital media on moviegoers' habits has finally been recognized by the film industry, albeit very late, especially given that HD flat screens, 3D monitors, home entertainment systems and mobile devices have raised the bar ever higher. Once the first silver-screen-suitable hardware solutions were in place, the technical standards and the appropriate software solutions needed for the digital revolution were still missing – Fraunhofer IIS researchers have filled that gap with the development of easyDCP software.



*Post-production color correction for the big screen with easyDCP and DaVinci Resolve software.*

# SOFTWARE CONVERTS FOOTAGE INTO DIGITAL CINEMA PACKAGES

For over 100 years, film was the refuge of analog technology. But the ever-increasing power of computers makes digitization in the film industry possible. Of course the highest quality standards for picture and sound stand in the foreground for the big screen, and this is even truer when it comes to digital technology. In 2007, after publication of the technical specifications and test results of the Digital Cinema Initiatives (DCI), hardware components were available, but no appropriate software tools to standardize and create digital cinema packages (DCPs). To fill this gap, Fraunhofer IIS researchers came up with easyDCP, an easy-to-use solution that enables even low- and limited-budget filmmakers to keep calling out: Action!

## Basis for digital cinema

In the film industry, analog motion picture film material – from celluloid to polyester – was used until the end of the twentieth century. It had to be spliced on the cutting table or scanned and digitized after processing for special effects, and then fully exposed onto film once again. These film reels were then delivered to the movie theaters.

Due to George Lucas' very successful effects and processing in his Star Wars films, the pressure for other film productions to digitally rework scenes

or enrich movies with special effects increased so as not to fall behind other film productions in the race to attract audiences. But this hybrid seesaw of production processes consistently led to ever-increasing costs, and required considerable time. With the development of digital film cameras and cinema-quality servers and projection technology, the motion picture industry began the transition to all-digital working processes for the big screen. Improved image quality, reduced distribution costs and piracy protection were all clear advantages of the switch to digital processes. A group of Hollywood studios agreed on a basic specification for digital cinema in 2000. With the establishment of Digital Cinema Initiatives (DCI), a joint venture of the six largest Hollywood studios, the film community began to address questions concerning standards and the quality requirements for distribution and digital reproduction, in a bid to emphasize the superior quality of films produced for cinema viewing as opposed to TV productions, which are adapted to less demanding sound and picture standards, and the ever-increasing capabilities of game consoles and other devices.

As part of this move toward digital processes, a new software-based format for digital motion pictures was introduced – the digital cinema package (DCP). In mid-2005, DCI awarded a contract to Fraunhofer IIS to develop a compliance test plan (CTP) to provide uniform test procedures for demonstrating compliance with its digital cinema system specifications (DCSS). Today this test plan is the global benchmark for

assessing the quality of digital playback systems in theaters. Already at this early stage, it was clear that test and production procedures for digital film were very complex. Tests conducted in

the Erlangen labs on all major brands of equipment turned up a multitude of potential sources of error; none of the systems could play back all of the digital films without errors.

The CTP specifies hundreds of tests that the playback system must pass in order to achieve DCI certification. Today, this certificate is the absolute prerequisite for playing back encoded "blockbusters" in every theater and on any server. Software modules have been developed to map the corresponding elements of the test plan in the software. Parallel to the test plan, the standardization of the user profiles for motion picture data compression (the JPEG 2000 profile) was developed under the direction of Fraunhofer IIS in the appropriate ISO working group. Extensive testing led to optimized parameter sets, which included contributions from Fraunhofer IIS experts regarding investigation into color space and image quality for digital film, the determination of target parameters for the encoding codecs and the creation of test plans for achieving worldwide compatibility. easyDCP is the result of the deve-

