Cooperating to Innovate

ViVERA – A Virtual Network for the Future
New Methods Developed for Generating Virtual Models
Potentials for Optimization in Mechanical and Plant Engineering
Dear Readers,

The Fraunhofer Institute for Factory Operation and Automation’s new magazine »IFFocus« vividly presents the outstanding achievements of the Fraunhofer IFF, which has long since made a name for itself far outside the region.

Since its foundation more than twelve years ago, the Fraunhofer IFF has honed and continuously enhanced its research profile. It undertakes applied research and development in the fields of logistics systems and networks, information logistics, automation, production and plant management as well as virtual development and training. Applying this orientation, complex logistics systems in industry, commerce, services and transportation can be planned using the newest methods and tools of computer graphics and simulation, operated with appropriate information and communications technologies and designed cost effectively using new automation concepts.

The institute’s researchers provide clients and partners an interdisciplinary mode of work, professional project management, state-of-the-art lab equipment and years of research and industry experience. The Fraunhofer IFF also ensures there is an ongoing transfer of know-how from the research community to corporate practice for the small and medium-sized enterprises in the region.

Here on the Elbe, applied research is developing into a pivotal locational factor that provides enterprises technology transfer and capable support in the form of innovative organizational solutions. Trends, strategies and future scenarios are being defined and acted on; applied solutions are being created.

I am convinced that that know-how and market alliances of enterprises in interaction with the Fraunhofer Institute and its partners and above all in close cooperation with Otto von Guericke University will generate new prospects in Magdeburg’s research scene and, beyond that, in the entire region.

The networking between academia and non-academic research institutions is in turn a prerequisite for international visibility and competitiveness in a globalized research scene, which manifests itself not least in the operation of several joint competence centers.

With its construction of the Virtual Development and Training Center VDTC and its assumption of the coordination of the »VIVERA« Virtual Excellence Center for Virtual and Augmented Reality, the Fraunhofer IFF is optimally prepared for the future.

Prof. Jan-Hendrik Olbertz,
Saxony-Anhalt Minister of Education and Culture
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Cornerstone Laid for the Virtual Development and Training Centre VDTC

The new VDTC building in the Magdeburg Scientific Port is visibly taking shape. The ceremonial laying of the cornerstone on June 23, 2005 drew many high ranking guests from science, business and politics to Magdeburg.

With a total investment volume of around 15.5 million euros, the building will eventually dominate the Scientific Port being redeveloped as a visible symbol of progress. Eighteen meters in diameter, the circular virtual reality testing facility housing a vaulted projection screen is already easy to make out. Approximately 170 new jobs will be created. The European Union, the Federal Government and the State of Saxony-Anhalt are supporting the project.

In the VDTC network center, researchers will collaborate interdisciplinarily with innovative service providers and industrial users. In the VDTC, they will jointly develop with clients tailor-made, virtual reality-based solutions for specific manufacturing tasks.

Interactive simulations and visualizations using virtual, augmented and mixed reality support realistically rendering complex technical systems and products. Moreover, the VDTC platform provides remarkable opportunities for training technical personnel. In cooperation with Otto von Guericke University, the VDTC will form an indispensable link between academic research and industrial application.

Companies from the sectors of the automotive industry, mechanical and plant engineering, machine tool manufacture, aerospace and medical technology, for example, are already taking advantage of the potentials of virtual engineering at the Fraunhofer IFF. Its researchers have already earned international recognition. The project VDTC-ProDiMA for instance received the »European Regional Innovation Award«, an important European Commission prize for innovation. The jury recognized the exemplary transfer of newest research findings to small and medium-sized enterprises in the region.

New Dimensions – Virtual Worlds: The Annual Fraunhofer Convention on October 19, 2005 in Magdeburg

At an awards ceremony at its annual convention, the Fraunhofer-Gesellschaft annually recognizes outstanding achievements in applied research in order to present visions of modern technology, to celebrate with clients and partners from politics and business and not least to give the colleagues in the some 80 research institutions it now has a bit of motivation for their daily work. This year, guests can expect a multimedia research show with the motto »New
8th IFF Science Days: Magdeburg Hosts Experts from All Over the World

The IFF Science Days have evolved into a magnet for academics and researchers and practitioners from industry. More than 350 participants from academia and research, the business community and politics came to Magdeburg to learn about new trends and developments in the fields of virtual reality and logistics. The center of attention at the 8th IFF Science Days was the international conference »Virtual Reality and Augmented Reality in Product Life Cycle Management and the Digital Factory«. The event was held under the patronage of Saxony-Anhalt Minister of Education and Culture Jan-Hendrik Olbertz.

Industry experts reported on the use of virtual reality (VR) and augmented reality (AR) in practice. They highlighted potentials and fields of application for these technologies and explained needs for research and development in the future. Researchers from institutes and universities presented the current state of research as well as current trends and technological developments in the field of VR/AR.

The conference is a contribution to the ViVERA project (www.vivera.org) supported by the BMBF, which is bringing together users and developers of virtual and augmented reality technologies.

The 9th IFF Science Days will be held on June 21-23, 2006.

ViVERA bundles the research resources of ten institutes and universities nationwide and its objective is to integrate VR technologies in enterprises.

The conference was accompanied by a whole series of other events covering fields of Fraunhofer IFF research. Noteworthy were workshops on wood logistics, RFID and telematics in logistics and documentation solutions in mechanical engineering. Industry working groups for cooperation in plant engineering and Web-based services completed the program.

Apart from the professional event, the evening party was a highpoint of the Science Days. In a relaxed atmosphere in the Scientific Port on the first evening of the conference, guests resumed their conversations from the day and established new contacts. The construction site for the Virtual Development and Training Centre VDTC, the cornerstone of which was laid during the Science Days, was a perfect backdrop for this get-together.
ResearchTraining@VDTC

In December 2005, the Fraunhofer IFF Virtual Development and Training Centre VDTC started an EU supported training program for up-and-coming researchers as part of a Marie Curie Action.

A Choice of Three Thematic Fields: Virtual product development, virtual process control and virtual-interactive training. Along with attending courses and collaborating on projects, trainees will also perform research in the Fraunhofer IFF LogmotionLab and VR lab. Training will be supplemented by modules on soft skills and languages and by conference attendance. The training program will be conducted in cooperation with the Otto von Guericke University Magdeburg and regional industry partners.

The European Union’s Marie Curie Programme enables young researchers from abroad to acquire experience at the VDTC.

Fraunhofer IFF LogmotionLab and VR lab. Training will be supplemented by modules on soft skills and languages and by conference attendance. The training program will be conducted in cooperation with the Otto von Guericke University Magdeburg and regional industry partners.

Application is open to researchers with fewer than four years of practical research experience or in a doctoral degree track. For more information contact Dr. Eberhardt Blümel, Division Director, Division of Virtual Development and Training VDT, Fraunhofer IFF, Tel. +49 (0) 391/40 90-110 eberhardt.bluemel@iff.fraunhofer.de.

This will subsume all actions in the field of human resources and mobility that are elements of the 6th European Research Framework Programme and is being funded by the EU with 1.58 billion euros. The objective of ResearchTraining@vdtc is to give twelve up-and-coming researchers from inside and outside Europe the opportunity at the Fraunhofer IFF to collaborate on international research projects or to gather practical experience in industry projects over four years. One to three-year stays are offered, which depending on the duration and the researcher’s interests can be concluded with a Master’s or doctorate. The thematic focus of the program encompasses application-oriented virtual engineering.

Vanderbilt University Visits the Fraunhofer IFF

A lively Sister Cities relationship has developed between Magdeburg and Nashville. Thanks above all to the German-American Dialog Center chaired by Dr. Uwe Küster, more and more groups with common interests are coming together. Thus, for example, the live transatlantic play »Das Treffen – The Other Side« had its celebrated simultaneous premiere in Nashville and in Magdeburg on September 30.

In the meantime, academic and research institutions also became acquainted at a first meeting. At the invitation of the German-American Dialog Center, a delegation from Vanderbilt University came to Magdeburg in May. After visiting Otto von Guericke University, top university leadership came to the Fraunhofer IFF. In lively discussion and a tour of the testing facility, the academics and researchers discovered common research foci such as image processing or the development of intelligent systems.

