FUTURE IS NOW

15

IMMS

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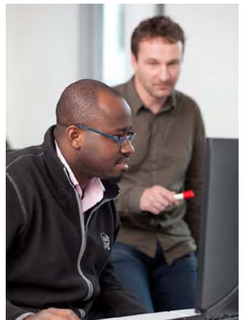


PREAMBLE

With the year 2010, an eventful and emotional year closed, which is summarized for you in this annual report and delivers you insight into the research and development work as well as into our multifaceted institute's life. Not only the successful year 2010 but also the jubilee of IMMS is themed by "Future is now". In 2010, the official start of IMMS as independent Thuringian research and development institute celebrates its 15th anniversary. "Future is now" has therefore more than 15 years of history of establishment and we are proud of what we have achieved!

Everything started in September 1995, still in the premises of the Ilmenau University of Technology (TUI) with a handful of employees. 19 December, 1995 was the official start and the foundation of the institute – which was attended by the Free State making available 15 million Deutsche Mark. In Erfurt, a branch office was established in February 1997 – offices in south-eastern Erfurt in Thuringia's Center of micro-electronics. Less than two years after the foundation of the institute – in October 1998 – IMMS was already established and the cooperation with TUI was strengthened at such a rate that it became the first associated institute of the university. At the same time the first spin-off of the institute was established: employees of IMMS founded, together with the engineer's office Eberhard, THESYCON GmbH. Already in December of the same year, the second spin-off, EMSYS GmbH, followed – EMSYS develops solutions for high speed applications in the field of bus systems and embedded systems. It becomes apparent, which enormous leaps the institute performed already during the first years. Today, we have almost 100 employees and work intensively in the first flight of the Free State to assist the industry to bring modern innovative developments to market. What and how we achieve this can be seen subsequent to this preamble.

Afore it is especially close to our heart to thank: first of all the Free State of Thuringia, by whose support our work is rendered possible. Thanks to all our business partners, friends, sponsors and persons who give us encouragement. At this point we would like to thank likewise the board of directors and the scientific advisory board of IMMS who provide their support and advice regarding all questions.

But the most important assets of our institute are our "heads" – employees, but also students, who bring forward our institute by their creativity, commitment and dedication and who bring in professional expertise and personal competencies. Therefore, we would like to thank all employees of IMMS in a special way for the constructive and trustful teamwork. "Future is now" is a continuously set challenge, that requires continuously highest commitment – which can only be achieved together, as IMMS team, for our customers and for us.

Dipl.-Ing.
Hans-Joachim Kelm

Prof. Dr.-Ing.
Ralf Sommer

FUTURE IS NOW – IMMS

IMMS as applied research institute has Centerd the "project future" since its foundation 15 years ago. In close cooperation with the Ilmenau University of Technology and its industrial partners, the institute works on application, distribution and deepening of research results and performs application-orientated research and development in the area of micro-electronics and systems engineering as well as mechatronics.

The IMMS strategy is characterized by developing solutions – via application-orientated research – that are targeting the final product. The future is "developed" here, at a Thuringia research and development institute, and enables our industrial partners to gain competitive advantages. Together, sustainable product innovations are developed. In doing so, the idea of an overall design strategy for heterogeneous systems has been developed – not least driven by the high tech strategy of the Federal Government. This means to build up an overall system competence by bridging the gap between micro-electronics and mechanics with multidisciplinary and a large potential of experience and knowledge.

The future trends identified for Thuringia and the growing areas deduced from that, are the drivers for the research and development work at IMMS. The strategic direction of the institute – to master technologies and methodologies – is orientated on these growing areas: precision engine construction, automation, communication technology, measurement engineering, control technology and feedback control, micro- and nanotechnologies, medical technology, automotive and green technology. The mega trends superior to these growing areas do not only drive future activities of IMMS but they are already part of current projects and research work – true to the motto "Future is now".

In order to implement these fields beneficially for our application partners, it is essential to apply technology know-how, as for example CAD from the device modeling based on FEM methods up to computer-aided design of circuits, systems and machines, precision and high temperature electronics, embedded software design and the integration of communication and energy harvesting functions. For an effective application of these technologies again a deep knowledge of methodologies is required. Those include inter alia skills in constructive design and knowledge of innovative design methodolgies, of model-based design including system and components modeling, virtual prototyping as well as the optimization of embedded electronic platforms for industrial applications.

How does IMMS achieve this leading position? The institute has dedicated itself for years to the idea „More than Moore", which means not only to create an increasing system complexity by an increasing integration level according Moore's law but to create at the same time more intelligent systems. Developments start with an idea and end in a design. IMMS goes beyond, starting with the design of the individual components and subblocks to the integration of the system and, ultimately, to the prototype. In future the institute will even accompany series production.

Our knowledge of all steps of the development process together with innovative ideas for more intelligent systems is the USP, which prepares IMMS and its partners for the future.

The researchers and developers of IMMS are like cooks in a specialty restaurant – closely connected both with the producers and their guests. The art is to bring the ingredients together to new creations, testing new and unusual ingredients and always preserve highest quality demands. Essential are the specialties and furthermore the additional value for the customers. Transferred to our institute these are for example applications in medical technology and bioanalytics or energy-efficient systems. Just like the actual trend of good cooking to preference regional aliments IMMS has always focused on close cooperation with regional enterprises. Besides this regional involvement, national and international visibility is our goal.

Our results of research and development work are internationally competitive and are going to establish a new light house with a visibility far across the boarders of Thuringia, saying „Future is now".

Strong Partners for Innovative Developments

In 2010 our cooperation with the Ilmenau University of Technology (TUI) again was very versatile and focused besides a broad scientific cooperation on high-quality education for our students. Research and education has a strong link, as for example students from TUI working at IMMS received two Best Paper Awards for their research works in analog circuits design methodologies.

Above all, there is a broad network and a close cooperation with the university in terms of research. Thus, contacts with 28 departments have been established – such as in electronics and information technology, mechanical engineering, computer science and automation, in mathematics but also in media and communication sciences. This mutual scientific work is also expressed by 12 research projects (as in 2010) in which IMMS and the university are partners. Main foci are nano-positioning and nano-measuring machines (SFB 622), multisensory systems (e. G. for the control of high-temperature processes), latest methods in the area of integrated analog circuit design, several activities in the field of microsystem technology and MEMS (with focus on systematic modeling, design and test), high-frequency technology (e. G. satellite navigation), measurements and identification of parameters of mechanical and specific electrical devices as well as in the area of biomedical engineering (for example the development of a personalized miniaturized audio dosimeter). Besides the current projects we work on new conjoint initiatives whereupon the application orientation according to the high-tech strategy of the German Federation is becoming more and more important.

But also regarding conjoint education IMMS imparts theoretical substantiated knowledge of methods with a high relation to application. Hence, many practical application aspects have been incorporated to basic engineering courses, which are very well received by the students. Furthermore, IMMS offers facultative training courses and tours to our industrial partners for the students. But the close relation to the students is especially reflected in their active integration as trainee (33), scientific assistances (28) and in the framework of student research projects, diploma, bachelor and master theses (15).

Networks Bringing Together Industry and Research

True to the motto „together we are strong“, it gets more and more important that protagonists in science and economics align with each other. That is also valid for Thuringia. Thuringia belongs to the leading regions in microsystem technology in Germany. Numerous SMEs produce highly specialized components and complex microsystems. IMMS – as intermediator between science and economics – brings in its competences in electrical engineering, optics, mechanical engineering, automotive, information and communication technology (ICT) and logistics. In doing so, IMMS has been actively participating for years in initiation and organization of regional and national clusters in the corresponding fields of technology. In Thuringia there are cluster initiatives like OptoNet (network for optical technologies), ELMUG (electronic measurement and device technology in Thuringia), automotive Thuringia (association of sub-suppliers of automotive components in Thuringia) or MNT (micro-nano-technologies Thuringia). At the same time, universities and research institutions are important holders of competence in microsystems technologies and nanotechnologies.

Networking incorporates joint trade show appearances to demonstrate the regional concentration of skills as well as the establishment of current workshop topics for education and training.

As a member of the science council of the AMA professional association for sensor systems, a study “Sensor Trends 2014” was worked out with IMMS as cooperator. On the basis of chosen application areas, the study combines experiences and development trends of sensor systems. So, new applications with high accession rates arise from areas like home appliances, security systems, medical diagnosis and therapy, biosensors and automotive engineering.

Also in the innovation panel “automobile lean in respirable dust” of the ACOD (Automotive Cluster Southern Germany), IMMS brings in its competences in sensor technology and signal processing.

Furthermore, IMMS is member of the Silicon Saxony registered association, the biggest industrial association of micro-electronics in Europe. Due to the close connection within the association, inter alia application-orientated research groups like “RFID Saxony” and “SatNav Saxony” have been formed by significant involvement of IMMS.

The IMMS competences are also integrated in the cluster “Cool Silicon”. Here, the special topic is a massive increase of energy efficiency in the area of micro- and nanoelectronics for the key sector of ICT.

But IMMS engages not only regionally but also nationally and internationally. Examples are the German edaCentrum pursuing electronic design automation (EDA) as a key for micro-electronics and micro-system technology as well as the international Cadence Academic Network in which IMMS is, together with the Ilmenau University of Technology, one of eight lead institutions.

These forward-looking cooperation between industry and research show that the technical, economic and environmental performance can be even more effective and expanded – an opportunity and challenge for sustainable thinking and business success.

TESTIMONIALS

IMMS has been the most important research partner of X-FAB incorporation for many years. 2010 the successful cooperation has been continued in many fields and deepened in strategic directions. In doing so, X-FAB deploys both the special competencies of IMMS as partner in publicly funded research projects and the engineer technical resources with direct industrial contracts. IMMS is well prepared to assist our "More-than-Moore"-roadmaps by its fields of expertise microelectronic, mechatronics and system design. The trend towards heterogeneous systems is also readable in research and other cooperation projects. They range from analog/mixed-signal design across integrated optoelectronics and micromechanics to the problem of liability of high temperature applications. As industry-orientated research institute, IMMS is perfectly prepared to meet both the requirements of the big industry and the predominant small and medium-sized operators.

DR. JENS KOSCH
CHIEF TECHNICAL OFFICER
X-FAB SEMICONDUCTOR FOUNDRIES AG

By its competence and expertise in the area of integrated drives, IMMS has made for years a hugely important contribution to the research of basics for nano-positioning and nano-measuring devices in Ilmenau. The now realized system is a milestone of this development. It demonstrates imposingly the potential of the drive principle in combination with high-resolution laser interferometers as measuring system, implemented by IMMS, and is at the same time an exemplar for the close and successful cooperation between IMMS and our specific field at the university.

DR.-ING. HANS-JOACHIM BÜCHNER
PROJECT MANAGER LASER INTERFEROMETRY
INSTITUTE FOR PROCESS MEASUREMENT TECHNOLOGY AND SENSOR TECHNOLOGY, ILMENAU UNIVERSITY OF TECHNOLOGY

In many conversations with our customers, we realized that above all outstandingly educated engineers – which have a comprehensive know-how and high technology competencies – are required for the development of more and more complex electronic systems. In this regard, Cadence Academic Network offers an ideal platform for the exchange of expertise within universities and between industry, universities and Cadence. IMMS and the Ilmenau University of Technology have been chosen as one of eight leading institutions as they assume a pioneering position for development, transfer and placement of state-of-the-art design methodologies.

DR. PATRICK HASPEL
COORDINATOR OF THE CADENCE ACADEMIC NETWORK (CAN)

The Institute of Microelectronic and Mechatronic Systems (IMMS) was accepted as regular member of the Open Source Automation Development Lab (OSADL) in January 2009. Since then, the IMMS is contributing to the development of Open Source software components for the automation industry. We gratefully acknowledge this contribution on behalf of our members and the worldwide community. In addition, IMMS and OSADL jointly organized training courses in 2010 on „Embedded Linux" using the company's facilities. At this occasion, I was able to convince myself of the excellent infrastructure of the IMMS as well as the remarkable professional competence and extraordinary organizational and teaching skills of the IMMS staff members.

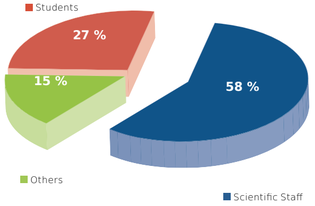
DR. CARSTEN EMDE
GENERAL MANAGER
OSADL E. G.