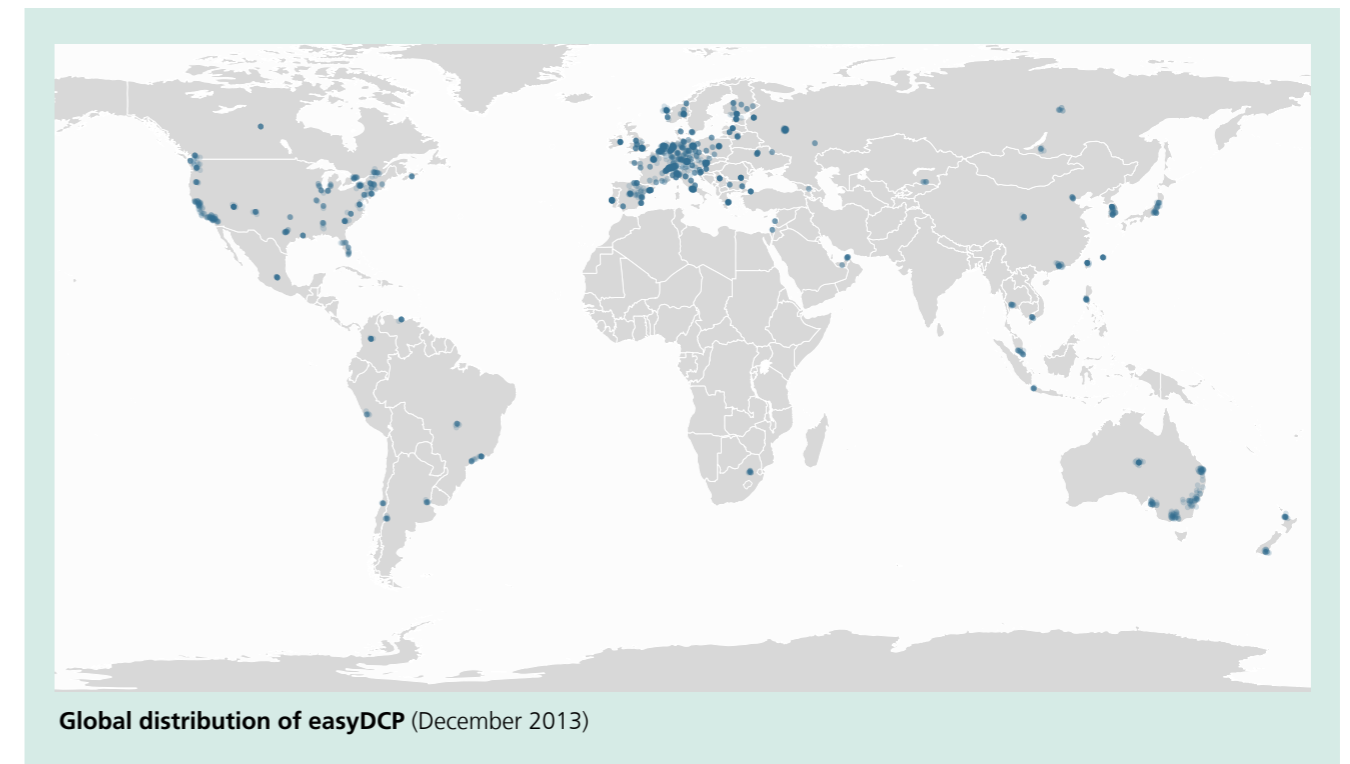
lopment of tools for the creation and quality control of digital film formats that make the complex procedures easier for users to perform. Now even amateur filmmakers can produce content for the big screen. This simplified tool for creating and encoding digital cinema packages ensures that even low- and limited-budget filmmakers will be able to screen their productions to a wide audience in the age of digital cinema.

## It's so easy ... tools for digital cinema packages

The film and TV industry has been quick to accept the new tools thanks to their convincing performance and practical user features. The organizers of major events such as the Berlin Film Festival have been using them for several years to preselect entries or fix problems quickly using Fraunhofer's integrated know-how. In the meantime, other user groups have been won over, including cinema advertisers, cinema operators, film archives, and suppliers and manufacturers of post-production and editing software. Today, easyDCP is a success-

ful revenue-earning product, especially through licensing fees, and is integrated in many post-production tools marketed by the major suppliers to the film and TV industries.

Current integration projects – either in direct cooperation with manufacturers or in collaboration with industry partners – account for about 60 percent of the market share of all manufacturers included in the study, foremost among them Quantel, and Avid. A further partner is Blackmagic Design, whose color correction software DaVinci Resolve 10 has included easyDCP as a standard offering for the past several months.



Global distribution of easyDCP (December 2013)



## AN INTERVIEW WITH HEIKO SPARENBERG

For Heiko Sparenberg, head of the Digital Cinema team in the Moving Picture Technologies department, the process of creating easyDCP software for post-production and its consequent further development is one of the most important focuses of his group.

*The easyDCP software created by Fraunhofer IIS has become one of the most highly reputed digital film and post-production tools on the market. How do you view this success?*

What in the end turned out to be such a great success for my group's development work couldn't possibly have been predicted. While opening up digital cinema to the major studios, we wanted to do the same for smaller, independent production companies and provide them with reliable solutions that are easy to use because they often have to work without a large staff of experts. That also explains the name: easyDCP. People laughed at first, but now it's treated as a standard and known throughout the industry. It was difficult to get a foothold in the industry as a research institute, even with such well-known developments as mp3 or the DCI specifications behind us. But from the beginning we concentrated on the needs of our users and customers, which is why, in addition to developing the software, we constantly sought out a dialogue with users, producers, and studios to optimize the product with their interests in mind.

*What were the biggest challenges for you so far?*

Let me answer that question two ways. From a technical standpoint, the development of a software tool that is platform-independent and allows DCPs to be produced and played back on standard hardware – there were numerous programming-specific hurdles there. In addition, it was important to ensure that the DCPs generated could be played back reliably on the various cinema servers without any dropouts

and didn't just result in a black screen. From the product management standpoint, the intensive exchange of information with our customers and partners was as important to us as the product's reliability. We were able to dispel doubts concerning the security of software-based solutions by providing intensive advice on appropriate security mechanisms and by pointing to the progress of digitization in the industry.

*If you could name only three things that give easyDCP the edge, what would they be?*

First of all, the convenient and easy operation, then its relatively low price since no complicated hardware is necessary, and finally the possibility of integrating the functionality of easyDCP into other professional post-production environments. This guarantees a time-optimized workflow.

*How do you assess easyDCP's market opportunities in the next two to three years? What are you planning?*

Even with over 1,000 licenses worldwide and other competitors, I still don't think we've reached market saturation. The current trend for our software is the entry into or cooperation with many leading manufacturers of post-production software. They have been integrating easyDCP into their products as an extra to enable people in the industry the complete workflow from start to finish – from creation to conforming and mastering to playback. We're seeing quite an increase in this demand, and not just from highly professional clientele.