Corinna Kunert explains the advantages of logistics supported by transponders to Gordon E. Gee, Chancellor of Vanderbilt University (right). Far left: German and Slavic Languages Dept. Chair Dieter Sevin.
BMBF Supports the Founding of a German-Russian Research and Development Lab

In Magdeburg, Parliamentary State Secretary at the BMBF Ulrich Kasparick emphasized the importance of this cooperation: »Joint research activities with Russia represent important impulses for economic development for Germany. « Both parties will profit from this. Russian institutes are known throughout the world for their basic and applied research findings. Germany will be providing its management know-how and technology. »The collaboration forms the foundation for reciprocal market access,« said Kasparick. Thus, research results could be transformed into commercially utilizable innovations more quickly.

IPK Biologists Thrilled at the Potentials of the Virtual World

Wonders are often hidden in the details. The botanical researchers from the Leibniz Institute for Institute of Plant Genetics and Crop Plant Research (IPK) Gatersleben were able to convince themselves of this during a visit to the Fraunhofer IFF. Their experimental subjects’ normally extremely small seeds grew to gigantic size in the CAVE (a virtual reality lab). The Fraunhofer specialists thus gave the IPK researchers impressive views. The researchers met for a joint workshop on »Interactive 3-D Visualization in Plant Biology«. They brought several hundred megabytes of data with them: Three-dimensional models of different, microscopic parts of barley seeds and cells, e.g. cell nuclei, developed by the IPK Pattern Recognition Working Group.

The institute’s director Prof. Michael Schenk commented: »We are extremely pleased at the joint research work with GosNIIAS and MADI. These are the leading institutes in Russia in these technical fields. This cooperation has enabled the Fraunhofer IFF to expand its international sphere of activities.«

The collaboration between the Fraunhofer IFF and the Russian partner institutes is part of the strategic partnership in education, research and innovation initiated in April of this year by Chancellor Gerhard Schröder and President Vladimir Putin. The »Joint Lab« will focus its work on the use of RFID transponders for the identification of spare parts in the aircraft industry and on the development of optical measuring systems for manufacturing and quality control.

For more information see: www.internationale-kooperation.de.
Central German Automotive Industry Meets at the 5th MAHREG Innovation Forum

The fifth MAHREG Innovation Forum was held at the Fraunhofer Institute for Factory Operation and Automation IFF on October 13 through 14, 2005. The forum presented an interesting mixture of specialized lectures and workshops on the subject of »Reliable – Faster and More Reliable Processes in the Automotive Industry«. Representatives from IAP Technology, IFA Maschinenbau and a selection of innovative MAHREG companies reported on practical experiences.

Fraunhofer IFF Director Michael Schenk gave a talk on »Virtual Techniques: A Regional Competence and a Range of Services for Small and Medium-sized Enterprises«.

In this week in October, numerous other events revolving around business and research were held in Magdeburg. Highlights were the international cooperation exchange »Intertech 2005« on October 11, 2005 and the »7th Magdeburg Mechanical Engineering Days« on October 11 and 12, 2005 focused on »Virtual Engineering«.

www.mahreg.de

EU Research Funds for Enterprises

An EU project in the field of innovation will kick off at the Fraunhofer IFF in November and aims to lead small and medium-sized enterprises (SMEs) to European research funds. Seminars and virtual discussion groups will be used to generate ideas, which, supported by the smE-MPOWER consortium’s expertise, will be translated into research proposals. Interested enterprises should contact Ms. Katrin Reschwamm at the Fraunhofer IFF: Katrin.Reschwamm@iff.fraunhofer.de

Intelligent RFID Logistics for Aviation

Siemens AG, IFB AG and the Fraunhofer IFF are jointly developing RFID logistics solutions for use in aviation. The intelligent radio tags make it possible to perfectly identify assets in logistics processes, to trace them and consistently document their path from production to consumption. The intended outcome of the research and development work is the presentation of a new product prototype: the intelligent trolley. The trolley and all elements belonging to catering systems such as trays and serving containers for catering to airline passengers will be equipped with RFID transponders. This will allow technically integrating them in the IT structure together with extending this with a Web-based monitoring system. Thus, the logistics chain can be optimized and monitored: If, for example, the refrigeration malfunctions, the system triggers an alarm. This is a practical function since easily perishable dishes are often on the menu. The system especially demonstrates its real, noteworthy features in inventory management. Inventories are taken automatically – a press of a button generates information on the current stock. Incorrect deliveries are detected immediately and processes can be traced easily. This will facilitate compliance with stringent food regulations, for instance, and help cut costs.

The consortium, consisting of the Siemens branch office in Magdeburg, the IFB AG and the Fraunhofer IFF, intends to jointly provide RFID solutions from Magdeburg and thus strengthen Magdeburg as a center of logistics and research. »Siemens very much welcomes this cooperation, particularly since the Fraunhofer IFF LogMotionLab provides outstanding possibilities for development and testing here. The intelligent trolley from Magdeburg will be a success. I’m firmly convinced of that,« said Kristian Tolk, head of the Siemens branch office in Magdeburg. The chances are excellent. After all, the number of trolleys in commercial aviation is moving roughly toward the hundreds of millions – a product life of five to ten years makes this a promising market.

RFID transponders optimize logistics processes in aviation.
Saxony-Anhalt Quality Prize Awarded by Minister Rehberger in November

Companies are not only competing nationally but increasingly also internationally. Companies have to excel in this competitive situation in order to have commercial success. With the announcement of its Saxony-Anhalt Quality Prize the Ministry of Economics and Labor is encouraging companies to compare themselves with the competition and thus improve the quality of their products and services.

Minister of Economics and Labor Dr. Horst Rehberger will award the Saxony-Anhalt Quality Prize to the winner on November 22, 2005. The Fraunhofer Institute for Factory Operation and Automation IFF has taken over managing the organization of the Quality Prize competition. Fraunhofer IFF Director Prof. Michael Schenk will chair the independent jury that will review and evaluate the companies’ quality work.

The Saxony-Anhalt Quality Prize is already a tradition: It is being offered for the fourth time and is awarded in annual rotation with the state’s Innovation Prize. The winner of the Quality Prize and three other nominated companies will profit from an image-enhancing competitive and marketing instrument. Just competing sends a positive signal to customers, employees and business partners because this makes the efforts to continuously improve services and products visible. Comprehensive professional feedback provides indications where top achievements are already being made and where potentials for improvement exist.

Investitionsbank and KfW Mittelstandsbank Advise Business Start-ups

There is a new development program for small and medium-sized enterprises in need of coaching when they are implementing their investment projects. Financial experts from the KfW and the Investitionsbank provide in-depth advising to improve the effectiveness of in-house consulting. On open days, business people have the opportunity to receive comprehensive personal consulting. Anyone putting forth an individual financing proposal involving public funds can receive tips about filing applications. Open days are held in Magdeburg, Halle, Dessau, Merseburg, Stassfurt, Stendal and Salzwedel at the local cooperation partners’ offices. Along with the chambers, these include economic development organizations and economic development agencies.

For more information call 0800/56 007 57 or the KfW Mittelstandsbank Infocenter at 01801-241124. www.ib-sachsen-anhalt.de

Agreement Reached on Cooperation with Start-up Livingsolids GmbH

This young company founded in Magdeburg in 2004 evolved out of the milieu of the Fraunhofer IFF. In the meantime, the company is headquartered in Wolfsburg – by no accident close to Volkswagen – while 15 employees currently perform research and development work in Magdeburg. Livingsolids works in the field of interactive virtual reality focusing on product life cycle management (PLM). Special emphasis is given to developing software that supports the use of virtual technologies in companies. To this end, the Fraunhofer IFF and Livingsolids GmbH reached an agreement this summer to collaborate closely.