IMMS IN FIGURES 2010

100 members of staff were employed at IMMS in 2010. Hereof, 59 were scientists, and as FTE 28 students were employed for research and development, which is equivalent to about 87 percent of all IMMS staff members.

As already during the previous years, all in all a large number of students (ca. 58) took advantage of the offer of IMMS to deepen and complete their education in praxis-orientated research: 33 students passed practical trainings, 8 diploma, 3 bachelor and 4 master theses were supervised and 3 employees are enrolled at a university as doctoral candidates at the moment.

Human Resource Development

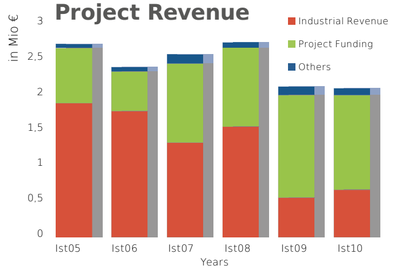


The earnings by industrial contract research recovered by about 30 percent. Nevertheless they have not yet reached the level before the last global economic crisis. The business situation 2010 stabilized on an unexpected high level and is on the verge of closing the gap on the level before the crisis.

The economic spirit is good. This allows to expect a fast increase of industrial contract research in the future.

Strategically, IMMS has focussed consequently on the future topics health, safety, energy, mobility, communication and automation as application areas of its research results. A sustainable and dynamic development of the transfer of research performances into industry is aimed for.

Project Revenue



Earnings through public project sponsorship in 2010 were stable. The positive development of project sponsorship characterizes the acceptance of IMMS as research partner. Mostly all of these projects are joint projects.

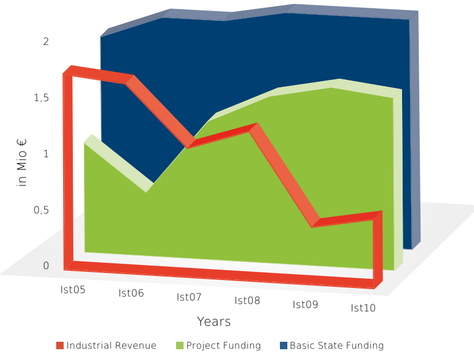
IMMS was successful in increasing its project activities apparently by its network activities.

The decrease of industrial contract research will not be permanent. But it is a great challenge for IMMS to overcome it. Earnings out of this activity serve the financing of loss-making public sponsored projects.

Due to its high dedication to collegiate education, IMMS was able to recruit enough degree holders to ensure the necessary number of scientific employees and their quality. Thereby, it was possible to work on the increasing number of public sponsored research projects.

The Free State of Thuringia took care for reliable conditions for institiutional allocation. This was especially conducive to the cooperation with small and medium-sized enterprises.

Financing Structure



THE IMMS TEAM

„We pave the ways for ideas, that are ahead of their time.“

„Future is now!“

AWARDS AND DISTINCTIONS

Director of the IMMS Institute Won the Teaching Award of the Ilmenau University of Technology

In 2010, the Ilmenau University of Technology has for the first time presented the award for teaching. In the future, professors and members of staff of the university's five faculties will be honored every year for special attainments. Professor Dr. Ing. Ralf Sommer, scientific director of IMMS, was among the awardees in 2010.

All honorees are characterized by how they attend to their students with great dedication. In the statement for the award was written that they are "undeviating and indefatigable a contact person for the students" and that they stood up for mentoring and placement of student research projects respectively bachelor and master theses as well as for traineeships. Above all they were strongly involved with the promotion of gifted up-and-coming talent.

Some of the awardees were successful "in a vitalized way" in always conveying knowledge of the studies of engineering terms "comprehensible and demonstrative" and in getting the students into the respective special branch of science. Others played a special part in rearrangement of the studies of Mathematics or elaborated new courses and teaching methods. The university annually provides prize money of 10,000 Euros in total for the teaching award. The teaching award 2010 was given to 11 awardees in total on October 9, in the course of the ceremonial matriculation.

Some of the awarders: (from the left) Dr. Karsten Henke, Prof. Horst-Michael Groß, Dr. Thomas Kups, Marko Hennhöfer & Prof. Ralf Sommer

Professor Töpfer Becomes Board Member of the Registered Association FLUXONICS

The director of the specific field "theoretical electrotechnology" of the Ilmenau University of Technology and employee of IMMS, professor Hannes Töpfer has been elected member of the board of the registered association FLUXONICS at the end of 2010.

This association is established internationally and dedicates itself to development of sensors and electronics on basis of single flux quantum technology. It is their aim to advance the development especially all over Europe and – which is involved – to promote technological innovations by means of research, training and knowledge transfer. FLUXONICS is composed of university laboratories, national research Centers as well as industrial enterprises of different European countries.

see internet: www.fluxonics.org

The scientiest from Ilmenau was chosen in recognition of excellent research in the field of superconductive electronics. In this area, the Ilmenau University of Technology is among the world's leading research establishments.

Professor Töpfer worked as manager of the department System Design at IMMS, until he was offered a chair at the university in 2009, since that he attends scientific projects at the institute.

CADENCE ACADEMIC NETWORK Lead Institution

The Ilmenau University of Technolgy, together with IMMS, was incorporated into the international Cadence Acedemic Network in 2009, as one of five lead institutions.

The academic network was launched in 2007 by Cadence Europe. The aim was to promote the proliferation of leading-edge technologies and methodologies at universities renowned for their engineering and design excellence. A knowledge network among selected European universities, research institutes, industry advisors and Cadence was established to facilitate the sharing of technology expertise in the areas of verification, design and implementation of microelectronic systems.

Besides several activities like contributions to CDN-Live 2010, IMMS organized two workshops together with Cadence in 2010, in which AMS designer as well as an assessment for the design infrastructure and application methodology took centerstage.

Due to IMMS and leading manufacturers in the field of EDA (Electronic Design Automation) working closely, the University and IMMS were furthermore equipped with the best commercial design software available nowadays (Cadence as well as MunEDA).

IMMS EVENTS: FROM “MORE THAN MOORE” TO OPEN SOURCE

Analog 2010 – With the Motto “More than Moore“

In cooperation with the association for information technology in the VDE (ITG) and the VDE/VDI association for micro-electronics, micro engineering and fine mechanics (GMM), IMMS organized the 11th ITG/GMM expert conference “Analog 2010 – Development of Analoge Circuits with CAE Methods” in Erfurt from March 22 to 24, 2010. The conference was themed by the topic “More than Moore”. This trend in electronical circuit technology, having emerged during the last years, towards diversification of technologies and integration of heterogeneous functionality requires a corresponding extension of the draft process for integrated analog/mixed-signal systems. On the occasion of “Analog 2010“ 30 articles in total were presented regarding current research works in this field. The scientific program was complemented by invited lectures and tutorials.

One tutorial dealt with the topic “Electronics for Medical Technology“. Hereby, Professor Dr. Maurits Ortmanns from the University Ulm explained the “circuit draft for implantable neuro-stimulators” – in particular for the special technological and scientific challenges when drafting electronic systems in this application area.

Together with Professor Ortmanns, IMMS also cooperates in the framework of a research project for the development of an electronic retina implant; the institute is responsible for the development of an energy-efficient IC detector for infrared data signals.

Further tutorials concentrate on the “Computer-based draft of reusable analog circuits” and “MEMS technologies in a pure play wafer foundry“.

A fluid transition was the introducing key note with the title “More than Moore: trend or hype?”. Dr. Jens Kosch from X-FAB Semiconductor Foundries Incorporation outlined the subject “More than Moore”, currently gaining significance, with system integration of analog components but also with sensors, actuators as well as biotechnical, optical and MEMS elements. “More than Moore” will – as per Kosch – gain an increasing relevance in the semi-conductor industry.

The conference confirmed its significance – as already in the past – as important event for the demonstration of Germany’s “landscape” of funded projects in the area of EDA research of methodologies.

The large proportion of participants from industrial enterprises proves the still high and continuously growing significance of the draft automation for the economic development of micro- and nanoelectronics and systems technology in Germany.

IMMS Offers a Series of Workshops for the Industry

In order to support the cooperation between the Thuringian research and development institute and the local industry, IMMS initiated a series of workshops in the field System Design in 2010.

Already in February 2010, IMMS organized together with the AMA (professional association for sensor systems, registered association) a workshop in Erfurt. The target ranged from a general overview of the technologic level via the presentation of typical but also novel application scenarios in the area of sensor systems up to the information on substantial elements of embedded systems as well as related technologies and relevant standards. The participants – mostly decision makers and members of staff of research, development, production and distribution of sensor manufacturers as well as of industrial users of sensors and designers of embedded systems – were enthusiastic about this hands-on-transfer of knowledge.

Hence, in July and November 2010 two more workshops – this time in cooperation with OSADL e. G. (Open Source Automation Development Lab) – with the topic “Embedded Linux” took place. With 20 participants each, both workshops were a complete success. During the workshops, the lecturers informed about chances, practical solutions and legal aspects of Open Source – followed by first practical steps in exposure to real-time capable embedded Linux. The participants from all over Germany and of course from Ilmenau and environments were able to test themselves and to bring in their specialist know-how.

Laudatory feedback from the participants encouraged the personnel of IMMS to continue these workshops and to tackle also other topics in the future. Thus, already on December 2, another workshop – now with the topic “Modular Platforms in the

Developments of Embedded Systems" – in cooperation with Arrow Electronics was offered.

Due to the fact that requirements to embedded systems, but also to their possibilities of realization, are getting more and more manifold, the advantages of modular approaches were retrieved and discussed. Furthermore some future trends on the field of development of embedded systems were shown and Arrow Electronics presented the Embedded Platform Concept (EPC) and the corresponding hardware components.

First of all IMMS likes to offer a platform for the local industry, in order to strike up a conversation directly with the institute and to get to know the competencies of IMMS – with a lot of examples of application – in a completely practical manner. At the same time the existing know-how is passed on to industrial partners and therefore a transfer of knowledge is established. Furthermore the existing connections between the IMMS and the industrial and network partners is to be consolidated. For 2011, further workshops are planned.

Long Night of Technology 2010 – "Highlights" also at IMMS

On the occasion of the "Long Night of Technology" in Ilmenau – organized by the Ilmenau University of Technology – on May 28, 2010, more than ten

thousand visitors on the mile of technology enjoyed science, technology, culture and treats with a total of 12 stations and more than 150 interesting and spectacular presentations and performances.

One station was IMMS in the Ernst-Abbe-Center. At six o'clock in the evening, IMMS opened its doors and presented:

- "Ilmenauer Speedway" – a footrace for children with sensor systems (IMMS/Sportident) via a small show-jumping course on the outside facilities
- "Shot-Putter" – a small but highly precise catapult with magnetic drive
- two stations where sensors detected acceleration and accuracy
- "Planar Motor PPS 100" which shows measuring, positioning and cutting to a hair by dint of modern manufacturing technologies.

In addition, the Heinz group of companies showed, together with IMMS, how temperatures can be measured by sensors on components, that are difficult to access or in extreme temperature ranges, for example below – 40 °C and above 125 °C.

IMMS was able to welcome almost 1,000 visitors on this evening and many conversations showed how interested in technical backgrounds the public was. Thus, the exhibits did not only attract the youth but did also inspire older people to ask and discuss.

INSTITUTE LIFE

RUN – We were Great!

Themed by “working together to win! Running together to win!” the second run of enterprises of Thuringia took place in Erfurt on 9 June. The new, optimized course led approximately five kilometers through Erfurt`s historical city center – with start and finish at the Dome. But also these five kilometers were not easy to overcome, at 28 degrees in the shade. More than 2,300 runners from 190 enterprises spurted when Mayor Andreas Bausewein gave the starting shot at 7 pm.

Also IMMS was represented this year with its own small team.

Murat Isikhan, Thorsten Reich, Jacek Nowak, Glenn Methner and Andre Jäger (from left to right) gave their best and finished their run being within the upper middle field. Great performance! Thereby, team spirit took center stage – first of all running should be fun. And the jubilating audience was able to witness that this was true.