*Do you have any concrete future plans?*

The next step will be to expand the possible formats for easyDCP to include the Interoperable Master Format (IMF).

## easyDCP SUMMARIZED

- Completely software-based and optimized to work with standard software
- Convenient and easy to use; even small and medium productions can create DCPs correctly
- Includes tools to create, play and encode DCPs
- Standard compliance in accordance with international specifications for digital cinema
- Platform-independent and reliable in the creation of DCPs
- Stand-alone or as a plug-in integrated in post-production tools from other manufacturers, including Blackmagic Design and Quantel
- Also used by film festivals including the Berlin Film Festival
- Marketed worldwide by the distribution partner easyDCP GmbH

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[www.iis.fraunhofer.de/easydcp](http://www.iis.fraunhofer.de/easydcp)

1 With easyDCP, digital cinema packages can be simply created, played back and encoded on a standard PC.



# 11 THINGS YOU ABSOLUTELY MUST KNOW



## COLLABORATIVE PROJECT TO SOLVE AGE-OLD MYSTERY

Fraunhofer IIS is one of the partners in a joint project led by the German National Museum and the Georg Simon Ohm University of Applied Sciences in Nuremberg. The aim of the project is to finally resolve the controversial question as to who first invented the pocket watch. Of the eight possible candidates, two are the Peter Henlein pomander watch, which forms part of the German National Museum's collection, and the Melanchthon watch owned by the Walters Art Museum in Baltimore, Maryland. Both of these timepieces were examined by experts at the X-ray Development Center in Fuerth-Atzenhof EZRT. The Fraunhofer experts used a micro-focus X-ray system to conduct precise measurements of the internal structure of the timepieces, which will enable the historians to identify their age. The results of these dating tests will be presented during a special exhibition at the German National Museum in December 2014. Virtual imaging software developed by the University of Applied Sciences in Nuremberg will be used to process the images recorded by the Fraunhofer Development Center for X-Ray Technology to allow visitors to take a virtual look inside these treasured masterpieces of the watchmaker's art.

## FRAUNHOFER SCS PUBLISHES STANDARD REFERENCES

In 2013, Fraunhofer SCS published a number of studies on logistics and related technologies and services, including a study devoted to city logistics. Two publications have become standard reference works for logistics and real estate professionals: "TOP 100 in European Transport and Logistics Services" and "Logistics Real Estate – Market and Regions 2013," which provide an in-depth analysis of trends in the European logistics market and evaluates the main logistics regions in Germany, Austria, Switzerland, Belgium and the Netherlands. Another study examines the potential benefits to be gained from the use of RFID technology in logistics applications. The recently created Center of Age-Sensitive Services ZAD has published an informative brochure on age-sensitive market research, which provides an overview of relevant current findings and theories from the fields of psychology, medicine and interdisciplinary research on aging.



[www.scs.fraunhofer.de/en.html](http://www.scs.fraunhofer.de/en.html)

## AN ARMCHAIR AS YOUR PERSONAL TRAINER

Not only are our lives getting longer, but increasing numbers of older people are left alone to take care of themselves. That is why researchers are developing technologies to facilitate our lives when we, too, grow older. As a member of the Gewos consortium (Gesund wohnen mit Stil), Fraunhofer IIS has developed a smart armchair that is comfortable enough for lounging in front of the TV but also includes features that enable us to stay fit and healthy. Outwardly, the GEWOS movement chair, manufactured by Himolla GmbH, looks just like any normal armchair. But looks can be deceiving: a glimpse underneath its seat cushions, back support and padded armrests reveals a host of sensors, circuit boards and all kinds of electronic devices. These integrated microelectronic systems continuously monitor the health of the armchair's occupant.

The data recorded by the sensors are transmitted to the TV screen via Bluetooth and Wireless LAN by a tablet PC integrated in the armchair. The displayed information enables the seated person to monitor changes in their heart rate, blood oxygen level, blood pressure and body weight over a defined period of time. If these vital signs deviate from a set range of values, the health assistant function kicks in, for instance recommending an exercise routine. The armchair is transformed into a rowing machine, in which the armrests are the oars and a foldaway foot support emerges from beneath the seat. The user chooses an appropriate exercise using the TV remote control. During the training session, the sensors continue to record vital signs and the health assistant alerts the user if the exercise is not being carried out correctly.



[www.gewos.org](http://www.gewos.org)





## RELIABLE POSITIONING WITH SINAFA R

SiNafaR is a project that derives its name from the German acronym for "safe navigation for autonomous robot systems." Its aim is to make robot navigation safer and more reliable. This research has led to considerable advances in the field of autonomous control systems. Remote-controlled air vehicles are already being used in aerial photography for the inspection of wind turbines, for example. But the controls have always been in the hands of specially trained operators, because the Global Positioning System (GPS) currently used to determine the position of unmanned air or ground vehicles is too unreliable, which sometimes causes the (semi) autonomous vehicles to deviate from their programmed route. These inaccuracies have to be corrected manually. Measures to improve the accuracy of these coordinates are an important component of the SiNafaR project. In collaboration with its partners, EADS Innovation Works, Zentrum für Telematik e. V., the University of Würzburg, and wilkon Systems GmbH & Co. KG, Fraunhofer IIS has developed an optimized system for the remote control of heterogeneous robotic systems. This research project is funded by the Bavarian Ministry of Economic Affairs, Infrastructure, Transport and Technology and supervised by IABG GmbH. Fraunhofer IIS is responsible for the system integration of the positioning technologies. The main objective of the Fraunhofer IIS researchers was to ensure that the remote-controlled robots can be navigated safely and are capable of automatically detecting and circumventing obstacles.