Magdeburg 2006: The Year of Science

Magdeburg is undergoing a transformation from a city of heavy engineering to a »City of Science«. This needs to be anchored even more firmly in the city and its residents’ self-image. For Magdeburg, being a »City of Science« means being a city of innovation, technological change and debates about the future. The former commercial port is being transformed into the Scientific Port – an example illustrating how science and research from Magdeburg has the power to effect structural change. The positive repercussions from this development reach as far away as Brussels and the EU has characterized Magdeburg as a city with innovative power for a second time (after awarding the European Regional Innovation Award). The year of Science directly follows the scientific and research activity of 2005. On the very same day as the Stifterverband für die deutsche Wissenschaft conferred the title of »City of Science 2006« on Dresden and awarded second place to Magdeburg and Tübingen, Mayor Trümper announced his decision to name 2006 the »Year of Science«.

Magdeburg: Traditionally modern. Till Eulenspiegel tests virtual reality.
An Interview with Prof. Hans-Jörg Bullinger, President of the Fraunhofer-Gesellschaft

In «Signposts to Tomorrow’s Markets» the Fraunhofer-Gesellschaft presents twelve thematic research areas meaningful for Germany. How did you select these areas?

The aim was to find a clear orientation for Germany in the midst of worldwide technology trends. To this end, our experts analyzed numerous foresight studies from other industrial nations and roadmaps from international companies. The results were then discussed with internal and external experts and developed further. The comparison of national and international research trends with the Fraunhofer-Gesellschaft’s present competencies and strengths generated numerous proposals for projects, which we reduced to twelve in the end. It could easily have been twenty. We believe, however, that the number has to remain manageable if we intend to communicate them as emphases. In particular, we expect these technology fields to yield innovations relevant to the market in the coming years. What distinguishes them is their outstanding potential for innovation and extreme relevance to the market. Moreover, the Fraunhofer-Gesellschaft is in the position to meet the great demand for research and development in these areas.

What is being done now?

Parallel to the start of the communication campaign, with which we intend to establish these areas in the general public, the institutes involved have begun to systematically develop the individual areas. The areas will now be energetically promoted together with partners from the business community. Our goal is to strengthen domestic business as a provider of innovative and globally successful products, processes and services. These technologies can be used to develop new markets and generate sustainable growth. The respective project coordinators are organizing conferences and workshops to discuss the thematic areas with all relevant partners in Germany. A first Fraunhofer symposium was recently held in Dortmund. Industry’s tremendous interest clearly demonstrated that we took up the right thematic area here at the right time. That is why I am confident that we will also make rapid progress in the other technology fields and be able to build upon the excellent response in the business community.

Where are the emphases in Germany?

Germany’s strengths are in traditional technologies, yet it is not keeping up with the international dynamic in high-tech. Germany’s technological strengths are being concentrated more and more intensely in the automotive sector. Added to these are a few sectors such as mechanical and plant engineering, laser technology, the electronics industry, new optical technologies and I&C technologies. Power engineering, medical technology and parts of the life sciences are developing especially dynamically.

Germany’s technological capability is disintegrating! How can we keep from falling further behind?

We can’t keep up with the world’s leaders in all fields. Rather, we need to concentrate on the fields of technology, which provide the best opportunities for development here. We have to invest massively in such fields if we intend to remain competitive. Other industrial nations are quite definitely banking on selected fields. To this end, both basic research and applied research have to be reinforced further. In particular, the path from an idea to a finished product has to be...
shortened. That means the innovation process has to be speeded up. The goal has to be eliminating Germany’s traditional weakness translating ideas into action.

What new ground has to be broken?

Germans are brilliant inventors and engineers. Among other things, they developed the fax, the compact disc, the telephone and MP3. Yet these inventions did not become innovations, meaning successful products, in Germany but rather in Asia and the USA.
The prerequisite is systematic innovation management in companies. Yet this is the problem in Germany. The innovation processes are often inefficient and rarely systematized. If companies intend to significantly speed up their innovation processes, then they will have to open up. They will have to bring know-how into the company and conversely make their know-how available to others too. Until now, research and development has taken place behind closed doors, disconnected and shielded from clients and partners. It functions more quickly and efficiently in networks, strategic cooperations or innovation clusters. If we agree on rules for our new openness, then we won’t need to be afraid of our »partners«.

Are we prepared for the future markets?

No, because when the upturn begins, companies will need experts quickly. Associations are already anticipating a shortage of engineers and natural scientists. While the number of new students and graduates is increasing in Germany, substantially fewer high school graduates are attending universities in Germany than in the OECD on average. In terms of numbers of new students, Germany only comes in 18th, far behind the leaders Australia, Scandinavia, Poland and New Zealand.
The proportion of graduates in Germany is also substantially lower than in the other OECD states. The demographic trend is aggravating this trend. The danger is growing greater that there will soon be shortages of experts precisely in these new seminal fields. The consequence will be that potential economic development in Germany will be hampered.

Isn’t Germany an obsolete model as a center of manufacturing?

If no countermeasures are taken, one to two million jobs will be at risk in German industry in the next ten years. More and more, value added and employment in the highly developed industrial societies of the 21st century are relocating to the tertiary sector. Experts estimate knowledge-intensive jobs will determine the job market around 2010. The proportion of workers in manufacturing will decline further and shrink to under 20 percent. Manufacturing outstanding products won’t be all that matters in the future. Discriminating clients expect comprehensive complete solutions and services throughout the entire product life cycle. From direct service support to systematic expansion of servicing, repair and maintenance services up through operator models and financial services, a broad range of novel solutions exist with great potential for an export-oriented economy. Innovative services and product-service combinations can become the motor for growth and employment even in Germany, traditionally intensely oriented toward production.
The project name ViVERA stands for »Virtual Excellence Network for Virtual and Augmented Reality«. ViVERA also means »it will live« in Portuguese. The project name couldn’t be more apt. ViVERA bundles nationwide research resources from ten institutes and universities in the field of virtual and augmented reality. The excellence network will further expedite and bring new life to the rapid development in the field of virtual technologies.
The field of virtual training is one focus of research at the Fraunhofer IFF in Magdeburg. The Fraunhofer IFF uses virtual models to train assembly, servicing and maintenance operations. The technology of 3-D projection in a CAVE immerses users in cyberspace. The projection conveys a feeling of being in the environment of a virtually represented machine or in an industrial plant. It is possible to explore a machine in the virtual environment or to move freely in a production hall. In addition to pure 3-D visualization, the models store interactive functions. Thus, operations can be performed on equipment and machines. For instance, the virtual model provides feedback on whether work has been executed correctly and in the right sequence. This makes it possible to realistically experience and learn in the virtual world. To better understand complex designs or technical details, the virtual objects additionally provide the option of looking inside a machine or making hidden components visible – an option normally not provided in reality. The coup: The education and training of personnel can already begin before a machine exists physically. While the real equipment is being built, personnel can already be prepared to operate it in the future. That shortens startup operations and the period of training on plants and machines and thus helps cut costs.

Production development provides another example of the potential of virtual technologies. CAD tools are used to design virtual products such as machines, components or vehicles. If functionalities are taken from the CAD programs and integrated in the 3-D models, virtual models are obtained. Their functions can be visualized and tested on a virtual prototype safely and inexpensively. Components from various suppliers and development partners can be brought together in the virtual prototype and tested in a 3-D functional model. Strength analyses or functional tests on a digital model save time and money, which would be needed for experiments on real prototypes.

The consistent use of systems for product data management (PDM) facilitates cooperation between several product development teams. PDM manages all the product data and supports distributed cooperative work. Later manufacturing processes are also engineered on a virtual model. The real-world manufacturing processes with their respective quality requirements and tolerances are used for tests and specifications on a virtual model.

Linking the ViVERA partners’ different competencies makes experiences using virtual and expanded reality technologies in nearly all areas of the product life cycle available. These encompass applications from product development to the testing phase and production and up through the training of personnel. Work is concentrated on fields of application in automotive engineering, plant engineering, mechanical engineering, shipbuilding and medical technology and pursues research emphasizing specific industries.

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Automotive Engineering
The simulation of assembly and disassembly processes constitutes a main focus in this field of application. For the most part, present day applications’ allowance for deformation behavior of flexible components has shortcomings. Ergonomic aspects of the assembly and disassembly of components, i.e. allowing for tools and accessibility of the assembly space, have been neglected so far.