IMMS/Fraunhofer IDMT Barbecue

In August, the brilliant summer weather was benefited for a shared barbecue with the neighboring Fraunhofer Institute for Digital Media Technologies. The staff of Fraunhofer IDMT and of IMMS converged hereby and the “neighborhood barbecue” became that successful that it will be repeated in 2011.

IMMS – Precision on Any Position

... and on any surface, is to be said. Since also at the BVMW-Sledge-Cup 2010 on August 20, ten employees of IMMS were amongst the about 80 participants form Thuringian enterprises. The two IMMS teams – the ladies themed by “Ilmenauer Girls Love it Fast (IMMS)“ and the gentlemen themed by “Precision on Any Position“ – were able to position themselves in the middle field during the first participation of IMMS in the sledge-cup. Franziska Schonert was even able to achieve the 3rd place in the ladies' individual results, versus strong competitors. Guests of honor participated also in the event.

So, Ute Oberhoffner, inter alia bronze medal winner at the Olympic Games 1984 in Sarajevo and silver medal winner of the Olympic Games 1988 in Calgary, as well as Hans Rinn, inter alia Olympia winner 1976 in Innsbruck and gold medal winner 1980 in Lake Placid, attended the sledge-cup.

IMMS Combines Sciences with Arts – Across Institute’s Sites

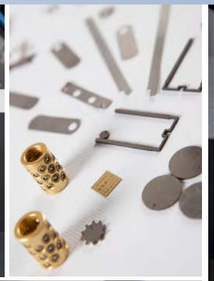
IMMS has committed itself for many years now to the demand to bring forward culture and arts and to integrate them in the institute’s everyday life. Hence IMMS took an exhibition of modern arranged photographs in its premises this year. The specialty of this years’ art exhibition is the performance at both locations of IMMS – Ilmenau and Erfurt – at the same time. A private view in the application Center

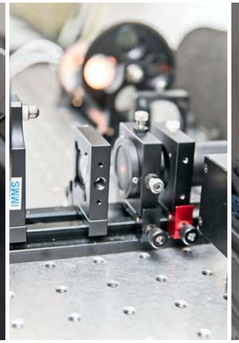
of Microsystems Technology in Erfurt had already taken place in March 2010. IMMS, located there with a part of its institute and the Research Institute for Micro Sensor Systems and Photovoltaic GmbH (CiS)

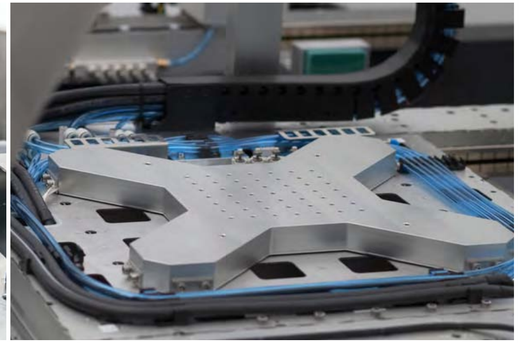
as well as the Research and Industry Center (FIZ) Erfurt, registered association, organized at the location Erfurt-Southeast, a photo show under the name “Dialogues – Photographic Pictures”. Since the opening of this exhibition, selected items of the artist Dieter Mueller could also be admired in the corridors of IMMS in Ilmenau. On the occasion of “Long Night of Technology“ on May 28, IMMS invited everyone interested in arts, photography and of course technology to the closing reception. The photographic works of Dieter Mueller invite to a dialog with the beholder. Creative power comes up by the possibilities of digital photo collages as well as by photography out of unusual views.

IMMS Has a Heart for Children

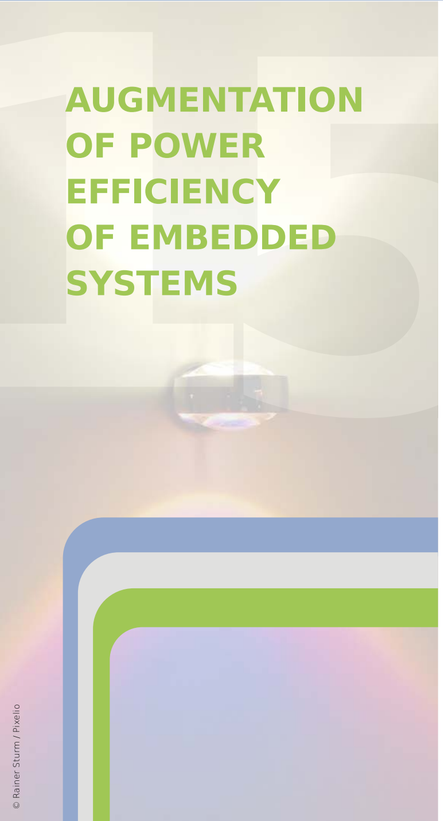
IMMS called on its staff this year to participate in a Christmas campaign for indigent children in Erfurt. Many followed this call – they packed and pasted affectionately Christmas parcels for children of all ages. These were given to the Evangelic City Mission Erfurt at the beginning of December. There, a Christmas party for indigent children of the capital city Erfurt was arranged on December 10, during which also the presents collected by IMMS were given to the children.







AUGMENTATION OF POWER EFFICIENCY OF EMBEDDED SYSTEMS



You cannot imagine today's workaday life without computers or laptops as work equipment and steady companion. But over 90 percent of the computer systems applied worldwide are so-called embedded systems. In 2008, 3 billion embedded systems and components were sold worldwide. Embedded systems monitor, control and regulate – often in secrecy – processes and plants. Famous examples are mobile phones, vital function monitoring of humans by medical devices, a multitude of different safety and comfort systems in the car (ABS, ESP) or controls of machines and plants in the industry.

Each of these systems needs energy – whether operated by electricity out of the power outlet or battery-operated. The work group "high tech strategy for the information society" of the national IT summit therefore reasons that "innovative technologies are required for the concepts of hardware as well as of software, but also for the operation of embedded systems. Simultaneously, the Federal Ministry of Education and Research assumes that the percentage of energy required by systems of information and communication technology will increase within the next ten years up to 20 percent. An efficient handling of the available energy, used for continuously more efficient embedded systems is therefore indispensable.

IMMS dedicates itself for some time to this central future-orientated topic and cooperates in the framework of several joint projects with partners in the industrial and research area. The initial point of all these measures for the power efficiency augmentation are detailed skills of the involved hardware and software components, of their interaction and their respective application field, in which the embedded system is meant to be applied to. The analysis of the components and their behavior enables both their efficient and resources-saving operation and their optimization. Special possible savings are disclosed by an intelligent power management of embedded systems which increasingly plays a decisive role, in excess of the precise control of the energy requirement of single systems, also in the area of distributed systems.

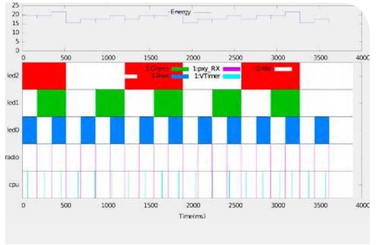


Figure 1: Analysis of the energy requirement of a transmitter

Research Project for Energy Efficiency "Cool ConSens" – Energy Efficient Radio Sensor Systems

As a partner in the clusters of excellence "Cool Silicon" [1], advanced by the Federal Ministry for Education and Research, IMMS develops, together with considerable enterprises and research establishments, technical solutions that will conspicuously reduce the power consumption in the area of information and communication technologies (IKT) – to the point of energy self-sufficient systems. Within the part project "CoolConSens" (support code 13N10401) energy efficient radio sensor systems are researched, which are meant to be applied to condition monitoring of technical systems. The specialists of IMMS are inter alia responsible in these projects for the detailed energetic analysis of selected sensor components, signal processing and radio components. In doing so, power consumption profiles of completely embedded radio sensor systems as well as their substantial individual components are analyzed amongst others. The upper part of figure 1 shows exemplary the overall energy requirements of a radio sensor during a typical operating cycle, whereupon the duration and the frequency of activation of substantial system components are noticeable in the lower part of the picture. On basis of these measurements and the power consumption profiles generated with them, new power management algorithms are researched. Conventional power management often does not limit itself to individual components within a radio network. But there are further steps in the research project, as the energy available in the whole network – taking into account the achievable measurement precision of the sensor system – is used effectively. The energy utilization out of the system environment (for example light, heat, oscillations) by means of energy harvesting solutions is meant to replace batteries. But this makes large-scale demands, unsolved so far, on the energy management of such embedded systems, since the availability of energy cannot be guaranteed and since it is often available very irregularly. Therefore, in "CoolConSens", solutions are researched, which use the available energy ideally within the preset measurement parameters and Quality-of-Service (QoS) requirements.

"Smart Home Services" – Building Management and Automation

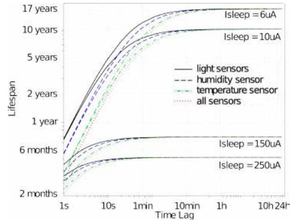


Figure 2: Battery durability of a radio sensor system

The network initiative “Smart Home Services” (SHS) [2] deals with the intelligent home of tomorrow by developing innovative system solutions for facility management and building automation. In this area also a multitude of embedded systems for sensory, control and communication tasks are applied whose energy consumption influences directly the factually useable possible savings of the primary energy requirement of buildings. Within the framework of the research project “SHS: Home” (support code KF2534503KM9), sponsored by the Federal Ministry of Economics and Technology, IMMS researches energy efficient communication solutions for building automation, whereupon wireless communication, battery-operated devices for measuring and control tasks (for example meters, climate sensors) are especially focused. The characteristics of these systems are the construction out of different components working together, that map, record, process and send measuring values. Their specific activation and deactivation has to be guaranteed in terms of reduction of the energy consumption. Out of it, research goals in detail are added up for therefore optimized circuits and hardware components, for energy efficient process algorithms and for novel radio protocols within the scale of wireless communication. Optimization on a system level has to keep in mind the facts, that the local processing of sensor data requires about 100 to 1,000 times less energy than their transmission via radio communication. As a result of the IMMS research work an extension of the battery durability of intelligent sensor systems from several weeks to more than 10 years is aimed. Especially the closed current consumption of the circuit and of the process intermittent of the system has therefore to be reduced respectively optimized (figure 2). The special challenge around building automation is on the one hand to guarantee long term operation and on the other hand to enable a bi-directional communication up to a transfer of the data via several interstations.

Parallel to that, IMMS researches within a further project, sponsored by the development bank of Thuringia, with the title “SHS: Facility” (project number 2010FE9073), an energy efficient hardware/software platform. By the realization of that, a central staging area for measuring data in flats and buildings and a gateway towards other communication networks is to be provided.

Center of Growth “CBS Customer Bautronic System”

Within the center of growth “CBS Customer Bautronic System“ [3] building automation systems for selected application areas are developed by Thuringian enterprises and research establishments, which resolve existing deficits of available offers regarding system integration and user integration. Within the IMMS subproject (BMBF – support code 03WKBD3C) a solution for wireless cross linking of sensors and actuators in buildings has been developed, which serves a user orientated building control. A multitude of sensors (inter alia for temperature, humidity, light, gas, movement, acceleration) and actuators permit to detect indoor temperature and further environmental conditions precisely to control the building technology – by observing the user behavior – accordingly. In combination with the localization solution developed by IMMS, additionally the position of single users can be detected exactly regarding the room and therefore individual adjustments regarding climatic and lighting conditions can be executed. The majority of the inserted sensors work battery-operated and their communication is effected on basis of the internet protocol (version IPv6). The energy requirement respectively the concept and the mode of operation of these sensors has been optimized for long-term operation. The results of the F&E works are demonstrated inter alia in the institution premises of IMMS in form of a substantial multi-hopable wireless network in long-term operation.

