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Dear Readers,

“Magdeburg is an outstanding center of virtual technology,” said Minister of Education and Research Annette Schavan about our center of research here in June 2008. During the 11th IFF Science Days, the Federal Ministry of Education and Research announced the start of the Virtual Technologies Innovation Alliance and funding of around 39 million euros for it. In addition to this support, industry partners will be contributing 170 million euros in investments over the next five years. The Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg shall be the research and technology hub. These are impressive facts that conceal highly interesting research projects about which you will find out more in this magazine.

Moreover, you will discover the exciting projects Magdeburg’s Fraunhofer researchers and their partners have on the drawing board. The topics are manifold and address different industries: From robots for electron beam welding to automated 3-D modeling of barley seeds. Things that appear unusual are the daily routine for Fraunhofer researchers: They are active in every sector as creative problem solvers.

Highlighting interactive humans and machines, this issue, IFFocus 2/2008, will inform you about fascinating research services of today that will conquer corporate practice of tomorrow. As different as our clients and their challenges are, they have one commonality: People’s lives ought to be made easier, better and safer with the latest technological innovations. This is what Fraunhofer researchers stand for.

I wish you interesting reading on your voyage of discovery through virtually unlimited virtual worlds. Perhaps it will inspire you in one way or another – we in Saxony-Anhalt would be glad to help you make your ideas reality.

Your

Prof. Michael Schenk
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More Reliable Technology Thanks to Virtual Reality

The Cutting Edge Interdisciplinary Research Project VIERforES Starts in Magdeburg

Computer technology runs everyday life. Increasingly, embedded systems control and monitor equipment that are used every day without a second thought. Researchers from Magdeburg and Kaiserslautern are jointly working on concepts intended to help enterprises optimize their products so that the integrated software functions properly. The researchers aim to make technical devices safer, more secure and more reliable.

The research project Virtual and Augmented Reality for Maximum Safety, Security and Reliability of Embedded Systems VIERforES was officially started in Magdeburg in September. Otto von Guericke University President Klaus-Erich Pollmann; Fraunhofer IFF Director Michael Schenk, Technical University Kaiserslautern President Helmut Schmidt and Fraunhofer IESE Director Peter Liggesmeyer signed the cooperation agreement. The Federal Ministry of Education and Research is supporting the project with 7.5 million euros as part of its initiative Advanced Research and Innovation in the New States.

The researchers intend to take advantage of the benefits of virtual reality to develop safe, secure and reliable technology. Things that are normally invisible shall take on form in cyberspace, precisely demonstrating how software integrated in machinery and devices performs. “Research findings shall enter directly into the development process and make DVD players, cars or entire power plants safer, more secure and more reliable. Automotive, medical, power and material handling engineering all particularly exhibit tremendous need for research,” says Prof. Michael Schenk, “After all, the industry is endeavoring to digitally map manufacturing processes from end to end.”

Calculating the performance of technical systems requires expert knowledge from specialists in the widest variety of fields of research according to Otto von Guericke University President Klaus Erich Pollmann. “It’s not enough to have clever mechanical engineers or computer scientists. Launching real innovations requires interdisciplinary collaboration among top researchers. That is VIERforES strength.”

Automotive engineering without embedded systems is inconceivable today. Every car has fifty to one hundred microcontrollers with well over one million lines of code performing a variety of control and monitoring functions. Many of these such as ABS are relevant to safety. The trend is ongoing. Conventional methods are basically unable to test whether the complex interaction of hardware and software in conjunction with a car’s mechanics and electrical systems is free of faults. While not every fault may cause an accident, manufacturers can suffer from expensive recalls and image loss. Methods of virtual development and testing provide one option to better control complexity: Digital models enable testing vehicle and software performance faster and more thoroughly and the results can be presented clearly in virtual environments. Magdeburg’s Otto von Guericke University and Fraunhofer IFF are contributing their expertise in the modeling and representation of complex mechatronic systems in virtual environments. Kaiserslautern’s Technical University and the Fraunhofer IESE have years of experience developing and testing embedded software systems. They intend to jointly develop strategies and tools to perform the most extensive virtual tests possible, in particular for safety-critical components in state-of-the-art vehicles.
To this end, the research organizations and their partners kicked-off a joint project on December 1, 2008. Small and medium-sized enterprises intending to establish business relations in Asia or needing support in business transactions with Asian partners will be able to rely on help from these experts.