Plant Engineering
During the development phase, visual-interactive plant models are used as a basis for communication to specify performance features and to coordinate the different subcontractors’ parallel development activities. Results of simulations of complex industrial processes can be visualized in a virtual model to support qualification measures. Potentials for augmented reality (AR) applications lie in on-site provision of visual-interactive assembly and maintenance instructions.

Mechanical Engineering
3-D visualization of machines and their mode of operation supports mechanical engineers in design. Until now, virtual reality (VR) support was more for reviews of the design approach than for the design itself. At present, machines are not designed immersively and this provides potential for a new demonstrator being developed.

Virtual engineering for mechanical and plant engineering are among the main foci of the Fraunhofer IFF.

The Fraunhofer IWU works on virtual reality-based solutions for machine tool manufacture.
The planning should also be drawn on for training to make patient-specific therapy training using VR technology possible.

In ViVERA, the researchers from the organizations involved are united in one network. They collectively profit from existing know-how and identify and resolve new problems in development. They transfer existing solutions to new fields of application and develop operational prototypes. A knowledge database documents the results of research and is available to a large community of users and interested parties.

An essential function of the ViVERA network is establishing contact between developers and users of virtual and augmented reality technologies. This is why collaboration in the network is not limited to national partners. International partners may also get involved in a special interest group discussing the requirements and applications of virtual and augmented reality technologies.

The Federal Ministry of Education and Research (BMBF) is supporting ViVERA with funding of 4.5 million euros up through the year 2007. It has based the network’s management in Magdeburg: The Fraunhofer IFF and Otto von Guericke University will jointly manage the nationwide ViVERA activities from Saxony-Anhalt.

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Carmakers are being confronted by the challenge of developing and launching new products in shorter time, at lower costs and with higher quality. This necessitates new approaches in product development, production planning and manufacturing. Virtual engineering addresses these problems and makes an integrated digital process chain possible from product development to a virtual factory and up through the real one. Experiences from the real factory are subsequently reincorporated in the virtual models.

Two ideas are fundamentally important here: On the one hand, closely connecting product development with production planning can influence the manufacturing compatibility of a product at an early stage. This is especially important since seventy to eighty percent of production costs are determined at the beginning of product development.
On the other hand, the virtual factory planned on the computer must be synchronized with the real factory’s processes and data. If optimizations have to be undertaken in serial operation then these must be reincorporated in the digital factory model. In the ideal case, optimization measures are assessed in the virtual model beforehand.

**Tests and Experiments with Virtual Models**

Virtual models used for product and process engineering are the chief element of virtual engineering. High-tech CAD tools are used to design vehicles and components. 3-D models are subsequently generated from the CAD data. If functionalities are integrated in these 3-D models, a virtual model is obtained. Its functions can be safely and inexpensively visualized and tested on the virtual prototype. Components from various suppliers and development partners can be brought together in a virtual prototype and tested in a 3-D functional model. Strength analyses, aerodynamic tests or crash tests on a digital model save time and money that would be needed for experiments on real prototypes.

The consistent use of systems for product data management (PDM) facilitates interdisciplinary cooperation between product development teams. PDM manages all the product data and supports distributed cooperative work.

Thus, development processes can be parallelized and the time until market readiness can be shortened decisively. Later manufacturing processes are also engineered on a virtual model. The real-world manufacturing processes with their respective quality requirements and tolerances are used for tests and specifications on a virtual model.

Along with the virtual engineering of products and processes, virtually planning and safeguarding the factory with its various production lines is also an important field of virtual engineering. The tools for the digital factory are used to create a virtual model of the plant. Libraries provide standardized components for rough layout planning, which is subsequently reviewed and refined with CAD models of the components to be manufactured. The virtual plant model can be used to verify control programs and all a plant’s essential functions. This makes a »virtual startup« possible, which helps cut time and costs during the real startup. Since carmakers have a manufacturing depth of around 20 percent, establishing virtual engineering among their suppliers too is crucial since they carry out the remaining 80 percent of the manufacturing processes.
Virtual Engineering at the Fraunhofer IFF VDTC
Together with academic and non-academic partners, the Fraunhofer IFF VDTC is addressing the issues of virtual engineering in a holistic approach.

One example is displayed in the picture on page 19. VDTC specialists have generated an interactive visualization of the type of gear VW uses in the Golf or the Bora.

The virtual model visualizes the gear’s geometry and function and can be used to support the development process. Such interactive and experimentable digital 3-D representations of an evolving product are called digital mockups (DMU). They allow already analyzing an inspection-compatible computer model and visualizing functionalities during the design phases. In the automotive industry, design reviews using virtual prototypes have already led to a substantial reduction of the number of physical prototypes.
Whether a design engineer or an assembler later on, the user of a virtual model can interact directly with the product and move freely in the virtual environment. Depending on the representation’s level of detail, every assembly and every single component of the machine can be examined. Techniques that make certain components of the machine transparent or hidden can also make internal and thus hard to access elements visible (top picture on page 20). Later on, the virtual model can be used to plan and test the gear assembly (bottom picture on page 20). Here, for instance, the joining sequence must be stipulated, accessibility tested and the collision of parts eliminated. The assembly sequence thusly generated forms the basis for planning production and training specialists.

The latter is a particular strength of the VDTC specialists at the Magdeburg Fraunhofer IFF: Their visual-interactive training system makes it easy to develop training programs from a functional representation produced in design. Thus, specialists can learn on a virtual model how to execute highly complex assembly steps. The after sales department can use similar models and techniques for virtual maintenance and operating manuals.

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October 26
Applying Virtual Reality and Simulation in Technical Training, Dr. Reinhard Pittschellis, Head of Product Development and Product Management, Festo Didactic GmbH & Co.KG, Denkendorf

November 2
Virtual Reality Applications in Flight Simulation, Marcus Bauer, Development Engineer Simulation & Virtual Reality, EADS Deutschland GmbH, München

November 9
Projective Virtual Reality: Robotics Know-how and Virtual Worlds for Outer Space and the Factory of the Future, Dr. Jürgen Rossmann, CEO EFR-Systems GmbH, Dortmund

November 16
Interaction in the OR: A New Fluoro-based Approach to Hip Operations, Dr. Martin Haimerl, Software Development Hip Applications, BrainLAB AG, Heimstetten

November 23
Augmented Reality Systems in Medicine: Examples of Applications from Research, Dr. Michael Scheuering, Business Line Computer Tomography – Physics and Applications, Siemens Medical Solutions, Erlangen

November 30
Integrating Virtual Reality in Networked Engineering Processes, Joachim Schwab, Head of Consulting YDEE, EDAG Engineering + Design AG, Fulda

December 7
Head Mounted Displays for Interactive Service Applications with Augmented Reality, Dr. Simon Brattke, Imaging Technique Research Carl Zeiss AG, Oberkochen

We look forward to seeing you!

Always Wednesdays at 5 p.m. at the Fraunhofer Institute for Factory Operation and Automation IFF, Sandtorstrasse 22.
New Method Developed for Generating Virtual Models

Dr. Rüdiger Mecke, Dirk Berndt

Virtual models are increasingly needed in the various process stages of the product life cycle (e.g. digital product development, marketing and user training). For the most part, three-dimensional models for the industrial sector are available from the CAD design process, which can be used as the basis for generating virtual models. Methods of reverse engineering can be used to convert physically extant prototypes (e.g. products, tools, mold patterns) into virtual models. However, these only supply a geometric description of the surface of 3-D models and require extremely time consuming, predominantly manual processing stages. Such data is not even available in other sectors such as medicine or cultural heritage preservation. Hence, the modeling of virtual models was very complex and laborious until now.
Researchers at the Fraunhofer IFF have started interdisciplinary collaboration in order to develop a method for quickly and automatically generating virtual surface models. Along with the geometry, the coloration (texture) will be captured with great precision and automatically integrated in the virtual model. In this way, the specialists from the departments of »Intelligent Sensor Systems« and »Virtual Prototyping« intend to develop new areas of application for virtual model use. Since elaborate manual modeling is dispensed with, the virtual models become attractive for other sectors too such as cultural heritage preservation.