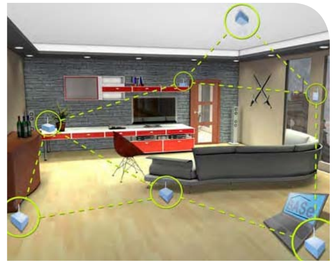


Figure 3: Simulated sensor network in a living room

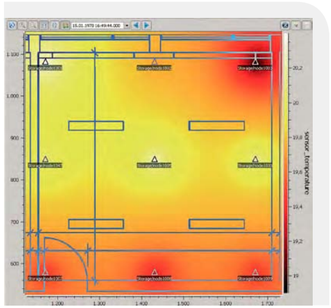


Figure 4: Comprehensive visualization possibilities of the sensor data

Innovative System Solutions for Energy Saving

The future F&E works of IMMS regarding energy efficient embedded systems focus on the one hand on the adaption and optimization of new technologies in the area of hardware and software. In the near future new and standardized radio protocols will be available which arouse in combination with new generations of radio transceivers and micro controllers the expectation of potential for further energy consumption reduction with simultaneous increase of stability and interference sensibility. On the other hand the works in the area of intelligent sensor systems are continued in order to research the possibilities of novel and substantially more efficient sensor and processing architectures for the increase of energy efficiency. The energy efficient realization of computationally intensive algorithms for the fast and highly precise sensor signal processing as well as for the safe communication in radio sensor systems can unlock completely new application fields for such embedded systems. IMMS offers comprehensive experience in this current area that is getting more and more important in the field of energy efficiency. This accumulates a perfect technological basis for innovative and sustainable solutions which are developed together with our customers.

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ENERGY CONSUMPTION MEASUREMENT AND SMART GRID INTEGRATION

The classical electric circuit is based on a clear structure of capacious energy generators like coal burning, gas, water or nuclear power plants on the one hand and energy users on the other hand. In times of renewable energy these conditions are changing. Many small, to some extent private wind and solar power plants, generate electricity and feed it into the grid, in amounts varying heavily according to time of day and meteorological conditions [1]. But at any time as much energy has to be fed into the grid as energy is taken from it. For this reason, new conceptions for the adequate control of energy generation and energy consumption are necessary. First approaches to control the consumption (system demand control) already exist, in form of the cheaper nighttime-produced electricity. According to this it is profitable in terms of money to activate electrical consumer loads at certain times; the energy providers on their part benefit from a more balanced grid due to the realization of a "smart grid".

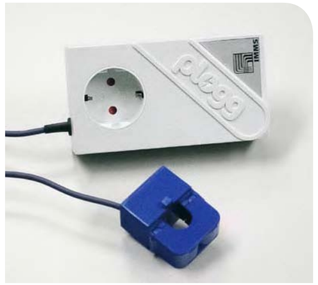

Figure 1: BASe-Meter wireless power outlet

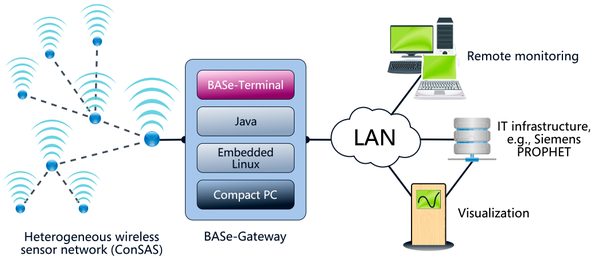

Figure 2: Assembly of the complete system

Network for Energy Measurement

In collaboration with the Ilmenauer Fraunhofer-Anwendungszentrum Systemtechnik (Fraunhofer implementation center for system technology in Ilmenau) a wireless network for the measurement of energy as a pilot scheme had been established to obtain a more precise view of the existing consumers and their behavior [2]. The individual users are realized in form of intermediate power outlets (figure 1) and can be refitted without any considerable installation complexity. They allow a highly precise measurement of the energy requirement and, in the current version, to switch on and off individual users remote-controlled. The measured data are forwarded wireless to a central station and are prepared for indication, analysis and further processing. Besides the hardware and software that had been developed at the IMMS for the actual sensor grid, a gateway solution is applied, which is based on an especially flexible application architecture [3]. It is possible to implement client-specific respectively project-specific system adjustments with low effort due to a combination out of both. In this manner object-specific optimization of the grid infrastructure on the one hand and a connection to the energy data management system SIEMENS PROPHET Solutions, on the other hand, had been realized.

Intelligent Control for Final Consumer Loads

Since January 2010, the law on the energy industry EnWG stipulates to provide "the respective terminal user with the real energy consumption and the real period of use". Therefore especially equipped electricity meters have to be applied in newly built houses. But information of the consumption of single devices is evolvable very restrictedly by means of electricity meters that detect consumption per accommodation unit. The hereby presented system permits to enlarge these digital measuring devices within the scope of so-called sub-meterings and to provide a monitoring of the individual consumer loads as well as an intelligent control. Furthermore it is to be fathom to which extent additional sensory information for instance regarding the indoor temperature can be applied beneficially.

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3D POSITIONING SYSTEM IN THE RANGE OF NANOMETERS

Collaborative Research Center 622 “Nano-Positioning and Nano-Measuring Machines”

The rapid pace of development of the future technologies, like for example nanotechnology, optical high technology or micro-systems technology, makes great demands on positioning systems used for inspection and analysis. Larger objects with dimensions of hundreds of millimetres have to be positioned and measured by requiring precisions in the range of nanometers.

Within the collaborative research center 622 „Nano-Positioning and Nano-Measuring Machines” of the Ilmenau University of Technology, scientists have worked for years successfully on providing the scientific basis for the necessary nanotechnological equipment.

Appraisers of the German Research Foundation DFG evaluated the collaborative research center in 2009 as a “light house with unrivaled precision” and agreed to a continuation of the sponsorship by the DFG for the next four years.

IMMS had collaborated, in the part project A5, considerably regarding these outstanding results. In doing so, it is the aim of the operation of IMMS, to research the basics of designing nanopositioning systems for large travel ranges of hundreds of millimeters. The particular challenge here is to configure the drive system in a way that position stability within the nanometer range as well as an exact nanometric movement of the positioning table is realizable despite the large dimensions and masses, which come along with the requirement of large operating areas.

At this point, conventional systems with roller guides and serial arranged linear axes reach their limits. Long kinematic chains, mechanical resonances and last but not least, frictional forces within the guiding elements rank among the critical parameters and limit the reachable precision.

Planar Air-guided Direct Drive System

A planar aerostatically guided direct drive system, offers completely new options compared to conventional systems and offers the best preconditions for a nanometric precise line movement with minimal friction.

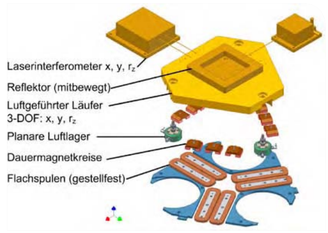


Figure 1: Principle of the planar drive system

Figure 1 shows schematically the configuration of an integrated planar direct drive system. The slider is braced almost frictionless by the air bearings and can move in x, y and r_z. The drive force is generated as Lorentz force between the frame-fixed flat coils and the permanent magnet circuits that are mounted to the slider’s underside. During regulated operation, the z-rotation of the slider r_z is locked by field forces. The x-, y-position of the slider as well as the rotation r_z are measured by high-resolution plane mirror interferometers. The system realized within the scope of the research works at the IMMS has the following performances:

- Traversing range 100 mm
- Acceleration max. 500 mm/s²
- Resolution of measuring x, y 0.1 nm
- Speed max. 30 mm/s
- Resolution of measuring r_z 0.001 arcsec
- Moved mass 9.6 kg

Realized in this form – the simple kinematic structure with a direct driven slider as the only moving part – offers a combination of high dynamics and highest precision.

Minimization of Disturbances

Regarding absolute precision up to the nanometer range, the importance of both external and internal disturbances and their elimination respectively minimization contributes significantly to the achievable precision. Friction forces have an especially strong influence on the quality of the positioning. By means of a planar air guide of the slider, these forces drop almost completely in the hereby presented system, which makes a decisive difference compared with roller guides applied in many cases to conventional drive systems. For systems afflicted with friction, especially in case of a shift in direction of the axis movement, the friction forces and above all the stick-slip-effect lead to considerable track errors. Mostly they are by a manifold larger than the track errors when moving continuously. Concerning this matter, air-guided systems offer decisive advantages.

Figure 2 shows the air-guided planar drive system assembled at IMMS.

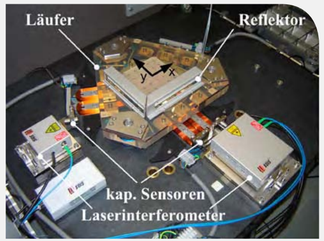


Figure 2: Planar nano-positioning system

Positioning in the Range of Nanometers

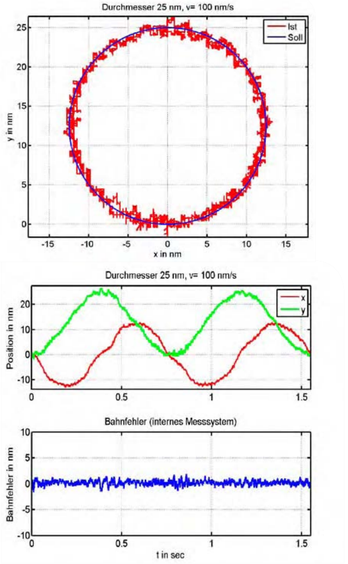
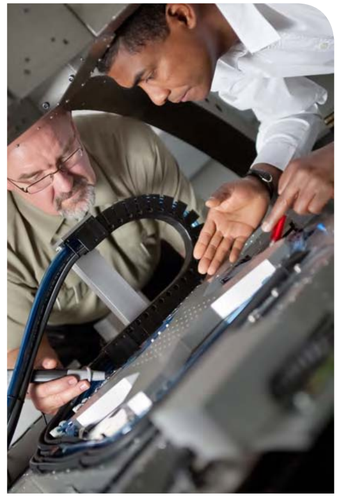


Figure 3: Circular driving with planar drive system (circle Ø 25 nm, v = 100 nm/s)

Figure 3 shows a 25 nanometers circular driving of this system. The depiction of the positioning signals and the track errors clarify the efficiency of the system and above all the smooth passing through of the reversal points of the axis movement. During the complete movement, the deviation from the reference track rests smaller than 1.8 nanometers. At the same time the current system offers a traversing range of ø 100 mm. A larger system is being assembled at the moment.

The research works of SFB 622 and especially of IMMS, are aimed at "reaching the limits of the technically feasible". Even if other technical solutions in the field of semiconductor technology already work with ca. 1 m/s and track errors of 4 nm – or even more precisely – the achieved solutions can be referred to a large and important step in development.

Particularly, when it comes to the combination of a high positioning resolution and large planar operating ranges (several 100 mm in x and y), the results of IMMS rank among the internationally leading ones.



Know-how for New Products

For IMMS, the basic research and the results in this field form the basis for numerous innovations and further developments. The hereby attained know-how, transferred to absolutely new assignments of tasks and applications of our industrial partners, will be the corner stone for the development of novel positioning systems with nanometer precision and so the initial point for new innovative products and methods.

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SMARTIEHS – INTELLIGENT MEMS TEST SYSTEM ON WAFER LEVEL

MEMS (micro-electro-mechanical systems) consist of one or more sensors, actuators and one electronic control system on a substratum respectively on a chip. Mostly their size is only a few micrometers (example see figure 1). These tiny systems have unlocked more and more new fields of application for years now and cannot be imagined away from today's everyday life. We are confronted with them as pressure and force sensors, in household appliances, but also, for example, in tires, to warn of a sudden decrease in pressure. Their low size makes them to ideal microphones for mobile phones since a more and more compact style is hereby substantial. Furthermore, they offer new functionalities due to their small size, as for example the possibility of orientation of the screen content to the position of the telephone. But MEMS are also applied as acceleration sensors in airbags, to inkjet print heads and much more. A multitude of devices gets more compact, more reliable, more efficient and more capable due to the integration of MEMS

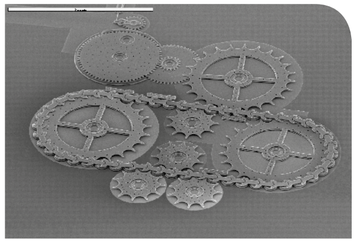


Figure 1: MEMS-Chain of only 500 micrometers
Source: www.sandia.gov/media/NewsRel/NR2002/images/jpg/chain1.jpg

Figure 2: Typical application of MEMS

Optimized Test of MEMS

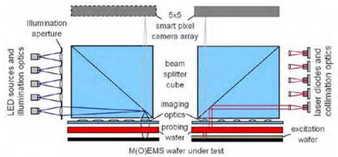
The fabrication processes of MEMS require a sequence of test steps for the monitoring of quality and for the safeguarding of performance parameters. Test procedures for MEMS applied so far, are based on a sequential measurement of single components and are therefore very time-consuming and cost-intensive. With the project SMARTIEHS, a concept for a parallel measurement system is implemented, which allows to measure up to 100 MEMS structures at the same time. Thereby, the measurement of the parameters is effected directly on the wafer, whereby following manufacturing steps like separation, contacting and housing can be dropped, if the defect of the component is detected.