Some small and medium-sized enterprises have already been drawn to Asia. The Middle Kingdom, China holds remarkable potential for sales, procurement and capital markets. The Asian tigers Thailand and Vietnam are experiencing annual economic growth of 4-6%.

"As far as export trade is concerned, Saxony-Anhalt and technology transfer organizations in Southeast Asia since 1999. Opierzynski has established a well functioning network of partners and interested enterprises over nine years. Demand has grown greater over the course of time and existing partners have indicated express interest in follow-up projects. While the Fraunhofer IFF’s Asia expert spent a great deal of time in the air, Opierzynski is now organizing a permanent representation in the metropolis. "The move to Bangkok has already paid for itself," reports Ralf Opierzynski, full of expectations for the future: ”This will enable us to expand our business relationships sustainably.”

Fraunhofer IFF Opens Branch in Bangkok

Asian Expertise Asia for Saxony-Anhalt’s Businesses

Martin Luther University Halle-Wittenberg, its Institute for Innovation and Entrepreneurship IIE and the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg intend to make it easier for companies in Saxony-Anhalt to enter the Asian market. The Federal Ministry of Transport, Building and Urban Affairs is supporting the project with around 400 000 euros.

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Early next year, Magdeburg’s Fraunhofer Institute will open a branch in the Thai metropolis of Bangkok where Ralf Opierzynski will be coordinating industry and transfer projects and establishing new contacts. The cooperation partners include the Federation of Thai Industries (FTI), the Asian Society for Environmental Protection (ASEP), the National Science and Technology Development Agency (NSTDA) and the Ministry of Science and Technology. Bangkok will be the hub to stepping up collaboration not only in Thailand but also with enterprises throughout the ASEAN region, particularly Malaysia, Vietnam, Indonesia and the Philippines.

The Fraunhofer IFF has been maintaining close relationships with small and medium-sized enterprises and technology transfer organizations in Southeast Asia since 1999. Opierzynski has established a well functioning network of partners and interested enterprises over nine years. Demand has grown greater over the course of time and existing partners have indicated express interest in follow-up projects. While the Fraunhofer IFF’s Asia expert spent a great deal of time in the air, Opierzynski is now organizing a permanent representation in the metropolis. "The move to Bangkok has already paid for itself," reports Ralf Opierzynski, full of expectations for the future: “This will enable us to expand our business relationships sustainably.”

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needs to catch up considerably. The regional economy presents unique opportunities small and medium-sized enterprises ought to take better advantage of," Fraunhofer IFF Director Michael Schenk urges.

This is also the view of the Organisation for economic Co-operation and Development OECD. One outcome of its conference on "Perspectives on Strengthening Entrepreneurship in East Germany" in November of last year was the OECD’s endorsement of regional and national organizations efforts to provide small and medium-sized enterprises support developing international markets.

A number of risks offset the great potential for business in foreign markets though. "Along with a lack of reliable market information and a selection of reliable partners, forty percent of the enterprises surveyed indicated that cultural dissonances adversely affect foreign activities. This is our point of departure," explains project manager Prof. Joachim Ulrich, Vice President of Research and Future Researchers at Martin Luther University Halle-Wittenberg. In the future, enterprises will profit from the expertise of researchers in the field of Asian studies for their foreign business and be prepared for the distinctive features of the Asian market. The researchers intend to transfer their knowledge and experience in intensive workshops, interdisciplinary field seminars, foreign study trips and personnel and contact brokering. On the one hand, seminars will treat concepts for the development of foreign markets, e.g. market studies, to reduce the risks when entering a new market. On the other hand, the adaptation of enterprises' Internet presentation to Asia will be analyzed by drawing on creative skills and experience with Asian cooperation from Burg Giebichenstein University of Art and Design Halle. Businesses will also learn entirely practical information for everyday international business transactions such as correct forms address for foreign business partners in correspondence and email or on the phone as well as basic facts about politics, business and religion. A trip of a delegation to the Asian target regions of China, Thailand and Vietnam will be organized to enable businesses to establish concrete business and collaborative relations.

Nearly Two Millions Euros for the Galileo Test Field in Saxony-Anhalt

In Magdeburg, Saxony-Anhalt’s Minister of Transportation Karl-Heinz Daehre, Minister of Education and Culture Jan-Hendrik Olbertz, Minister of Economics and Labor Dr. Reiner Haselhoff and University President Klaus Erich Pollmann signed a cooperation agreement for this project in which nearly two million euros are being invested. "The Galileo Test Field will establish the basic conditions to concentrate transportation research in Sachsen-Anhalt on one applied project for the future," said Daehre after the signing.