In restoration, damage to the substance of an architectural monument is presently documented by the restorer taking pictures and making drawings of an object. Afterward, the damage is drawn in on the pictures. Naturally this only allows relatively imprecise information. A two-dimensional damage map does not reveal how deep a scratch or crack has penetrated the substance of a building. Mapping is labourious manual work that naturally also reflects a restorer’s subjective assessment of the damage on a monument. This new method would simplify this painstaking work: Optical 3-D metrology captures and digitizes the surface together with its coloration. In the process, damage to the structure is revealed. This data is the basis for generating virtual models that are extremely realistic because of their high level of detail.

Metrological Capture
A light sectioning sensor mounted on a measuring arm captures the geometry. The sensor developed by Fraunhofer specialists consists of a camera and a line laser and operates based on the principle of light sectioning. By using integrated hardware-based image processing, up to 100 contour lines each with approximately 1000 3-D measuring points on the object can be digitized per second. This produces a spatially dense and highly detailed representation of an object surface in the form of a three-dimensional point cloud. A major advantage of this system is its ability to even capture larger complex free-form surfaces with a large number of measuring points completely in one step. Compared with conventional methods, this eliminates complex reconstruction of the point cloud from several perspectives. The accuracy of the 3-D measuring points is approximately +/-0.1mm.

In a second step, a high-resolution, calibrated color camera also mounted on the measuring arm takes a set of pictures of the surface texture. On the basis of parameters known from calibration, the camera’s spatial position and orientation can be determined very precisely and image errors caused by the objective used are eliminated. The number of pictures necessary mainly depends on the geometry of the real object.

Fusion of Geometry and Image Data
The metrologically captured point cloud is first used to generate a geometric surface model in which triangles connect the individual 3-D measuring points. The pictures taken are used to assign color information to the 3-D points of the surface model. A special test is performed to eliminate errors when allocating color to those surface areas hidden from a camera image’s perspective. Taking the camera as the starting point, the rays of vision to specific 3-D-surface areas of the geometry model are tested for multiple overlaps. If the test detects an occluded area, then the corresponding color values are not used for texturizing.
Three variants are differentiated based on the model’s subsequent application later on:

Variant A assumes the 3-D model is scanned very densely, every measuring point being assigned a color value. The result is a virtual model that has an extremely high resolution (average distance between measuring points approximately 0.5 millimeters) and is dimensionally accurate.

Variant B includes a preprocessing operation that generates additional scanned points if the geometry, based on the measurement for example, is available in a low resolution form. This step is necessary in order to be able to visualize high quality models.

Variant C involves another approach, which generates virtual models above all for such areas of application that require a greatly reduced quantity of data (e.g. 3-D Web applications, virtual reality scenarios). Color is assigned conventionally, i.e. a two-dimensional image is projected onto a larger surface areas of the model (texture mapping). The largely automatic procedure first reduces the model’s geometry until it adequately represents the 3-D model using the least quantity of data possible. After this, the surface texture must be generated from the camera images so that the perspective is not distorted in the virtual model.

The basis technology presented here allows a relatively broad range of potential applications. Significant in this context is the virtual models’ resolution that can be scaled as desired depending on the application. At this time, prototypical use in various fields of application is being tested and developed further.

**Tables:**

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<tr>
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<th>Variant A</th>
<th>Variant B</th>
<th>Variant C</th>
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<tr>
<td>Density of geometry data</td>
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<td>Allocation of color</td>
<td>for every measuring point</td>
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<td>Examples of applications</td>
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Virtual Reality Provides a Better View

Potentials for Optimization in Mechanical and Plant Engineering

Dr. Martin Endig

Great potentials for optimizing time and cost lie dormant, specifically in the after sales unit of mechanical and plant engineering firms. These potentials can be realized by effectively utilizing all sources of information on machines and plants if all the information available is provided in a standardized framework. To this end, Fraunhofer researchers from the Virtual Development and Training Centre VDTC in Magdeburg together with their partner Enigma Information Retrieval GmbH have launched a novel service on the market, which, among other things, uses virtual reality to visualize information. PMO («Plant Maintenance and Operation Services») has successfully proven itself in first field tests for technical documentation.
Product Documentation Today: Unmanageable Quantities of Data

Every manufacturer or supplier of technical products such as machines and plants is legally obligated to deliver documentation for them. Not only does the documentation have to be complete and in keeping with the law but it should also be supplied in a practicable and in user-friendly form. This looks different in reality though: Buyers receive from equipment manufacturers and their suppliers paper documentation in which information is compiled in quantities that can hardly be coped with and usually in a form that is unmanageable. Since technical equipment is becoming more and more complex, it is becoming increasingly difficult to present detailed specifications comprehensively. The result: Costs that could be cut are incurred, e.g. excessive labor costs or costs from redundant administration of the contents of documentation. Common IT technologies and systems only partly resolve these problems. What matters however is providing individual solutions for small and medium-sized enterprises based on their existing systems and stipulated standards in an integrated framework.

Product Documentation Tomorrow: Virtual-interactive Scenarios

Virtual-interactive 3-D scenarios provide one solution to this problem that affects every equipment manufacturer, operator and service provider. Virtual reality allows producing clear and realistic customized visualization of complicated technical systems and operations. Based on this trendsetting technology, PMO has been launched on the market. PMO stands for »Plant Management and Operation Services« and is an after sales solution for compiling, distributing, organizing and supplying service information in an integrated plant information system.

For the operation of machines and equipment, Fraunhofer specialists designed the application and use the Enigma 3C software platform as its technology.

With its product Enigma 3C, Enigma is the only software company that offers an integrated platform for the entire after sales unit, which leads to more efficacy in the installation, operation and maintenance of complex equipment and products. Enigma is a privately owned business with its headquarters in Burlington (Massachusetts, USA) and branches in San Francisco, London, Paris, Munich, Toronto, Tokyo and Tel Aviv. More information about Enigma can be found at www.enigma.com.

PMO provides generalized functionalities directly tailored to the needs of small and medium-sized enterprises. Users independently enter their individual equipment information such as maintenance instructions or safety regulations. Ultimately, customized equipment solutions also necessitate an individual solution for their documentation. PMO, for example, subsequently allows a full text search and a search using individual parameters on all levels. Filter functions, which provide complete or detailed views on the basis of different features, only provide information matching user-specific queries. That makes product documentation manageable because the information is now on hand in a structured form. Moreover, this is completely independent of the type of documentation — whether an image, a video, a drawing or a text. Thus, the documentation proves to be particularly practicable. Interesting is the individuality generated by the basis system, which results in tailor-made, customized software systems with which equipment manufacturers can offer their clients, the equipment operators, high-tech forms of documentation as a service in addition to their actual products.

Documentation in Transformation: From Written Data to Virtual Presentation

When PMO was being developed, the uppermost question was how to utilize existing information and documentation more effectively to obtain added value for the operation of equipment. The advantages are obvious: PMO allows much more than merely more intensive utilization of the equipment because the resultant greater availability alone can increase the efficiency of work.

Although we live in an information society, our machines and equipment are documented in an outdated form — paper. In the future, archived knowledge will have to be retrievable «on demand».
Servicing and assembly operations are made noticeably easier since product documentation is available in a very user friendly form. For example, a state analysis reveals equipment’s need for maintenance. Resultant actions are then supported by PMO service maintenance instructions previously entered in the system. PMO uses standard PC technologies so that maintenance mechanics can, for example, take equipment documentation on a tablet PC directly into a factory hall to a machine and use it on site. The documentation operates with all types of documents relevant for industry and hence can be used on the widest variety of output devices such as PC, laptop or PDA.

The possibilities of virtual 3-D models are far from exhausted with virtual-interactive product documentation. There are, for example, innovative potentials for schooling and training specialized staff. The operation of a machine can, for instance, be learned without having to interrupt production. Employees can already learn how to handle a new machine even before it has been installed in the factory. It becomes quite easy to casually mention virtual models from the engineering phase to provide a visual-interactive model of a flocking mill for documentation. In the future, CIMBRIA SKET will only deliver its flocking mill with virtual-interactive product documentation.

What is more, the 3-D model of the entire plant can be walked through virtually. Information and documents are requested by simply selecting them and then clearly presented in a browser window. All essential information such as supplier information and service and maintenance information is available immediately.