Besides capture of geometric and topological parameters, the system allows by means of a static and dynamic stimulation of the mostly membranous structures also the capture of natural frequencies and natural modes of the devices under test. These are again a very good indicator for the correct behavior of the MEMS component.

IMMS works on a clutch of different, challenging, constructive and control technical developmental tasks in the course of the project SMARTIEHS. Hence, as an example, the whole conception of the test system has been worked out, which integrates the components of the project partners. Another subtask is the development of the regulation of the scanning unit. But IMMS brings in already existing competences regarding development of hard- and software for the processing of camera signals and interconnects the MEMS test system software-sided with a SUESS prober station PA200.

Novel Measurement Method

Core components of the system are micro-optical processed interferometer matrices which measure 25 Dies each (MEMS structure within the wafer composite) in the arranged laboratory sample. The inspection system (figure 3) has thereby two different 5 x 5 interferometer matrices, which are realized as "probing wafer". A laser interferometer (LI), Twyman-Green configured, permits the measurement of dynamic parameters, like natural frequencies and natural modes, whilst a low coherence interferometer (LCI), Mirau configured, allows the measurement of profiles respectively deformations. The evaluation of interferometer signals is effected respectively by a 5 x 5 matrix of smart pixels cameras.



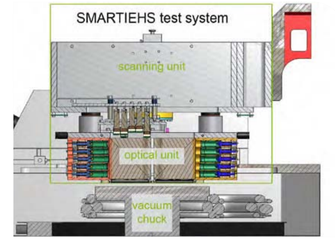


Figure 3: Principle construction of SMARTIEHS instrument: optical unit (above), whole system (beneath)

By dint of the LI configuration, from the determination of the natural frequencies of the structures, their material tensions can be gathered, which are an important indicator for a correct manufacturing process (figure 4). For that purpose, the MEMS under test are stimulated electro-statically and the occurring oscillations are detected via the LI matrix.

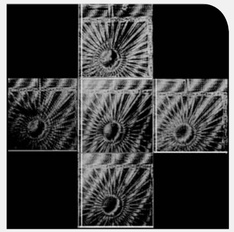


Figure 4: Interference pictures of five channels, by LI matrix

The second configuration (LCI) serves inter alia the measurements of topology of MEMS structures. During a test run at constant speed equidistant interference pictures (figure 5) of MEMS structures are captured by dint of the LCI matrix, from which the altitude profile can be reconstructed very precisely.

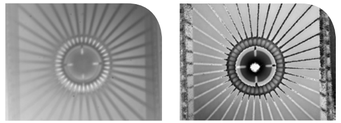


Figure 5: Interference picture (left) and phase picture (right) of an IR sensor, measured by a LCI channel

Precision Drive allows Maximum Accuracy

Both measurement methods require a high-precision arrangement of the optical unit (lighting, beam guidance and interferometer matrices) for the MEMS wafer under test. Additionally, a relative movement with 0.1 to 1 mm/s at a permanence of below one percent has to be ensured for the topological measurement by means of a LCI adjustment, whereupon disturbing tipping may not influence the adjustment towards the tested object.

The measurement by dint of LI matrix requires an accuracy of positioning of below 10 nm, whereupon the precize parallel adjustment of the optical unit towards the MEMS wafer has to enable a pitching and rolling movement of +/- 0.02 degrees.

The scanning unit, realized by IMMS, for the movement of the optical unit consists of three plunger coil drives, whose position is regulated by three high-resolution laser interferometers. As solid body guidance of the scanning unit serves three star-shaped compound springs, which enable a very high stiffness ratio within and across the direction of movement. Thereby, a very stiff mechanical connection of the inactively regulated axes between optical unit and the device under test is managed. Additional coil springs compensate the weight of the arrangement and lead to a drastic reduction of energy within the plunger coil drives.

The approximate positioning of the MEMS wafer relatively towards the scanning unit is effected by a probe station (SUESS PA200), in which the total measuring arrangement is integrated.

Figure 6: plunger coil drives of the scanning unit (on the left); schematic arrangement of the scanning unit developed at IMMS (on the right) which arranges the optical unit relatively towards the MEMS wafer and moves it precisely

Parameter Identification by Means of Dynamic Measurements

Besides the capture of topological characteristics of MEMS objects, especially the material tensions within the MEMS, mostly arranged of several layers, are determining for their correct functioning. If process parameters deviate from the standards during fabrication, undesired mechanical tensioning and forming can lead to maloperation and to early failure of the components.

By dint of measurement of natural frequencies of the MEMS components, their stress condition can be gathered from a FE model.

An identification tool, developed at IMMS, permits now the detection of parameters depending on natural frequency, as for example layer thickness or stress, from the frequency response of the MEMS component. The parameter range, to be captured by measurements, is scanned before via FE simulations and is polynomial approximated for easier handling.

The initially not definite allocation of peaks of the frequency response to the natural frequencies of the systems is effected together with the actual parameter identification within an optimization submodule.

Efficient and Fast Tests

The SMARTIEHS concept allows an efficient and considerably accelerated test of MEMS on wafer level by the simultaneous measurement of several dozens of Dies at the same time. Besides topological parameters, also layer thicknesses and layer tensions can be captured via frequency measurement on basis of a parametric FE model.

The further works focus now on the gradual optimization of the interaction of all modules of the test systems and the integration of a superior control. Continuative, the system is to be checked for aptitude within a multitude of MEMS systems. The determination of layer tensions and the elasticity modulus in very thin layers are the center of these processes.

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MICRO-ELECTRONIC LIGHT SENSORS

Light is the most important medium through which we humans perceive our world. The predominant part of all sensory input we use for orienting ourselves in our environment and for communicating with other human beings is received visually. Through our eyes, we can sense the spatial distribution and temporal variations of the intensity and color of the ambient light. From this stream of information, our brain derives conclusions about distances, motion and properties of objects and decodes the contents of written and symbolic modes of communication. Consequently, for the ubiquitous electronic information and automation technologies that shape our life today, light plays a major role as information carrier for man-machine and machine-to-machine communication.

Photodiodes in Electronic Devices

Light-based electronic sensors and communication systems require both light-emitting components, such as LEDs or displays, as well as devices called photodiodes, which are capable of converting light signals into electrical signals for further processing. It may not always be as obvious as in the case of the megapixel image sensors built into digital cameras: light sensors – consisting of photodiodes and electronic readout circuits – can nowadays be found in a wide variety of industrial and consumer devices, such as TV remote controls, DVD players, home cinema systems, notebooks, or mobile phones. As these devices are continually becoming smaller, more powerful, more energy-efficient, and cheaper at the same time, the performance requirements for light sensors keep increasing proportionally. Electronic light sensors have to be integrated in ever less space and offer higher sensitivity and switching speed while consuming less power. To ensure cost-efficient mass production, they should be manufactured using standard fabrication processes for silicon integrated circuits.

Optimization of Integrated Photodiodes

Within in an industrial collaborative research project supported by the federal state of Thuringia, IMMS and X-FAB Semiconductor Foundries AG jointly developed methods for integrating photodiodes efficiently into existing low-cost CMOS and BiCMOS processes for the production of microelectronic circuits. The aim of this project was to optimize the light sensitivity and switching speed of silicon photodiodes over a wide spectral range from red light to blue light. A photo detector integrated circuit, or PDIC (which is the type of laser light sensor used in PC data drives for reading and writing Blu-ray Discs, DVD, and CD media), was chosen as a particularly challenging lead application for demonstrating the industrial practicability of the research results. Based on the first results on photodiode process integration, a PDIC for high-speed Blu-ray Disc drives was designed by IMMS during the first project year and manufactured successfully by X-FAB (see the Annual Report 2009 for a detailed description of the PDIC).

Further Applications for Light Sensors

During the second and final year of the project, further application areas for CMOS-based light sensors have been explored, some of which differ greatly from Blu-ray Disc PDICs in terms of the corresponding technical requirements. In this context, an integrated receiver for fiber-optical data communication with bit rates of greater than 100 MBit/s as well as an ambient light sensor (ALS) have been developed. The ALS evaluates the brightness of the ambient light according to the characteristic of the human eye and can be used in applications such as smart building lighting systems or mobile displays for controlling – and reducing – energy consumption (see page 46 in this publication). While the primary requirement for Blu-ray Disc PDICs and optical data receivers is high switching speed, the focus during the development of an ambient light sensor is on matching its spectral responsivity to that of the human eye as well as on energy efficiency. Switching speed plays only a secondary role. Within the framework of the project, functional solutions based on monolithically integrated photodiodes and CMOS/BiCMOS readout circuits were demonstrated successfully for all considered applications.

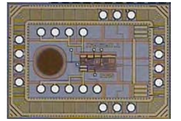

Figure 1: Integrated optical receiver D3005A

Measurement Technology for Characterization and Modeling of Photodiodes

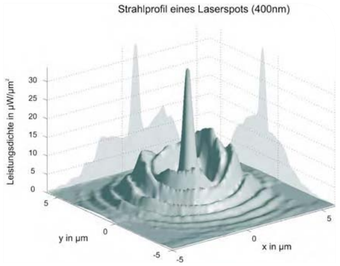

Figure 2: Beam profile of the laser image on the wafer (λ = 400 nm)

In addition, IMMS focused on methodology development for measuring and modeling the characteristics of optoelectronic devices and circuits, which is a prerequisite for the design of integrated light sensors in an industrial setting. The physical behavior of photodiodes and sensor circuits must be measured precisely and modeled mathematically to provide circuit designers with accurate simulation models for the basic components from which integrated light sensors can be constructed. Precise characterization of optoelectronic devices also requires very good knowledge of the characteristics of the measurement rig setup itself.

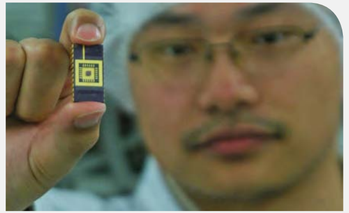

Figure 3: Optimization of micro-electronical circuits at the IMMS

Parameters such as the diameter and brightness profile of the laser beam used to stimulate the photodiodes, as well as the properties of the materials used to fabricate the devices under test, have great influence on the precision of the measurement results.

To quantify and understand these influence factors one at a time, a set of test structures for the characterization of photodiodes and laser beam profiles have been developed using several semiconductor manufacturing processes from X-FAB. With the measurement results thus obtained, the optical measurement rig was calibrated and, subsequently, used to determine the characteristics of the optoelectronic components and circuits developed within the project with the desired accuracy.

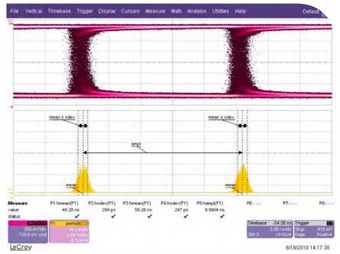

Figure 4: Measured eye diagram for 100 MBps PRBS pattern

Innovative Sensor Systems

Over the course of the project, the institute's existing skills in design, simulation and test of integrated CMOS light sensors have been enhanced significantly. The know-how gained during the development and characterization of the demonstrator circuits (PDIC, data receiver, ALS) can be transferred to further application areas such as industrial sense-and-control or biomedical systems. It will enable IMMS to offer a wider range of R&D services for innovative optoelectronic sensor system solutions in these and related fields. Project partners are invited to share IMMS's experiences and service offerings within national and international R&D collaboration programs.