<http://www.iis.fraunhofer.de/en/bf/In/referenzprojekte/sinafar.html>

## INTELLIGENT TRAINING WITH SPORTS SHIRT AND E-BIKE

A new sports shirt has been developed that will help gym visitors to pace their training and avoid over- or under-exertion. Coupled with a smartphone and an e-bike, it becomes part of an intelligent training machine. The FitnessSHIRT developed by researchers at Fraunhofer IIS continuously measures physiological signs such as changes in respiration, pulse rate and heart rate variability and transmits this information to its wearer. Conductive textile electrodes woven into the fabric capture data on the wearer's cardio activity, and an elastic chest band records respiratory movements. A detachable electronic unit then uses special algorithms to convert these raw data into more familiar units such as pulse and respiration rates. The data can be transmitted to a smartphone or PC via a wireless link, enabling them to be further processed for evaluation of vital functions such as stress, physical capacity, eustress and distress. The comfortable fit of the garment and the opportunities it offers for monitoring performance data caught the attention of the designers of the MENTORbike – a novel training system consisting of an e-bike, a smartphone, and an intelligent service platform. The project partners led by BitifEye Digital Test Solutions intend to apply their concept in combination with the smart cycling shirt. It will be linked via a Bluetooth-enabled smartphone to the bike and the Internet platform used to analyze and document the data. The smartphone mounted on the handlebars collects the transmitted vital parameters and turns on the electric motor when required. Industrial partner Vitalshirt plans to start production of the FitnessSHIRT for commercial distribution in the 2nd quarter of 2014.



[www.iis.fraunhofer.de/fitnessshirte](http://www.iis.fraunhofer.de/fitnessshirte)

## TSG HOFFENHEIM ADOPTS REDFIR® WIRELESS TRACKING TECHNOLOGY

RedFIR® helps the trainers at TSG 1899 Hoffenheim to analyze the performance of its junior players, both as a team and individually, when training and in competitive matches. During training, miniature radio transmitters worn by the soccer players and built into the ball emit signals to a ring of antennas surrounding the training ground, recording each movement of the players and the ball. The captured data are analyzed using an SAP HANA platform and delivered to the trainer in real time. This enables the trainer to give the players on-the-spot feedback on their game performance and training progress. The RedFIR® system is also capable of providing a tailored analysis and evaluation of the players' actions with the ball, like ball possession (number and duration of possessions), passing (successful passes, misdirected passes, forward passes, one-touch passes) or goal attempts (shots on goal). The software can also be used to simulate entire tactical maneuvers.



[www.iis.fraunhofer.de/redfir](http://www.iis.fraunhofer.de/redfir)

## DRESDEN BRANCH OF THE INSTITUTE: SPACE POSITIONING

To ensure that satellite radio and TV signals are received correctly, the broadcasting satellites must remain in a constant position relative to the Earth's surface. This requires occasional corrections to their orbital path. Fraunhofer IIS/EAS and SES ASTRA have been working on a new technical solution to optimize this maneuver. The result is an extremely precise method for determining the position of geostationary satellites, which opens up new possibilities for their operation. The innovative, low-cost measuring system known as Passive Correlation Ranging (PaCoRa) is highly flexible and offers a method of minimizing the fuel consumption of the rocket motors used to correct the satellite's orbit with relatively little effort. Instead of sending special location signals, PaCoRa employs a method based on the processing of the standard digital signals used in radio and TV broadcasting. The partners received support for this project from the European Space Agency (ESA).



<http://s.fhg.de/qGc>



## EMBEDDED WORLD 2013: SPECIAL AWARD FOR FRAUNHOFER IIS SCIENTISTS

Researchers in the departments of Communication Networks and Power Efficient Systems received the special exhibition and conference in Nuremberg embedded AWARD on February 26, 2013 at the embedded world for the combination of two easy-to-apply technologies. The maintenance-free, energy-autarkic and wireless multi-hop sensor network simplifies the implementation of applications to perform structural monitoring, control machines and equipment, automate complex buildings, and provide smart metering or security functions.

The basis for the sensor communication is known as the s-net@ wireless protocol stack, which requires only the smallest amounts of energy to initialize and operate a wireless multi-hop sensor network. When these highly efficient power management circuits from Fraunhofer IIS are combined with energy harvesting – energy production from the local environment, such as through temperature or electrical oscillations – batteries and their subsequent maintenance become superfluous. This solution makes it possible to create wide-area, maintenance-free, wireless sensor networks for the Internet of Things.



[www.iis.fraunhofer.de/prs02](http://www.iis.fraunhofer.de/prs02)



## HDR FOR MOVING IMAGES – BRILLANT PICTURES IN ANY LIGHT!

The spotlight bathes the singer in bright light. The rest of the band and the background disappear into darkness, or else the singer's face appears indistinct or masklike because of the harsh light.