The flocking mill field test demonstrated that virtual-interactive product documentation based on PMO is a practicable solution for today’s documentation problems and excellently suited for use in business especially because of its options for customization.

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Virtual-interactive product documentation makes the functioning of complex equipment easier to understand: Here a flaking mill.
Successful use of minimally invasive surgery not only presupposes the corresponding medical technology but also sound professional skills on the part of operating physicians. They use endoscopic devices to perform operations and can monitor the procedure on a screen.

"Using realistic virtual training programs to practice this technique would be a great support," in the estimation of Prof. Hans Lippert Director of the Department of Surgery at the Magdeburg university. While this does not replace guidance from an experienced surgeon, it does however make great sense as a supplement to optimally prepare for an operation. Along with using such simulation devices to teach medical students and young doctors manual and diagnostic skills, the experienced surgeon sees planning operations for particularly difficult cases as another potential use.

Virtual OR Training Programs for Surgeons
Operating with Complete Confidence

Dr. Matthias Pross, M.D.

In operative medicine, surgical techniques have been considerably improved and refined in recent years. A milestone was reached when minimally invasive surgery was introduced. A great advantage of this surgical method is the substantially lower level of stress for patients, i.e. less pain, rapid recovery of mobility and short hospital stays.
This prompted the doctors in Magdeburg to establish contact with the Fraunhofer Institute for Factory Operation and Automation IFF. Together, they contemplated how the potentials of virtual reality could be employed for training on the operation simulator. The Magdeburg Fraunhofer researchers are specialists in the field of virtual training. For instance, they developed a virtual training scenario for Airbus, which is used to teach servicing the hydraulic unit. Three-dimensional representation as well as authentic shaping is an enormous challenge for research though that can only be met in a network of many specialized organizations. They quickly found a partner in Dr. Eberhard Blümel Director of the Division of Virtual Development and Training who expressed interest in this project. »This is not a matter of providing schematic, individual virtual training steps for operations on an organ as is already available for the bladder, for example, but rather a concept for realistic scenarios in the entire abdominal cavity and, beyond that, possibly even for the entire human body later on,« explains Asst. Prof. Matthias Pross, M.D, Assistant Medical Director of the Surgical Clinic, who is overseeing this project for the university hospital. The doctors in Magdeburg see in this cooperation with the Fraunhofer Institute optimal conditions for achieving their ambitious goal. In the opinion of the cooperation partners involved, the combination of empirical values and the surgeons’ knowledge and the Fraunhofer Institute’s researchers’ technical know-how could make preoperative planning of extensive operations with the aid of a training program reality in a few years.

»The goal here is as authentic an operation simulation as possible with extremely accurate tissue properties,« emphasizes Dr. Pross. The three-dimensional representation of anatomical structures as well as their modulation is based on the anatomy of a patient generated by means of computer tomography data. In addition, very specific criteria have to be considered such as tissue pressure or tissue resistance, which is different in bones than in organs for instance. This implies, for example, that the surgeon factors in risks during the operation and trains managing potential complications. Here too, the researchers’ ambition is that the simulator displays consequences corresponding to how a surgeon proceeds. The psychological stress the operating physician is subject to in such situations plays an extremely important role. In order to more intensively integrate this emotional side in training too, researchers from the Leibniz Institute for Neurobiology are also collaborating on this project as further partners.

Development of the operation simulator is being supported by the internationally renowned medical technology firm Storz, which is providing the hardware and expects great things from the project. The doctors and researchers in Magdeburg are also hoping to receive funds from the German Research Foundation and the State of Saxony-Anhalt for their ambitious undertaking. Clinic Director Prof. Lippert is confident and could by all means imagine that in the future virtual operation training equipment could be produced in Magdeburg for the international market.

Asst. Prof. Matthias Pross, M.D. is Assistant Medical Director of Surgery at Otto von Guericke University Hospital Magdeburg.
In order to be able to provide an answer to this question and be able to design virtual-interactive training even more effectively in the future, the Fraunhofer IFF conducted a comparative study.

To this end, various questions about learning performance during training in virtual-interactive environments were treated. Interest focused on different aspects such as forms of educational methodology in a virtual environment and the way facts and process knowledge are communicated. Interaction, immersion and imagination are criteria, which play a vital role in learning performance and retention of what has been learned in a virtual work environment.

In an initial study, various qualitative and quantitative research methods were employed to first examine the following three hypotheses:

1. The use of virtual reality (VR) educational modules to acquire knowledge can reduce learning/handling time on a real asset.
2. Preparatory use of VR scenarios minimizes the number of errors in operations on a real asset.
3. VR educational modules help improve retention of knowledge.

A complex educational module, which was to be mastered without previous and specialized knowledge, was designed as the test object in order to be able to recruit a sufficiently large number of test persons. During the test, every test person has to complete the same task: the assembly of a model. Different resources are available to prepare for and complete the task.

Better Learning in the Virtual World

Study Findings

Heike Kissner, Michaela Schumann

Machines and equipment are becoming more and more complex. Safety regulations for their operation or servicing are growing increasingly stricter. The number of potential sources of error is consequently rising. Whenever humans are involved in processes, the «human factor» must be taken into account. Only when operating and service personnel have been optimally trained and feel confident handling machines and equipment can sources of error be minimized.

Magdeburg Fraunhofer researchers have developed a methodology for effectively designing qualification processes. Special learning modules are used to reproduce complex operations on machines and equipment in virtual reality. They enable future operating and service personnel to learn these operations. How well does one really learn in the virtual world though?

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Data is collected in two stages and this begins when the first test is taken. A post-test follows after a three week break. This testing procedure was similar to the first phase and was referred to for the analyses of knowledge transfer and retention.

A questionnaire was used to assign test persons to appropriate test groups. Three groups passed through the testing procedure: The control group (K) and two comparison groups (V1 and V2). The test persons in the control group went into the test unprepared and used the paper instructions prepared. The test persons in the V1 group were allowed to work with the computer-based educational module before the test. The educational module gave the test persons an overview of the assemblies as well as virtual assembly of the model. They likewise had the paper instructions in the subsequent test situation. The V2 group experienced the same conditions as the V1 group before the test but completed the test using the VR educational module.

The initial results of this test revealed that virtual training tends to help reduce the time working on the real object and can noticeably minimize errors when a very process-oriented operation is being performed. The test person’s motivation and the time and effort put into training play a crucial role here. The chart clearly illustrates the distribution of errors in the first test series. In a comparison with the control group, test group 2, which really assembled the model using the educational module, completed the test with only a quarter of the errors.

Another emphasis of the study is testing the retention of the acquired knowledge. Since all the post-test takers minimized their time and reduced their errors, the results tend to confirm that knowledge is retained. Another important aspect, which stands for the use of the specially developed VR systems, is its manageability as a training system. The analysis of data reveals that experienced VR system users did not perform any better than »newcomers«. That means its use can be learned intuitively and easily. The results demonstrate that intensive VR training can reduce the rate of errors in work and production processes, minimize work time and boost employees’ retention of knowledge.

The test provided a wide variety of indications for further aspects of research and raised extensive issues, especially concerning the design of VR training from a didactic perspective. Apart from the main foci of the test (time, errors, retention), a multitude of indicators were identified that specifically point out aspects of design and use of virtual-interactive training that will have to be investigated in other studies. The goal is to research these indicators in order to be able to develop guidelines and starting points for the conception and design of virtual-interactive training applications and in order to design the embedding of training in qualification processes so that it specifically promotes learning.

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Exercise for test persons:
Assembling the test model.

<table>
<thead>
<tr>
<th>Number of errors</th>
<th>K</th>
<th>V1</th>
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Comparison: How many errors do the different test groups make when completing the test problems?
Virtually Full Steam Ahead

Marco Schumann

To be an engineer just once... That childhood dream can now come true on a PC at least. A virtual engineer’s cab of a steam locomotive will help the Harzer Schmalspurbahnen GmbH in the future when it trains its honorary engineers and trainees. In the streamlined version, laypersons can also chug along as far as the Brocken.