Project title: "Modeling and optimization of photodiodes and DVD front end amplifier circuits"

Short title: TAB DVD photo diode
Grant no.: 2006 VF 0046

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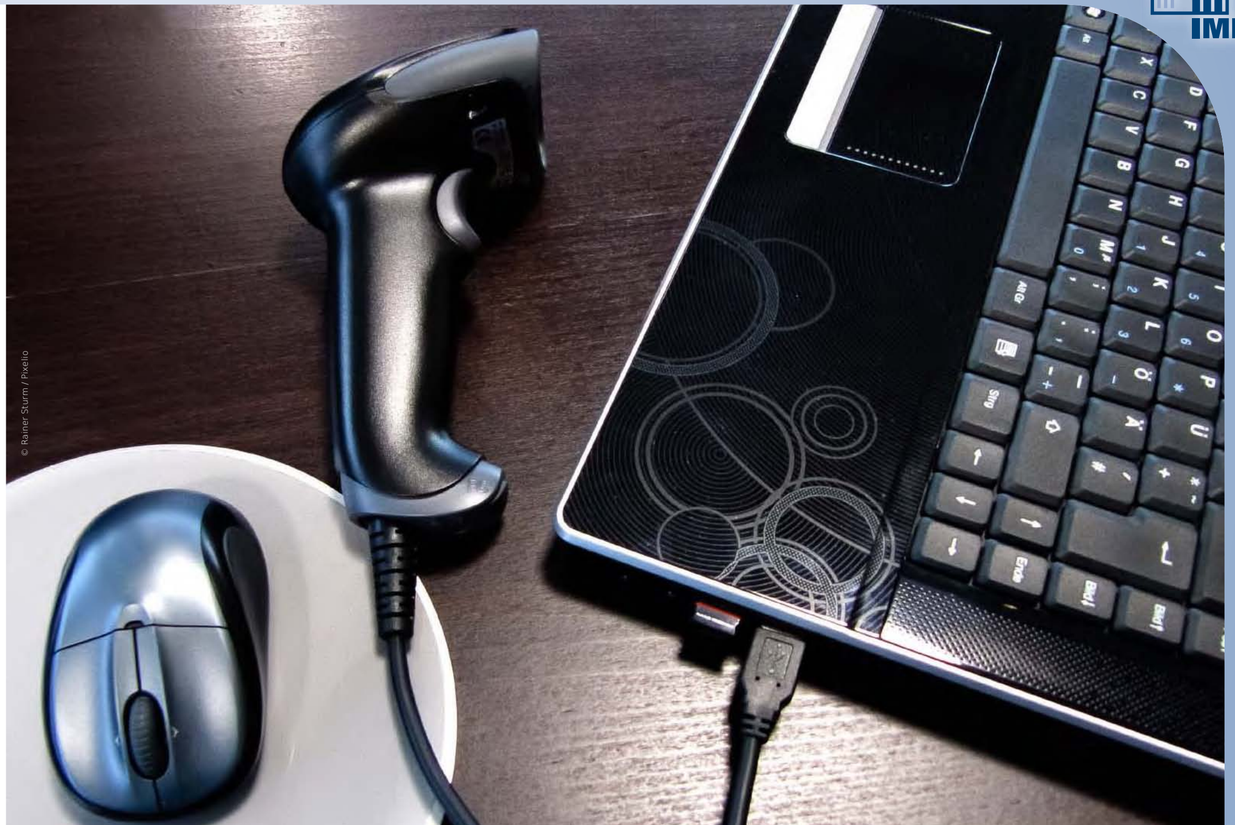

AMBIENT LIGHT SENSOR – CIRCUIT DEVELOPMENT AT IMMS FROM THE IDEA UP TO THE SAMPLE

By means of the ambient light sensor D3010A, an innovative circuit has been developed, which shows at the same time, how circuit development can be realized by IMMS from the idea up to the sample. The ambient light sensor (ALS) permits, like shown in figure 1, to detect and evaluate the brightness of the ambient light according to the perception of the human eye. This evaluation is effected by a threshold control whereas ALS provides as output signal the information “dark” or “bright” ambient light.

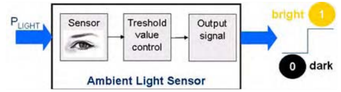

Figure 1: Functionality of the ambient light sensor D3010A

ALS D3010A is ideally suitable for mobile applications due to its low energy requirement of 40 µW (operating voltage: 2.0 V), which can be reduced to less than 5nW by “sleep mode” as well as due to its low chip surface (without scribe lane) of 0.64 mm². Furthermore, externally needed components for definition of automatic thresholds as yet, are already integrated.

Multitude of Applications

The ambient light sensor can be applied wherever visibility conditions must be adapted to the human eye. In figure 2 you can see exemplarily a laptop and a cell-phone. In terms of such products, the contrast ratio of the displays depends on ambient light.

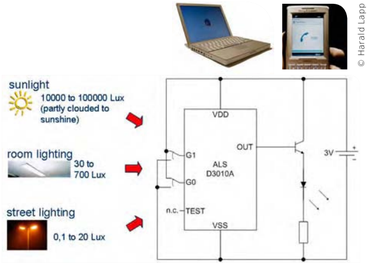

Figure 2: Application of ALS D3010A

In case ALS is integrated in a cell-phone or a laptop, the ambient light can be detected with the sensibility of the human eye and evaluated by the threshold control. With the information “dark” or “bright” ambient light, edited by ALS, it is possible to switch on or off a background lighting for ideal contrast ratio. At the same time the energy demand of the display can be reduced. Furthermore, the application in SMART-sensor systems is supposable. In comparison to other fabricants, the ALS D3010A offers the possibility to evaluate the ambient light and to require thereby only a low demand for power output. The small chip surface saves production costs. The end consumer benefits from the application of ALS in various aspects. Mobile applications can be used considerably longer (for example with one battery charge), by switching off unnecessary background lighting.

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Technical Implementation of the Circuit Development

Figure 3 shows the schematic construction of ALS. With G1 and G0 you can chose between three thresholds and the sleep mode. The three thresholds correspond to the different brightness sensibilities of the human eye and are implemented by a modifiable electricity bank. The following Schmitt trigger conduces to generate more steep edges as well as to suppress switching operations caused by noise. Hereafter, perturbations, effected by mains frequency of artificial lighting, are prevented by means of a filter. At the output OUT, a high signal (bright ambient light) for lighting conditions above the threshold, and a low signal (dark ambient light) for lighting conditions below the threshold are edited.

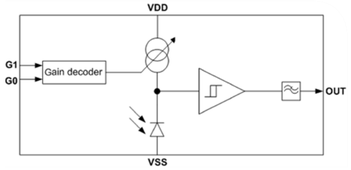

Figure 3: Block diagram of ALS D3010A

The spectral sensitivity of the sensor within ALS is adapted to the human eye and has its maximum sensitivity accordingly, as to be seen in figure 4, at a wave length of about 555 nm.

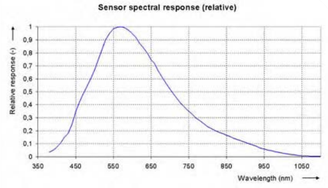

Figure 4: Spectral sensitivity of ALS D3010A
Source: X-FAB Semiconductor Foundries AG

The switching circuit is designed for an operating voltage of 2.0 V to 3.6 V and has a current consumption of less than 1 nA in the sleep mode. The chip surface (without scribe lane) of the developed sample adds up to 0.8 mm x 0.8 mm, using the processes XH035 of X-FAB Semiconductor Foundries AG and is for comparison of sizes opposed to the picture of a coin.

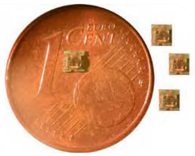

Figure 5: Sample in comparison with a one cent coin

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From the Idea to the Sample

The development of a sample presupposes the implementation of the following processes: brainstorming, electrical design, physical design (layout), wafer production, packaging as well as samples. The process flow and the competences of IMMS during the corresponding processes are to be seen in figure 6.

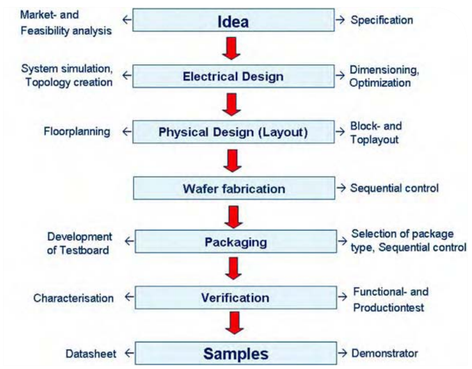

Figure 6: Competencies of IMMS during flow

Based on market and feasibility analysis during the first process "idea", a specification is generated. Followed up by a system simulation during "electrical design", whereby optimal system architecture is chosen, respectively possible weak points are detected betimes. From this results manual dimensioning as well as optimization by means of latest EDA methodology. Both for electrical as well as for physical design, IMMS offers the complete portfolio. Floor planning, block and top layout in the physical design are backed up likewise by the latest methodologies like "floorplanner" and "autorouter". The choice of package type, necessary during the process "packaging" as well as development of the test version, are likewise affected by IMMS. The following verification is adopted by IMMS measurement technology which executes characterization, functioning and production tests on more than 120 square metres of laboratory area. Furthermore fault analysis and lifetime tests are possible. IMMS provides on request a data sheet and demonstrators regarding the tested sample.

Summary

The correct function of the samples was proved by an internal measurement technology whereby IMMS has an innovative ambient light sensor available. The sensor is characterized by integrated thresholds besides a low power and Die area saving construction. Especially the low-energy draft offers the possibility for future advancements to integrate an energy harvesting system. An ALS, functioning energy autarkic, would shape possibilities of application and areas of assignment certainly more multifaceted. For this reason, ALS is an example that the chip design of IMMS – as the customer may expect it – can be realized from the idea up to the sample applying the latest design methodologies.

Support project: "Modeling and optimization of photodiodes and DVD front end amplifier circuits"

Short title: TAB DVD photodiode
Support code 2006VF0046

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THE PROJECT OKTOPUS AND THE FURTHER DEVELOPMENT OF MEASUREMENT TECHNOLOGY AT IMMS

The BMBF (Federal Ministry of Education and Research) research project OKTOPUS (Optimal Configurable Test Organization Platform with Support for Synthesis) was finished successfully in September 2010, but will continue to improve our measurement technology at IMMS. From 2007 until 2010, Konrad Technologies (tester manufacturer), Atmel Germany GmbH, X-FAB Semiconductor Foundries AG and Melexis GmbH (semiconductor companies) as well as Friedrich-Alexander University Erlangen-Nuremberg and IMMS formed a project team to analyze modular test platforms and their application in semiconductor testers. The research topics included scalable tester architectures, adaption and calibration solutions on production level and a continuous test flow.

One Platform – Multiple Applications

The test platform is based on a PXI rack with embedded controller and works with LabView Software (National Instruments). According to the actual test problem it will be completed by tester instruments. This concept allows a flexible and cost effective test solution.

Characterization of RF-IPs

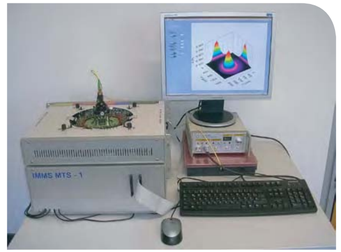
Application: On-wafer test with automatic prober control

Tester configuration with 2.7 GHz RF-Suite and PMU.

Advantages:

- reduces test time by 50 %, compared to IC-CAP measurements
- allows flexible measurement data formats and automated analysis
- can be reused for multiple IPs

Test of Optoelectronic ICs



Application: Analysis of light field sensors

Tester configuration with digital pins and PMU.

Advantages:

- a commercial load board can be used small sized and mobile measuring station
- large-area optical stimulation, matches production test conditions
- custom-designed user interface

MEMS-Test

Application: Development of procedures for the parallel on-wafer testing of MEMS (this research project is supported by EU).

Test with automatic probe control.

Advantages:

- the test platform can be integrated in a complex tester assembly
- easy synchronization of components

Quality Management

Application: Parameter monitoring during wafer process

Tester configuration with digital pins and PMU.

Advantages:

- six times faster, compared to solutions with HP82000 and external measurement devices
- low cost solution
- can be reused for different semiconductor technologies

Transfer of Know-how

The large application of the new techniques requires a knowledge-transfer from the OKTOPUS project staff to all other staff of the specific field "industrial electronics and measurement technology" of IMMS. IMMS will offer special training courses to get familiar with the features of the new test system. Future users can be trained in the fields system configuration, fundamentals of programming, calibration of and test methodology for special IMMS hardware solutions. Also advanced training offers for industrial partners are under way. Currently four PXI / PXIe racks, completed with further test instruments can be used for training of IMMS internal or external users. Furthermore one more station is reserved for student lab projects, undergraduate/graduate studies and feasibility studies.