In order to optimize the shot under these difficult conditions, the engineers in the Moving Picture Technologies department present an HDR prototype camera array for professional moving pictures. HDR stands for high dynamic range, which means the range in contrast between the brightest and the darkest pixel that the camera can capture is enhanced. Each camera in the array records a differently exposed image during the shooting. In a post-processing step, the images are automatically fused together into a single HDR image with highly dynamic range.

By avoiding a series of time-sequential multiple exposures, double images in moving pictures are avoided. For HDR, researchers use a camera array consisting of several individual cameras with various filter attenuations. Using a powerful algorithm, the engineers assemble the different individual shots into an HDR image. This is a clever solution in situations where a single standard camera would be unable to cope with the complete range of contrasts in the scene – an unrivaled requirement for a perfect picture.



[www.dcinema.fraunhofer.de/ibc2013](http://www.dcinema.fraunhofer.de/ibc2013)



## REVOLUTIONARY 3D AUDIO EXPERIENCE FOR THE CAR

A concept car with 3D sound experience is the result of a three-way cooperation between Bang & Olufsen, Audi and Fraunhofer which will revolutionize previous expectations about what car audio systems can do. The Audi Q7 was presented at the 2013 Consumer Electronics Show in Las Vegas.

The new 3D audio system plays back music in three dimensions once it is analyzed in detail based on psychoacoustic parameters. This analysis makes an intelligent distribution of the incoming signal to the car's loudspeakers, which results in a highly accurate reproduction of the original three-dimensional sound. With the touch of a button, users can change the settings with the help of Audi's multimedia interface and customize the 3D intensity. Harald Popp, head of the Multimedia Realtime Systems department at Fraunhofer IIS, says "Thanks to the results of our research and development in the field of 3D audio, the Bang & Olufsen Advanced Sound system in the Audi Q7 concept car has impressive dimensionality and ambiance, which acoustically dissolves the geometry of the car. The system plays back the music's pristine depth with a precision that is a whole new experience for the listener."



[www.iis.fraunhofer.de/symphoria](http://www.iis.fraunhofer.de/symphoria)

## DEPARTMENT OF IMAGE PROCESSING AND MEDICAL ENGINEERING ISO 13485 CERTIFIED

The Image Processing and Medical Engineering department at Fraunhofer IIS has established a quality management system based on DIN EN ISO 13485 "medical devices – quality management systems – requirements for regulatory purposes" and the related design of the development processes.

Certified in early 2013, the quality management system guarantees that the legal requirements applicable to the development of medical devices are met during the research and development process. At the same time, it provides more transparency and control of the process workflows. The certified management system can speed up the development process for medical devices, increase their safety and reliability and minimize their potential risks. Fraunhofer IIS customers can apply the resulting research from Fraunhofer IIS directly in their medical devices which means the approval process is significantly simpler and faster.

The scope of the quality system covers all developments of the Image Processing and Medical Engineering department at Fraunhofer IIS and will be applied to hardware and well as software development. With certification, the time to market is shortened; research results in the form of medical products reach the market faster.



[www.iis.fraunhofer.de/pms01](http://www.iis.fraunhofer.de/pms01)

# NOTABLE EVENTS OF THE YEAR



## INAUGURATION OF CENTER OF AGE-SENSITIVE SERVICES ZAD

The Center of Age-Sensitive Services ZAD was inaugurated in Nuremberg on June 19, 2013. Operated jointly by the Center for Applied Research on Supply Chain Services SCS (representing Fraunhofer IIS) and the Friedrich-Alexander-Universität Erlangen-Nürnberg, the center offers services based on research into the related subjects of age, aging and demographic change. Professor Heuberger comments: "The social impact of demographic change brought about by a combination of low birth rates and an increasingly elderly population deserves greater attention. By setting up the ZAD in collaboration with the University of Erlangen-Nürnberg FAU, we wish to play a part in mastering these challenges." With expert advice and the use of reliable, scientifically proven tools, answers can be found to even the most complex issues and specific topics – from the development of age-appropriate products and services and adapted workplace solutions to general questions concerning future business strategies. The ZAD employs an interdisciplinary approach involving partners with specialist knowledge in gerontology, psychology, the social sciences, ergonomics and industrial engineering, and business information systems. All solutions are developed with an emphasis on applicability in a business context. The ZAD receives financial support from the Bavarian Ministry of Economic Affairs and Media, Energy and Technology.



[www.zad-nuernberg.de](http://www.zad-nuernberg.de)

## INAUGURATION OF L.I.N.K. TEST AND DEMONSTRATION CENTER

On April 26, 2013, Fraunhofer IIS inaugurated a new test and demonstration center devoted to positioning, identification, navigation and embedded communication technologies. The L.I.N.K. center in Nuremberg was created as the result of a joint initiative by the European Union, the German federal government, the Bavarian regional government, and the Fraunhofer-Gesellschaft. It provides an optimized working environment in which not only the IIS but also its customers and partners can test new technologies under realistic conditions and improve their process workflows. This work is backed by the institute's R&D expertise in positioning, communication and identification systems and in supply chain technologies and services. Offering 1,400 square meters of laboratory space and a further area of 10,000 square meters for outdoor testing, this in-house facility is used by Fraunhofer IIS researchers to develop, test and integrate new positioning and communication technologies, including GPS and Galileo satellite navigation, radio-assisted location systems, RFID and smart-object technologies, WLAN and wireless sensor networks. Depending on the application, the IIS develops new solutions from scratch or on the basis of existing technologies, and is thus able to offer future-oriented solutions for numerous sectors of industry. The center is equipped with a unique test infrastructure, including a newly developed 3D positioning system that allows series of measurements to be conducted automatically at up to 1,000 measurement points with a resolution and repeat accuracy of  $\pm 1$  mm. Endurance tests of supply-chain and logistics applications can be conducted using a combination of indoor and outdoor test environments. The outdoor area includes a test track for the road testing of radio-controlled driver assistance systems.