A drawn out whistle already announces the aging heavyweight from a distance. Then the old lady comes puffing around the corner. Every summer, historic steam trains take nostalgic tours through Germany: through “Franconian Switzerland”, the Black Forest or Thuringia for instance. On the other hand, a fleet of 27 regularly operating steam locomotives clatters along the Harz narrow gauge railway’s stretch of over 130 kilometers of rail the whole year, conveying around 1.1 million passengers annually. With the operator, the Harzer Schmalspurbahnen GmbH (HSB), and the Harz University of Applied Sciences in Wernigerode, researchers from the Fraunhofer IFF Virtual Development and Training Centre VDTC in Magdeburg have now constructed a virtual engineer’s cab.
It will support the HSB in the future when they train their trainees and honorary engineers. In a somewhat reduced, commercial version of the program, steam locomotive fans can try their hand at being the engineer of the new steam locomotive 99 7232 on their home computer.

»Normally we use our virtual reality software to model high-tech plants based on their design data,« explains Marco Schumann from the Fraunhofer IFF. »That’s why it was a challenge to show that the same tool can be used to visualize an historical locomotive for which the technical drawings don’t even all exist anymore.« In painstaking work, the researchers collected the data for the 3-D model from old plans and books and – when necessary – by taking measurements on the original locomotive with a digital camera and meter stick. Together with the experts from HSB, they then allocated the proper functions to all the locomotive’s little levers, switches and manometers. The finished program allows future and hobby engineers to interactively drive a steam locomotive – including the view and the background noise – from the tiny Harz village of Schierke to the final destination of Brocken. The advantage of the virtual representation, says Schumann, is that »hidden operations such as the steam’s path through the engine can be made visible.« In addition, trainee engineers can learn operations related to safety and safely practice for tricky situations.

The time and effort that go into such historical models are extreme. However, Dr. Dietrich König from the Harzer Schmalspurbahnen GmbH sees this as an opportunity to preserve knowledge about how vintage technology functioned that would otherwise be lost: »Architectural historians are already resurrecting entire cities. Virtual reality can be used to bring milestones of industrial history interactively to life for instance.« Thus a trip with the steam locomotive could be supplemented by a bumpy tour in a car from the early 20th century.

The CD can be purchased from the Dampfshop at www.hsb-wr.de.

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Virtual Reality Based Modular System for Plant Layout

Hendrik Winter, Dr. Klaus Richter

Even in the early design phases, the planning of complex sorting, processing and residual waste treatment plants demands great imagination, experience and technical background from sales and layout engineers. The novel virtual reality-based development tool »AMB-VRBuilder« makes it easier for planners to design their plant system.
components in the virtual environment during interactive plant layout. The junction points are contextually selected by the interconnection techniques geared toward the material flow, activated and joined together.

This kind of automation of component configuration supports speedy, intuitive work on a design. Typical configurations of subsystems can be stored in structured form and reused.

Hendrik Winter works in planning and design at AMB Anlagen Maschinen Bau GmbH.

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Simulation is increasingly starting to be used profitably even in basic and advanced training of engineers and skilled labor. Until now, technically oriented training has followed a typical sequence:

First, an instructor theoretically imparts the basics on a board or – somewhat more up-to-date – by using transparencies or projector shows. The emphasis here is on communicating »knowledge«. Second, the basics learned are applied in practical exercises (unfortunately this part is omitted again and again, especially at universities). Only here are »skills« taught.

As a rule, practical exercises are performed on a training plant that represents a didactically reduced form of an industrial plant on which one will work later. The picture shows an example of such a plant, the modular production system MPS® made by Festo Didactic. It is a didactically prepared model of an automated assembly line, used to train mechatronics engineers.

Trainees can, for example, use this equipment to:

- Become acquainted with and test the interplay of system components in mechatronic systems,
- Practice programming the controls,
- Practice assembling, modifying and starting up a mechatronic system,
- Perform troubleshooting,
- Apply the basics of preventive maintenance and
- Optimize the plant for different objectives.

Virtual Reality in Training

Dr. Reinhard Pittschellis

Virtual reality has found a permanent spot in the design of new products and the layout of new plants. Time savings and greater reliability are the primary benefits for users. One can start creating programs, conducting feasibility studies or demonstrating a product to potential customers long before the real plant is available.
MPS® is less complex than real industrial plants so that trainees quickly understand interrelationships. All typical components of an automated assembly line are on hand – there are magazines, handling devices, assembly cells with robots and transport systems. The consistent use of industrial components makes it possible to directly apply what is learned to practice. On the one hand, the modular setup supports a multistage approach (e.g. from system to component) and, on the other hand, it is an excellent basis for teamwork. However, a critical disadvantage of expensive training systems is that making practice equipment available to every trainee is seldom feasible because of the cost. If however a simulation is available along with the practice equipment, then making a practice environment available to every trainee is no problem. The exercises can even be done at home depending on the trainees’ computer equipment.

The use of simulated systems provides even more advantages beyond that: Trainees can observe things not visible in reality, perhaps because the process runs behind protective hoods (e.g. welding cells) or is very fast or very slow (e.g. logistics processes). A simulation makes it easy to observe dangerous processes in any magnification or running faster or slower than in reality. A simulation can also allow running a process repeatedly without having to worry about wear or material consumption.

The Simulation System COSIMIR® in Training
One example is the simulation program COSIMIR®. This program can be used to become acquainted with the function, operation and programming of industrial robots. In contrast to conventional simulations systems, trainees do not first have to deal with the modeling of the plant, rather they find functional models. In addition, the didactic part, through which trainees enter the simulation, contains a detailed description of the robot cell and sample programs.

The trainee sees a three-dimensional representation of the robot in the simulation window, the point of view of which can be freely set, the robot program and the working points can be taught and a virtual handheld controller can be used to manually operate the virtual robot. At first, trainees can use the handheld controller to operate the robot in different coordinate systems and display the coordinate systems at the same time (e.g. tool coordinates in the tool center point). This is one of the didactic supports possible only in a simulation.

Trainees can then learn the working points necessary for program execution and give them names. To make learning easier, other windows with other views of the robot can be selected or the view and the zoom can be set as desired. Afterward, trainees create and run the robot program. If an error occurs, nobody gets hurt and no equipment is damaged. An attempt can be repeated as often as desired. Debugging functions such as single-step mode are also available, which make finding programming errors easy.

If the program finally functions as desired and the training center has the real robot cell, the program can be downloaded into the robot control and run there exactly as in the simulated environment.

It is likewise possible to teach trainees troubleshooting techniques. The trainer can use a menu to set specific faults (e.g. misaligned sensors, cable breaks, cabling errors). When the program runs, trainees will determine that the system does not operate as desired and must use the signal level to localize the fault. They can fall back on the signals and thus, for instance, determine that an optical limit switch does not have any signal level even
How realistic a simulation must be to produce learning success remains unresolved. Is it sufficient, for example, to read signal states in a menu or does signal reading with a voltmeter have to be simulated? Does the operation of the program create additional confusion?

These few examples already demonstrate that efficient use of simulation programs for training not only necessitates further technical but also didactic developments and research.

Dr. Reinhard Pittschell is Head of Product Development and Production Management at Festo Didactic GmbH & Co. KG in Denkendorf.

On October 26 he will visit the Fraunhofer IFF and, as the first speaker in the Guest Lecture Series »Virtual Reality: Humans and Machines in Interactive Dialog«, give a presentation on »Applying Virtual Reality and Simulation in Technical Training«.
Prof. Schenk Reelected to the Executive Board of the BVL

Prof. Michael Schenk, Director of the Fraunhofer IFF, was reelected to the executive board at the general assembly of the German Logistics Association BVL in June.

After his reelection, Schenk remarked: »Saxony-Anhalt is a center of logistics. The location of the international hub of DHL in Leipzig will have a positive impact on the economy in Saxony-Anhalt and create jobs. I am pleased to be on the executive board of the BVL again because I am able to take advantage of and expand outstanding networks for Saxony-Anhalt’s business.«

With around 6800 members, the German Logistics Association is Germany’s largest logistics organization and unites managers and executives from industry, commerce, the service sector and science and research. It is the stated goal of the BVL to further consolidate its leadership in the field of logistics and to promote logistics as a research discipline. The BVL initiates intersectoral and trend-setting logistic concepts to secure companies’ domestic and international competitiveness.