Future Trends

For a further increase in performance of these test systems, development and application of FPGA based tester instruments will be forced at IMMS. This can be used to fulfill special requirements for test time, asynchronous test applications and software defined instruments.

From Research to Industrial Application

Since test methodology and adaption is similar to industrial testers, these test platforms can migrate from laboratory to production. In 2010 the new designed PXI systems for RF test were used to perform quality tests for industrial semiconductor fabrication. Due to theses test systems, IMMS is able to develop and provide efficient test methods and solutions with state-of-the-art test technology. New research and industry projects will be implemented into these test systems in the future. The main criteria for further research are to reduce hardware cost and test time as well.

The project OKTOPUS was funded by BMBF
Support code. 13 N 10345

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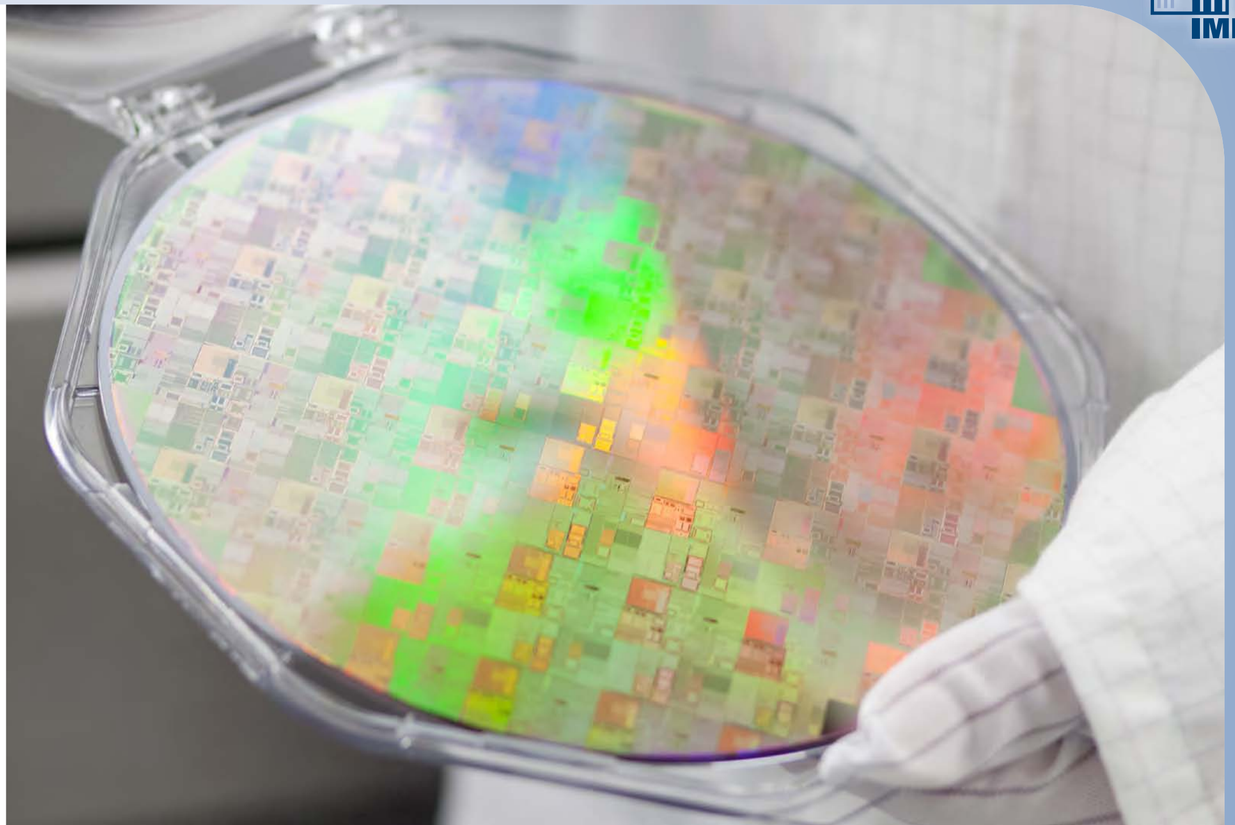

NEW ELECTRONIC MEASUREMENT LABORATORY WITH INTERNATIONAL CLEAN ROOM STANDARD

In the microelectronic branch of IMMS, located in the south-eastern region of Erfurt, a new advanced electronic measurement laboratory had been opened within the third quarter of 2010. Thereby, IMMS is able to execute characterization and test of integrated circuits as well as the analysis of the reliability of electronic components and systems at an international level.

120 m² of newly equipped laboratory space offer enough room for the characterization and the test of integrated circuits on wafer or for the analysis of reliability of electronic components and systems.

International Quality Standards

It is an important step for IMMS, that this laboratory fulfills the requirements of clean room class 7 according to DIN ISO 14644. In this clean room class less than 400 particles with a diameter of 0.5 to 5 µm can be found in one liter of air. Impurities and dust particles can heavily affect the reliability of electronics. Therefore such working environments are a substantial precondition to develop and produce sustainable integrated circuits and systems with higher integration density. The clean room offers optimal working conditions for the staff of IMMS and its partners,

which are furthermore corresponding to common international quality standards.

The investment in new technologies – like in this case in the new measurement laboratory – consolidates the south-eastern region of Erfurt as site of micro-electronics and is at the same time an implemented part of the future and innovation program (ZIP) of the Ministry of Economic Affairs, Employment and Technology of Thuringia. Therein, the state of Thuringia admits to sponsorship of research and technologies in the scope of seminal development of measurement technology, control technology and control engineering but also of optics/photonics, medical engineering, power engineering and environmental technologies as well as media technology and energy-efficient drive systems.

Enhancement of the IMMS Line of Action

The new electronic measurement laboratory will enlarge the fields of activity of IMMS and will deal with the following assignments of tasks in the future:

- On-wafer measurements with the objective of functional tests of integrated circuits and the optimization of technology and design processes of micro-electronics and micro-systems technology.
- Research of novel and more efficient test methods in matter of test time, application of cost effective test platforms as well as the development of specific intelligent test hardware.
- Characterization of components and circuits on-wafer or as packaged component in a wide temperature range of – 40 °C up to 300 °C.
- Analysis of reliability and endurance tests of integrated circuits, components and systems, according to international standards.
- Quality control of components and circuits.

Investment in Innovation

The staff of IMMS researches and develops innovative and complex solutions with system approach, from a holistic point of view. Methods of resolutions, that can be implemented by means of simulation and effective design methods in integrated circuits, result from an idea or an industrial assignment of tasks. In doing so producibility and high rate of yield has to be assured by robust circuit technology. The technical solution will be completed by the design of PC-boards (hardware) and intelligence (software).

To test these solutions based on industrial standards is an essentiell part in the development process. Verifiability, reproduction, and the exact adjustment to given specifications are indispensable and are secured by the internal IMMS measurement technology. The new measurement laboratory therefore opens up new possibilities for the implementation of tests on the highest level.

Application fields of the tasks of IMMS are sensor technology, optronics, industrial and automotive electronics as well as telecommunication engineering and medical engineering.

Besides the processing of research projects, the electronic measurement laboratory is also available for the execution of test services for small and medium-sized companies.

The IMMS demand for quality crosses all levels – from integrated circuit to the point of holistic solution. The options to unify everything under one umbrella is the specification of IMMS and offers therefore the precondition to bring up products out of ideas.

Special thanks go to the operating company for applications and technology centers Thuringia (BATT) for the valuable support of establishing the necessary infrastructure.

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Dr. V. BOOS (18.05.-19.05.2010). EDADB – eine Infrastruktur zur Dokumentation und Wiederverwendung von Schaltungstopologien. Dresden: in Proceedings DASS 2010.

S. HESSE[1], H.-J. BÜCHNER[2], Prof. Dr. G. JÄGER[2], Dr. C. SCHÄFFEL[1], H.-U. MOHR[1] & B. LEISTRITZ[1] (31.05.-04.06.2010). First results of an interferometric controlled planar positioning system for 100 mm with zerodur slider. Delft, NL: 10. International Conference of the Euspen Society for Precision Engineering & Nanotechnology.

1 IMMS Institut für Mikroelektronik- und Mechatronik-Systeme gemeinnützige GmbH, Ilmenau
2 Institut für Prozessmess- und Sensortechnik, TU Ilmenau, Ilmenau

Dr. C. SCHÄFFEL[1], S. MICHAEL[1], B. LEISTRITZ[1], M. KATZSCHMANN[1], N. ZEIKE[1], K. GASTINGER[2], M. KUJAWINSKA[3], M. JOZWIK[3] & S. BEER[4] (31.05.-04.06.2010). Optical, mechanical and electro-optical design of an interferometric test station for massive parallel inspection of MEMS and MOEMS. Delft, NL: 10. International Conference of the Euspen Society for Precision Engineering & Nanotechnology.

1 IMMS Institut für Mikroelektronik- und Mechatronik-Systeme gemeinnützige GmbH, Ilmenau, Germany
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4 CSEM Center Suisse d'Electronique et de Microtechnique SA, Zurich, Switzerland

D. KIRSTEN, A. ROLAPP & Dr. D. NUERNBERGK (13.09.-15.09.2010). Testmethodik zur Untersuchung von geringen Leckströmen. Wildbad Kreuth: 4. GMM/GI/ITG-Fachtagung – ZuE (Zuverlässigkeit und Entwurf) 2010.

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1 IMMS Institut für Mikroelektronik- und Mechatronik-Systeme gemeinnützige GmbH, Ilmenau
2 TU Chemnitz, Professur Mikrosystem- und Gerätetechnik, Chemnitz
3 X-FAB Semiconductor Foundries AG, Erfurt

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1 LZS Universität Erlangen, Erlangen
2 IMMS Institut für Mikroelektronik- und Mechatronik-Systeme gemeinnützige GmbH, Ilmenau
3 Konrad GmbH, Radolfzell

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1 IMMS Institut für Mikroelektronik- und Mechatronik-Systeme gemeinnützige GmbH, Ilmenau
2 X-FAB Semiconductor Foundries AG, Erfurt

S. ANDERS[1], M.G. BLAMIRE[2], F.-I. BUCHHOLZ[3], D.-G. CRÉTÉ[4], R. CRISTIANO[5], P. FEBVRE[6], L. FRITZSCH[1], A. HERR[7], E. IL'ICHEV[1], J. KOHLMANN[3], J. KUNERT[1], H.-G. MEYER[1], J. NIEMEYER[3], T. ORTLEPP[8], H. ROGALLA[9], T. SCHURIG[10], M. SIEGEL[11], R. STOLZ[1], E. TARTE[12], H.J.M.ter BRAKE[9], Prof. Dr. H. TÖPFER[8,13], J.-C. VILLEGIER[14], A.M. ZAGOSKIN[15] & A.B. ZORIN[3] (15.12.2010). European roadmap on superconductive electronics – status and perspectives. In: Physica C: Superconductivity, Volume 470, Issues 23-24, Pages 2079-2126. Amsterdam, NL: Elsevier Science BV.

1 Institute of Photonic Technology (IPHT), Department of Quantum Detection, Jena, Germany
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14 CEA Grenoble, Nanosciences & Cryogenics Institute, Grenoble, France
15 Loughborough University, Department of Physics, Loughborough, United Kingdom

Presentations

Dr. W. SINN (23.02.2010). GALILEO – Regionale Initiativen in Deutschland & Konvergenz zur Identifikation. Berlin: AMA-Wissenschaftsrat.

B. BIESKE[1] & K. GILLE[2] (28.02.-02.03.2010). Charakterisierung von HF-Zellen verschiedener Technologien unter Nutzung modularer PXI-Testsysteme. Paderborn: 22nd ITG/GI/GMM Workshop „Testmethoden und Zuverlässigkeit von Schaltungen und Systemen“ (TuZ 2010).

1 IMMS Institut für Mikroelektronik- und Mechatronik-Systeme gemeinnützige GmbH, Ilmenau
2 X-FAB Semiconductor Foundries AG, Erfurt

M. REINHARD, M. MEISTER, U. LIEBOLD, T. COHRS & Dr. D. NUERNBERGK (28.02.-02.03.2010). Erhöhung der Testqualität für optoelektrische Schaltungen durch Charakterisierung des Strahlprofils. Paderborn: 22nd ITG/GI/GMM Workshop „Testmethoden und Zuverlässigkeit von Schaltungen und Systemen“ (TuZ 2010).