[www.iis.fraunhofer.de/testbeds](http://www.iis.fraunhofer.de/testbeds)

## IIS FOUNDER CELEBRATES HIS 80<sup>TH</sup> BIRTHDAY

The founder of Fraunhofer IIS, Prof. Dr.-Ing. Dieter Seitzer, celebrated his 80th birthday on April 17, 2013. To mark this occasion, selected guests were invited to attend a special reception held by the institute on April 18, 2013, including high-ranking representatives of the business, science and political communities, and numerous friends and acquaintances who had accompanied Professor Seitzer during his career. The event honored Professor Seitzer's determining influence on a whole generation of microelectronics engineers trained at the engineering faculty of the Friedrich-Alexander-Universität of Erlangen-Nürnberg, and his role as the founder of Fraunhofer IIS, which he directed from its creation until 1998. As the engineering faculty's technology transfer officer, Professor Seitzer was responsible for establishing a liaison office for research and technology transfer in 1981. Under his management, this was transformed in 1984 into the Center for Microelectronics and IT Research, which in 1985 gave rise to the Fraunhofer Working Group on Integrated Circuits and five years later the Fraunhofer Institute for Integrated Circuits IIS. Professor Seitzer was one of the first to recognize the potential of audio data compression. He developed the basic principles while still a student, and continued to devote considerable efforts to enhance the technology after joining Fraunhofer IIS. The result was the mp3 format, today recognized as an industry standard throughout the world. Professor Seitzer has received many distinctions, including the Order of Merit of the Federal Republic of Germany (first class), the Bavarian government's state medal, the Order of Merit of the Free State of Bavaria, the city of Erlangen's Golden Ring, and the Bavarian Maximilian Order for Science and Art.



[www.iis.fraunhofer.de/pms03](http://www.iis.fraunhofer.de/pms03)



## FIRST EVER IEEE SYSTEM ON CHIP CONFERENCE HELD IN GERMANY

From September 4–6, 2013, the IEEE System on Chip Conference (SoCC) took place on German soil for the very first time. Fraunhofer IIS in Erlangen hosted more than 100 international, high-ranking participants from across the entire SoC research and development community for the 26th SoCC. The conference program included challenging lectures, workshops and presentations of scientific papers and project case studies. Ron Martino, Vice President Microcontroller R&D at Freescale Semiconductor Inc., a global leader in Embedded Processing Solutions, gave a keynote speech on “The SoC innovations roadmap.” Further introductory talks were given by Kaijian Shi, Technical Program Chair, and Carsten Elgert, Cadence Director of Product Marketing for IP based in Munich, who spoke about “Strategies for the correct use of IP in SoCs.” Volker Politz, VP Business Development at Imagination Technologies USA, gave his perspective on future heterogeneous SoC architecture with lower power dissipation.

The Fraunhofer IIS has long been active in system-on-chip development and sees it as great recognition that the conference was held at the institute. “For us, it serves to honor the research work we do,” says Norbert Schuhmann, General Chair of the SoC Conference and head of the research department Digital System Development at Fraunhofer IIS. System on Chip (SoC) refers to the integration of an entire electronic system on a chip and is the basis for many of today’s technologies found in cell phones, mp3 players, video systems, vehicles and automation technology.



[www.ieee-socc.org](http://www.ieee-socc.org)

## NEW EZRT BUILDING OPENED AT FUERTH LOCATION

X-ray technology is nothing new at Fraunhofer IIS. Originally created from a joint department of Fraunhofer IIS and Fraunhofer IZFP in Saarbruecken, it was a field that offered great potential from the outset. With the opening of the new Development Center for X-ray Technology EZRT building in Fuerth-Atzenhof on July 11, 2013, a single building infrastructure was created in which to house all employees who had previously been spread over several Fraunhofer IIS locations. The new facility allows Fraunhofer IIS to pool various measuring and testing technologies under one roof and to expand the internationally active Center for Non-destructive Component Testing and Material Characterization. “Making the invisible visible using the latest X-ray technology is the key competence of our new site in Fuerth-Atzenhof,” explains Professor Albert Heuberger, Executive Director of Fraunhofer IIS. “The Development Center for X-ray Technology strengthens our presence in the European metropolitan region of Nuremberg,” adds Professor Randolph Hanke, Head of the Development Center for X-ray Technology.