Logistics plays a special role in the state of Saxony-Anhalt’s future growth and value added. Apart from a geographically convenient location, Saxony-Anhalt also provides attractive infrastructural and labor conditions. The special significance of logistics for economic development in Saxony-Anhalt has been underscored by the Ministry of Economics and Labor in its declaration to make logistics one of its emphases of financial support.

Marco Schumann Heads the ViVERA Central Office

The degree holding computer scientist with a minor in business administration studied at Otto von Guericke University Magdeburg and the University of Wisconsin-Stevens Point, USA. In particular, he has focused his interests on the specialization of computer graphics and simulation.

Marco Schumann already acquired his first experiences at the Fraunhofer Institute as a student 1995. Marco Schumann began his work as a Fraunhofer IFF researcher in 1998 when he created a simulation model of an autobody paintshop. In the years following, Marco Schumann was involved in developing the virtual development and training platform and he managed the Harz Regional Competence Center, a branch office of the Fraunhofer IFF in Wernigerode from 2002 through 2004. At the end of that year, the now 32 year old researcher was entrusted with managing the ViVERA project.

The central ViVERA office was set up at the Fraunhofer IFF in October 2004. The acronym stands for the »Virtual Excellence Network for Virtual and Augmented Reality«. The national network bundles the competencies in the field of virtual and augmented reality of six Fraunhofer Institutes and universities located in Magdeburg, Berlin, Chemnitz, Darmstadt, Rostock and Stuttgart.

New »Technology & Training« Competence Center at the Fraunhofer IFF

With its Virtual Development and Training Centre (VDTC), the Fraunhofer Institute for Factory Operation and Automation IFF has started an ambitious expansion program. In the future, the developmental competencies present in Magdeburg will be supplemented by technology-based training programs and a related focus on research and development.

The newly established competence center is a joint initiative of the Fraunhofer IFF’s Division of Virtual Development and Training with Prof. Klaus Jenewein from the Chair of Vocational Didactics for Technical Disciplines in the Department of Vocational Education and Human Resource Development at Otto von Guericke University Magdeburg. The partners have agreed to acquire jointly supported research and development projects and develop them in collabor-
atively both with the professional research competence present in Magdeburg and regional business. Another objective being pursued to transfer technology directly and to sustainably benefit the state of Saxony-Anhalt’s economic structures will be creating a technology-based offering of training for industrial specialists and implementing this at the VDTC.

Heike Kissner New Head of Department of »Virtual Interactive Training« at the Fraunhofer IFF

In May 2005, the 34 year old computer scientist accepted an offer to head her department. Together with her team, Heike Kissner develops training solutions that very vividly and understandably visualize »hard« facts about machine behavior and technological processes. Earlier, as deputy head of department, the native of Ilsenburg, had already assumed work requiring great responsibility. Firmly integrated in the project work at the institute, the young researcher has been able to extensively develop the field of virtual-interactive training for herself.

After majoring in computer science at Otto von Guericke University in Magdeburg, Ms. Kissner worked with learning software in the Department of Educational Science. It turned out that precisely the differences in modes of communicating cause researchers from different fields of science difficulties.

»Researchers from the two fields – engineering science and humanities – often don’t understand each other since their technical terminology as well as their methodological approach varies greatly when they work on research problems,« Heike Kissner observes. During this time, she learned to understand both »languages« and to function as an intermediary between the two professional worlds. Since 2003, the young researcher has been working at the Fraunhofer IFF on applying exactly this training to the creation of training applications in virtual-interactive training and work environments.

New Department »Data and Information Management«

The institute’s expansion with the VDTC has led the Fraunhofer IFF to expand its division of »Virtual Development and Training«. The organization of a new department »Data and Information Management« has given this important field the status it deserves. Dr. Martin Endig has been put in charge of organizing the department. The degree holding computer scientist attracted attention as the manager of the model project VDTC-ProDiMA. Last year, VDTC-ProDiMA was honored with European Union’s European Regional Innovation Award. The award in Brussels brought international recognition to the highly innovative industry developing in Saxony-Anhalt.

Prof. Klaus Jenewein

The background is the Fraunhofer IFF’s outstanding competencies in the field of virtual reality technology. A technology platform based on an authoring system is able to substantially reduce the time and effort companies need to generate an application for putting training measures into effect. Thus, a technical prerequisite has been created for more intensively recruiting small and medium-sized enterprises as partners for technology-based training too. One focus of the competence center’s work will be developing qualification measures geared toward working processes, which can be carried out both in real and virtual work environments.

In the coming winter semester, the competence center will be presented at an opening event. This event will be announced on the Fraunhofer IFF website: www.iff.fraunhofer.de.
Dr. Martin Endig earned his Diplom in Computer Science from Otto von Guericke University Magdeburg in 1996. He remained at the university until 2001 where he worked on database theory, Internet technologies and engineering applications. After completing his doctorate in Computer Science, he started working at the Fraunhofer IFF. One focus of his work is the description and realization of practical information systems with different contents for small and medium-sized enterprises. Generally this includes developing an infrastructure to support after sales divisions.

Antje Buschsuhlte has a close relationship with science: She studies neuroscience at Otto von Guericke University Magdeburg. The institute was extremely happy about its celebrity visitor. After all, it performs research research for professional sports. For instance, the latest developments in metrology were used to develop a digital javelin together with the Halle/Magdeburg Olympic Training Center.

**Fraunhofer IFF Garners Soccer Cup**

Fraunhofer IFF associates not only have sharp minds but also extremely nimble feet, something they demonstrated at this year’s Fraunhofer-Gesellschaft soccer tournament in Bonn on June 18. Twenty-five Fraunhofer teams from throughout Germany were hosted by the previous year’s winner St. Augustin.

In the beginning, it didn’t look like the Magdeburg team would be winning anything: In the preliminary round, the team came up against St. Augustin, which ended the game with a 2:0 victory. After the IFF kickers beat a number of other teams, they moved up to the quarter finals where they came out with ties though: 1:1 against IPT Aachen and 0:0 against SIT Darmstadt. The other teams fared no better though and in the end a penalty shootout decided who would advance to the finals. »In the semifinals, our players came up against Fraunhofer IPMS and beat them 1:0. It was close since IPMS was top scorer with nine points in the tournament,« player Marcel Wipper recalled.

In the finals, the players faced St. Augustin, which had once catapulted the Magdeburgers out of the running in the semifinals in Münster four years earlier. After another penalty shootout, the decision was in the hands of the opposing team. IFF goalie Mattias Franke gave his all and stopped the decisive ball from Aachen’s Andreas Brossig. The game ended with a surprise victory for the Fraunhofer IFF team.

The challenge trophy and team cup have been brought back to Magdeburg for the first time. As the victor, the Fraunhofer IFF team will be organizing the next tournament.

**Why Antje Buschschulte Was Wielding a Cleaning Rag in the Fraunhofer IFF**

This had nothing to do with a lost bet as one might surmise. The Olympic medalist and world champion found a new sponsor in her hometown of Magdeburg. The swimming star recently closed a deal with the Weidenmann Group, a service provider for the Fraunhofer IFF. Her first public presentation involved a photo shoot and a film shoot with MDR television at the Fraunhofer IFF.
The former commercial port is turning into the Scientific Port. Where goods were once transshipped, the latest research findings will soon be being exchanged and applied as business innovations. The Scientific Port serves as a model of how science and research can effect structural change in a city.
Virtual competence network – real teamwork.

Specialists from six Fraunhofer Institutes and six universities have combined forces in the ViVERA network to facilitate transferring the results of research to corporate practice faster.
Virtual reality has come to dominate numerous fields of application. Along with the automotive industry, mechanical and plant engineering and the aviation industry, researchers at the Fraunhofer IFF are also performing research in the field of medical technology.
The aviation industry in particular takes advantage of the virtual-interactive training at the Virtual Development and Training Centre VDTC of the Fraunhofer Institute for Factory Operation and Automation IFF.
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Ceremonial Opening

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Magdeburg Scientific Port