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T. ELSTE (03.03.2010). Mobile Audio Dosimeter for the prevention of noise-induced hearing impairment. Nürnberg: Embedded World Conference.

S. LANGE (09.03.2010). Entwurf eines PDICs für 12fach Blu-ray Schreib- und Leselaufwerke. Erfurt: 45. Mikroelektronik-Seminar.

S. LANGE, H. PLEß & Dr. E. HENNIG (11.03-12.03.2010). Entwurf eines PDICs für 12fach Blu-ray Disc Schreib- und Leselaufwerke. Ulm: 12. Workshop Analogschaltungen.

S. MICHAEL (24.03.2010). Parameter Identification of Membrane Structures – Chances and Limitations. Grenoble, France: SSI 2010 – MEMUNITY Workshop.

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S. ENGELHARDT, E. CHERVAKOVA, W. KATTANEK & T. ROSSBACH (23.04.2010). Modulare Systemplattform für drahtlose Sensornetzwerke. Dresden: 4. Innovationsforum „Software Saxony“.

S. SCHRAMM (23.04.2010). Optimierung industrieller Echtzeitanwendungen auf Basis von Open-Source-Technologien. Dresden: 4. Innovationsforum „Software Saxony“, TU Dresden.

W. KATTANEK (23.04.2010). Software-based energy management for wireless sensor systems. Dresden: 4. Innovationsforum „Software Saxony“, TU Dresden.

M. MEISTER (05.05.2010). Testmöglichkeiten auf Waferebene am IMMS. Erfurt: 49. Mikroelektronik-Seminar.

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Dr. W. SINN (19.05.2010). Konvergenz von Navigation und Sensorik – Quelle neuer Wertschöpfung. Dresden: 5. Silicon Saxony Day, SatNav Saxony Workshop.

G. NITSCHE & K. AGLA (18.05-19.05.2010). SystemC (-AMS) zur frühzeitigen Validierung und Optimierung des Systemkonzeptes komplexer Smart-Sensor-Systeme. Dresden: 5. Silicon Saxony Day.

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Dr. W. SINN (08.06.2010). Erfolgskritisches Wissen bewerten und entwickeln – Praxisbericht. Ilmenau: TU Ilmenau (Ringvorlesung).

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1 Mechatronics Group, Department of Mechanical Engineering, Ilmenau University of Technology, Ilmenau
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K. GASTINGER[1], M. KUJAWINSKA[2], U. ZEITNER[3], C. GORECKI[4], Dr. C. SCHÄFFEL[5], S. BEER[6], R. MOOSBURGER[7], M. PIZZI[8] (12.04.-16.04.2010). Next generation test equipment for micro-production. Brüssel, Belgien: Photonics Europe 2010.

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1 SINTEF IKT Optical measurement systems and data analysis, Trondheim, Norway
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4 CNRS FEMTO-ST, Besançon, France
5 IMMS Institut für Mikroelektronik- und Mechatronik-Systeme gemeinnützige GmbH, Ilmenau, Germany

Dr. W. SINN (23.06.2010). Energieversorgung im Spannungsfeld. Suhl: ELMUG-Technologiekonferenz „elmug4future“.

Prof. Dr. H. TÖPFER (23.06.2010). Komplexitätsaspekte in drahtlosen Sensornetzwerken. Suhl: ELMUG-Technologiekonferenz „elmug4future“.

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S. UZIEL (23.06.2010). Sensornahe Signalverarbeitung. Suhl: ELMUG-Technologiekonferenz „elmug4future“.

W. KATTANEK (21.07.2010). Praktische Aspekte der Gestaltung von drahtlosen Sensornetzwerken. Ilmenau: Eingeladener Vortrag zum Institutskolloquium des Instituts für Informationstechnik der Technische Universität Ilmenau.

A. AMAR (11.08.2010). Design of optical receivers (System and circuit level approaches). Erfurt: 50. Mikroelektronik-Seminar.

Dr. W. SINN (26.08.- 27.08.2010). Satellitennavigation für Inspektionen in Land- & Forstwirtschaft. Jena: 8th NEMO-SpectroNet Forum.

Prof. Dr. H. TÖPFER[1] & I. PETRINSKA[2] (11.09.2010). Energy harvesting for wireless sensor networks. Sofia, Bulgarien: Eingeladener Vortrag zum internationalen PhD Seminar on Computational Electromagnetics and Optimization in Electrical Engineering CEMOEE 2010.

1 IMMS Institut für Mikroelektronik- und Mechatronik-Systeme gemeinnützige GmbH, Ilmenau, Germany
2 Technical University of Sofia, Bulgaria

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M. GÖTZE[1], T. ROSSBACH[1], Dr. A. SCHREIBER[1], S. NICOLAI[2] & H. RÜTTINGER[2] (14.09.2010). Distributed in-house metering via self-organizing wireless networks. Ilmenau: Internationales Wissenschaftliches Kolloquium (IWK), Technische Universität Ilmenau.

1 IMMS Institut für Mikroelektronik- und Mechatronik-Systeme gemeinnützige GmbH, Ilmenau
2 Fraunhofer Application Center for Systems Engineering, Ilmenau

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S. SCHRAMM (28.10.2010). Echtzeitanwendungen mit Li-

nux – quantitativer Vergleich verschiedener Ansätze am Beispiel einer EtherCAT®-Echtzeitkommunikation für eine ARM9-Plattform. Mittweida: 12. Informatik-Tag.

H.-U. MOHR, Dr. F. SPILLER & N. ZEIKE (03.11-04.11.2010). Entwicklung eines magnetische Direktantriebes für große Verfahrbereiche mit sub-µm-Genauigkeit. Winterthur, Schweiz: Internationales Forum Mechatronik 2010.

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Prof. Dr. H. TÖPFER (10.11.2010). Drahtlos vernetzte Sensorsysteme zur Erhebung von Messgrößen zur Gebäudeautomation. Jena: 33. Stammtisch „Automatisierungstechnik“ Fachhochschule Jena.

G. METHNER (07.12.2010). IMMS Ambient light sensor D3010A – Entwicklung, Charakterisierung, Anwendung sowie die Kompetenzen des IMMS von der Idee bis hin zum Sample. Erfurt: 54. Mikroelektronik-Seminar.

Dr. W. SINN (09.-10.12.2010). Satellitennavigation und Identifikation – Zukunftstechnologien mit enormen Marktzuwächsen. Dresden: 4. RFID-Symposium.

Dr. W. SINN (15.12.2010). Intelligent Street Control with Mobile Infrared Imaging. Jena: 9th NEMO-SpectroNet Forum.

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I. GRYL, G. KROPP & R. PARIS (28.02.-02.03.2010). Entwurf und Einsatzerfahrungen eines flexibel konfigurierbaren PXI-Testsystems für on-wafer Messungen im Halbleiterbereich. Paderborn: 22nd ITG/GI/GMM Workshop „Testmethoden und Zuverlässigkeit von Schaltungen und Systemen“ (TuZ 2010).

K. AGLA (08.03.2010-12.03.2010). From SystemC to Real Hardware. Dresden: Date 2010 – Design, Automation & Test in Europe.

D. KIRSTEN & Dr. D. NUERNBERGK (17.03.-19.03.2010). Evaluation of Low Leakage Currents using a Floating-Gate Transistor. Glasgow, UK: Ultimate Integration on Silicon.

A. AMAR & T. COHRS (22.03.-24.03.2010). Adaptive gain control for high dynamic range optical receivers. Erfurt: 11. ITG/GMM-Fachtagung ANALOG 2010.

W. WU & M. ISIKHAN (22.03.-24.03.2010). Application of 3-D EM-Simulation in Research of Integrated Inductors, System in Package (SiP) Design and Package Effects. Erfurt: 11. ITG/GMM-Fachtagung ANALOG 2010.

D. KIRSTEN & Dr. D. NUERNBERGK (22.03.-24.03.2010). Programmierbare Präzisionsreferenzspannungsquelle durch Nutzung eines analogen Floating-Gate-Speicherelements. Erfurt: 11. ITG/GMM-Fachtagung ANALOG 2010.

A. RICHTER (22.03.-24.03.2010). Symbolische Analyse von effizienten Y/S-Parameter-Umrechnungen für N-Ports. Erfurt: 11. ITG/GMM-Fachtagung ANALOG 2010.

M. REINHARD, U. LIEBOLD, G. METHNER, M. MEISTER & Dr. D. NUERNBERGK (22.03.-24.03.2010). Testfeld zur Charakterisierung von Laserspot-Größen zur Untersuchung und Modellierung des HF-Verhaltens von pin-Fotodioden. Erfurt: 11. ITG/GMM-Fachtagung ANALOG 2010.

B. BIESKE[1], M. LANGE[2] & S. BEYER[2] (22.03.-24.03.2010). Test von differentiellen 2,4 GHz IEEE 802.15.4 / ZigBeeTM ICs: Grenzen und Möglichkeiten. Erfurt: 11. ITG/GMM-Fachtagung ANALOG 2010.

1 IMMS Institut für Mikroelektronik- und Mechatronik-Systeme gemeinnützige GmbH, Ilmenau
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A. JÄGER[1] & K. GILLE[2] (04.05.-05.05.2010). X-FAB PLL Demonstrator – Increase in design efficiency by the use of high abstraction level modelling and mixed-level simulation. Hannover: 4. edaWorkshop.

1 IMMS Institut für Mikroelektronik- und Mechatronik-Systeme gemeinnützige GmbH, Ilmenau
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S. HESSE[1], H.-J. BÜCHNER[2], Prof. Dr. G. JÄGER[2], Dr. C. SCHÄFFEL[1], H.-U. MOHR[1] & B. LEISTRITZ[1] (31.05.-04.06.2010). First results of an interferometric controlled planar positioning system for 100 mm with zerodur slider. Delft, NL: 10. International Conference of the Euspen Society for Precision Engineering & Nanotechnology.

1 IMMS Institut für Mikroelektronik- und Mechatronik-Systeme gemeinnützige GmbH, Ilmenau, Germany
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Dr. K. FÖRSTER (05.10.-07.10.2010). OKTOPUS: Anwendungsfelder Halbleitertest. Randolfzell: Projektabschluss-Meeting.

Dissertation

D. KIRSTEN (Dezember 2010). Entwicklung, Entwurf und Anwendung von nichtflüchtigen Analogwertspeicherelementen auf Basis von Floating-Gate-Speicherzellen in einer Standardtechnologie. IMMS GmbH, Ilmenau

Patents

Dr.-Ing. C. SCHÄFFEL. Vorrichtung zur Positionsbestimmung eines Läuferelements in einem Planarantrieb und dergl. Bewegungssystem(6D)

Dipl.-Math. D. KAROLEWSKI, Dipl.-Math. M. KATZSCHMANN, Dipl.-Ing. H.-U. MOHR, Dr.-Ing. C. SCHÄFFEL, Dr.-Ing. F. SPILLER, Dipl.-Ing. N. ZEIKE. Mehrkoordinatendirektantrieb

Dipl.-Ing. D. KRAUSSE, Dr.-Ing. E. HENNIG, Dipl.-Ing. E. SCHÄFER, Prof. Dr.-Ing. R. SOMMER. Verfahren zur automatischen Topologiemodifikation beim Entwurf von analogen integrierten Schaltungen

Trade Shows

embedded world	02. - 04. March	Nuremberg	OSADL shared booth
11. ITG/GMM-Fachtagung ANALOG 2010	22. - 24. March	Erfurt	Organizer: IMMS
Lange Nacht der Technik Ilmenau	28. May 2010	Ilmenau	Organizer: Ilmenau University of Technology
Bonding	03. - 04. May	Dresden	
Silicon Saxony Day	18. - 19. Mai 2010	Dresden	
D&E Entwicklerforum "Embedded-System-Entwicklung"	19. - 20. October 2010	Ludwigsburg	OSADL shared booth
inova	20. October 2010	Ilmenau	
SPS/IPC/Drives 2010	23. - 25. November 2010	Nuremberg	OSADL shared booth
Precision Fair 2010	01. - 02. December 2010	Veldhoven/ Eindhoven (NL)	ELMUG shared booth
electronica 2010	09. - 12. December 2010	Munich	OSADL shared booth