[www.iis.fraunhofer.de/pms05](http://www.iis.fraunhofer.de/pms05)

## SIEGFRIED FÖBEL NAMED SMPTE FELLOW

The Society of Motion Picture and Television Engineers awarded Dr. Siegfried Föbel Fellow grade membership for his outstanding achievements and contributions to innovation within the motion picture and television industry. Föbel and his team initiated and ran many well-known projects that introduce and evaluate future-oriented innovations for both motion picture and broadcast systems. Of particular note are the standards and technical specifications for SMPTE and the International Organization for Standardization (ISO) that he and his team developed on behalf of the Digital Cinema Initiatives DCI.

They also adapted the specifications for Germany and its Länder, developing and publishing these on behalf of the German Federal Film Fund. Software developments such as the easyDCP software suite allow even small and midsize post-production companies without access to specialists and in-depth expertise to generate a perfect digital cinema package (DCP) able to be shown in every digital cinema. In addition, the development portfolio of Siegfried Föbel’s team of Fraunhofer IIS experts is enhanced by a number of camera innovations, camera electronic developments and solutions for digital film archiving. Currently, the IIS scientists are working on new formats for scalable workflows, as well as focusing on new recording technologies using high dynamic range (HDR) and light-field recording and processing technologies as part of their work on future innovations in moving picture technology.



[www.iis.fraunhofer.de/prs06](http://www.iis.fraunhofer.de/prs06)

## ART & TECHNOLOGY – NEW SERIES OF EVENTS AT FRAUNHOFER IIS

Art meets Technology: Fraunhofer IIS in Erlangen will be hosting exhibitions every six months designed to capture the exciting interplay between art and technology. At the Art & Technology launch in May 2013, artworks by Elvira Gerhäuser were shown in combination with SHORE™, the facial recognition software developed in-house at Fraunhofer IIS. The exhibit combined the emotions derived from viewers’ expressions with their reception of a selected painting. Image details captured by two cameras transformed the viewer’s gaze in the form of emotional data into visible perception processes.



[www.iis.fraunhofer.de/pms07](http://www.iis.fraunhofer.de/pms07)

The series continued in November with “Fraunhofer’s backbone. Traces of technological picture components.” The exhibition showcased artworks created by Fraunhofer IIS staff that revealed surprising and challenging insights into the way technology is used. More than 70 artworks were on display, including microscopic images of bone-marrow cells, pictures captured using a VEMPIRE time-of-flight camera, arresting X-ray images, WakeUp receiver layout impressions, and brilliant shots taken with a high-speed camera. The most eye-catching piece was a twelve-meter-high banner featuring a picture of Joseph von Fraunhofer in which each individual pixel in the image was an image of a bone-marrow cell.



[www.iis.fraunhofer.de/pms08](http://www.iis.fraunhofer.de/pms08)



## PROFESSOR RANDOLF HANKE IS NAMED INTERIM DIRECTOR OF FRAUNHOFER IZFP

The Executive Board of the Fraunhofer-Gesellschaft has named Prof. Dr. Randolph Hanke interim Director of the Fraunhofer Institute for Nondestructive Testing IZFP in Saarbruecken. Hanke, acting Director of Fraunhofer IIS and Head of the IIS' Development Center for X-ray technology in Fuerth, took up his new position on October 1, 2013. Prof. Dr. Christian Boller remains a member of the institute's management.

Fraunhofer IZFP is a leading R&D center for physical nondestructive testing methods and the characterization of materials. The institute also specializes in the control and monitoring of manufacturing processes including facilities components, and evaluating the condition of existing infrastructures. Founded in 1972, Fraunhofer IZFP has around 200 employees at its two sites in Saarbruecken and Dresden. From January 1, 2014, the Dresden location continued to operate as part of Fraunhofer IKTS with a main focus on Material Diagnostics.

Professor Randolph Hanke's appointment sees the leadership of the institute enhanced by the addition of a personality very familiar with the Fraunhofer landscape – a familiarity that goes back a very long way – with a successfully established reputation within the field of science and research. Professor Hanke, who is also Chair of X-ray Microscopy LRM at the University of Wuerzburg, successfully set up and headed the Development Center for X-ray Technology EZRT over many years, and will continue to lead this division at Fraunhofer IIS.



[www.izfp.fraunhofer.de/en.html](http://www.izfp.fraunhofer.de/en.html)

## OPENING OF TWO APPLICATION CENTERS

Recently introduced as a new model as part of the Fraunhofer-Gesellschaft, Fraunhofer IIS has opened application centers in both the Lower Bavarian and Upper Franconian regions of Southern Germany. In Deggendorf, Fraunhofer IIS has been working with the Deggendorf Institute of Technology (DIT) and the Wolfgang Pfeiffer Foundation of industry partner Intercontec Produkt GmbH since May 21, 2013, researching contactless, non-destructive measurement techniques based on X-ray computed tomography. Besides integrating CT into the teaching curriculum via mechanical engineering internships and student projects, the application center also offers technologies from the fields of materials and product development, process development and quality assurance for regional and nationwide industry.



[www.iis.fraunhofer.de/pms11](http://www.iis.fraunhofer.de/pms11)

On July 4, 2013, in Coburg, Fraunhofer IIS and the Coburg University of Applied Sciences and Arts together inaugurated the Applied Research Center for Wireless Sensor Technology. The center is dedicated to creating and developing solutions based on energy-saving, wireless sensor networks and other low-range wireless communication standards for use in manufacturing, environment monitoring and health. Possible applications include enhancing production tools with sensing and data handling capabilities, observing weather conditions and bio-mass growth in order to optimize the use of fertilizers on agricultural land, and providing patient-friendly support for rehabilitation exercises.



[www.iis.fraunhofer.de/arccoburg](http://www.iis.fraunhofer.de/arccoburg)

## TOP RESEARCH UP CLOSE DURING THE LONG NIGHT OF SCIENCE

On October 19, 2013, Fraunhofer IIS took part in the Long Night of Science, where it presented current research results and projects. With more than 40 different items on its program, Fraunhofer IIS hosted one of the largest events of the night. From six in the afternoon until to one o'clock in the morning, visitors were able to look into the laboratories, talk to scientists and learn just how diverse and exciting technical research can be. The public's response was impressive, not only in Erlangen. The new location in Fuerth-Atzenhof, open to the public as part of the Long Night of Science for the first time, was also very popular. Fraunhofer IIS was also represented at "Auf AEG" at the Energie Campus Nuremberg. With well over 4000 visitors to its three different locations, Fraunhofer IIS was once again one of the big attractions of the night.

The next Long Night of Science event is scheduled to take place on October 24, 2015.

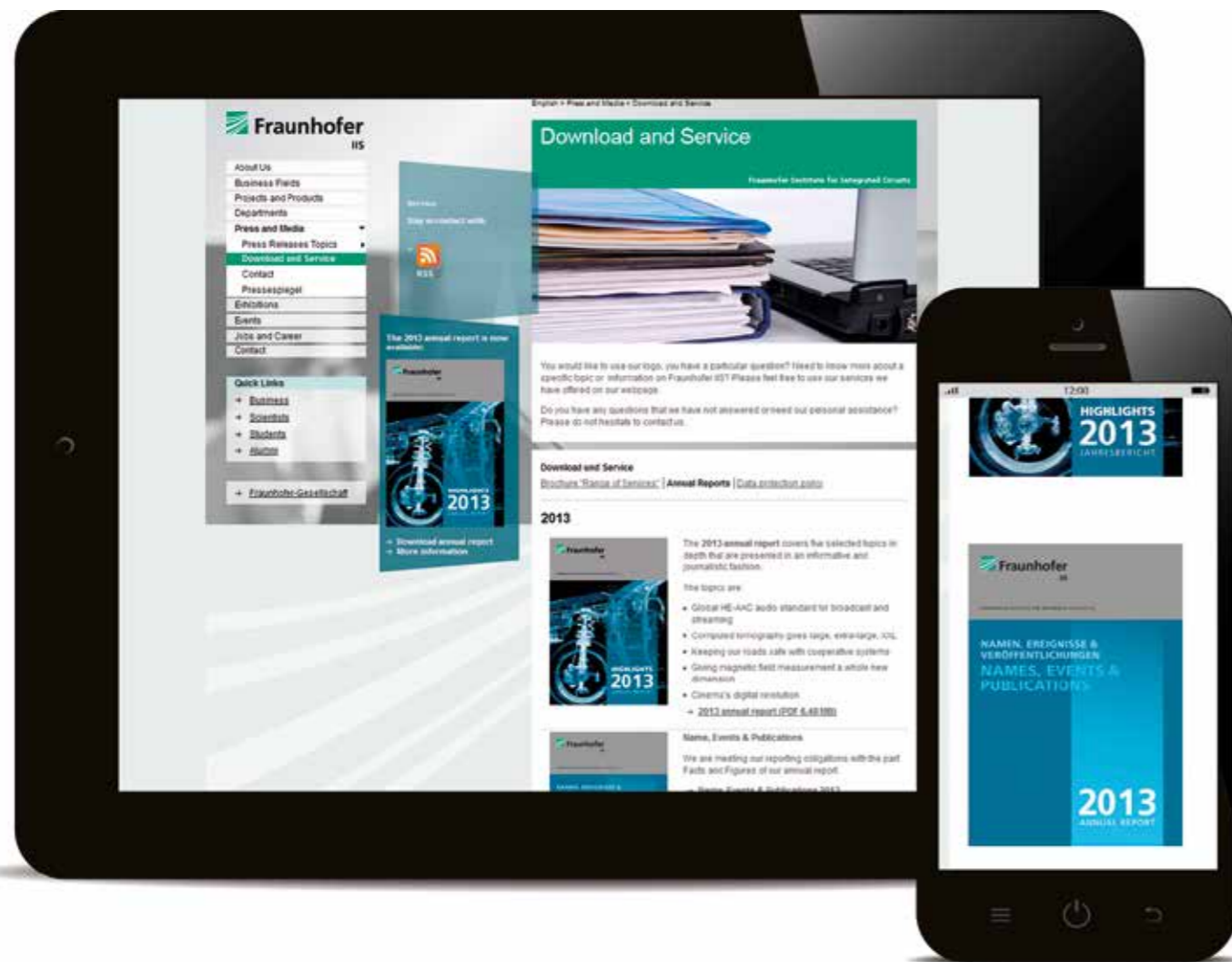


[www.iis.fraunhofer.de/pms10](http://www.iis.fraunhofer.de/pms10)

**NAMES, EVENTS &  
PUBLICATIONS**



AVAILABLE AT  
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## NAMEN, EREIGNISSE & VERÖFFENTLICHUNGEN NAMES, EVENTS & PUBLICATIONS

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