According to the Minister of Transportation, who is in charge of coordinating this state initiative, this establishes the basis for research organizations and enterprises in Saxony-Anhalt to play a role in the development of this technology in Europe. "This is a milestone for Otto von Guericke University in the capital as well as for Saxony-Anhalt as a center of research and technology as a whole," Daehre pointed out.
The three ministries involved are financing the construction and operation of the Galileo Test Field. This year and next year, 1.8 million euros will be invested in measuring equipment, sensor systems, software and lab equipment at Otto von Guericke University and 180,000 euros will be furnished for research staff. Thus, it will already be possible to carry out the first research and development projects in 2009. Stress is placed on involving consortiums from Saxony-Anhalt, specifically the university, non-academic research organizations and industry partners, in national and European research programs. “An important prerequisite to sustained economic growth is the quality of the transportation infrastructure. To keep it up-to-date, we are investing in transportation research,” says Minister of Transportation Reiner Haseloff.

“We expect a sustainable impact from our inter-ministerial support strategy that secures and creates jobs in the key industries of transportation and logistics,” the minister explains. That is why the involvement of and support for small and medium-sized enterprises is especially important to the state.

### Knowledge Management Expedition

Anyone who effectively exploits the knowledge in her enterprise can save a lot of money - that is certain. Yet, how should knowledge be organized? Finding one’s bearings in the jungle of knowledge management methods and instruments and identifying the right solution for one’s own needs is virtually impossible without outside assistance, particularly for small and medium-sized enterprises.

The Fraunhofer IFF and Fraunhofer IPK jointly hosted the professional conference “ProWis: Knowledge Management Expedition” in Berlin in June 2008. The goal was to provide small and medium-sized enterprises concrete assistance to organize knowledge. Many interested businesspeople attended since this issue is growing increasingly important in our market economy. Individual cases were discussed together with Fraunhofer experts and solutions were sought collectively.

The next opportunity will be at the knowledge management conference WM2009 to be held in Solothurn, Switzerland on March 25 to 27, 2009. Among other things, successfully implemented methods and examples from the field will be presented, which demonstrate how management can be profitably implemented in small and medium-sized enterprises.

### Expert Forum on Energy Efficiency in Plant Engineering

Scarce resources, steadily rising energy costs, environmental pollution – Germany’s plant manufacturers are facing tremendous challenges. Experts discussed the latest trends and practicable solutions at the 10th Industry Working Group on Cooperation in Plant Engineering in Arnstdorf in Bavaria.

The industry is banking on renewable energy sources and boosting plant efficiency. This necessitates new concepts and practicable solutions though. Ludwig Heck from BASF SE presented interesting approaches to energy efficiency and highlighted three mainstays: planning structures and organization,
First DHL Innovation Award Winners Chosen

The world’s leading express and logistics provider, DHL awarded its first DHL Innovation Awards on November 19, 2008. In the presence of around 200 guests, clients, employees and researchers were recognized for innovative logistics solutions that are in development or being implemented. “The logistics industry needs ranges of efficient and intelligent products and services to master the challenges of the future,” explained host John Allan who, as President of Deutsche Post World Net Finances and Global Business Services, is also in charge of technology and innovation management. “Whether climate neutral shipping or continuous monitoring of temperature-sensitive high-tech medicine, DHL Innovation Center is already providing its customers future proof solutions. The DHL Innovation Award recognizes creativity and business ideas that have advanced our industry.”

Among others, Metro AG was recognized for successfully implementing RFID chips in its supply chain and the insurer Allianz for sending all its correspondence and mailings climate neutrally since July of 2008.

The winners were selected by a jury of distinguished experts: Prof. Michael Schenk (Fraunhofer IFF), Chris Caplice (Massachusetts Institute of Technology), Prof. Eckard Minx (Daimler AG), Ulrich Kasparick (Federal Ministry of Transport, Building and Urban Affairs) and Dr. Keith Ulrich (DHL-Innovation Center).

Experts from all over the world work together at the DHL Innovation Center in Magdeburg, “We consider ourselves a forum that brings Germany’s plant engineers together. The response confirms our approach and the experts profit from the mutual exchange.”

The Fraunhofer IFF has been organizing the Industry Working Group together with the Association for the Promotion of Mechanical and Plant Engineering in Saxony and Saxony-Anhalt for five years. It provides plant manufac-

turers, supplier companies and plant operators a common discussion forum that presents trends and prospects and thus enables them to access innovative development.

The next Cooperation in Plant Engineering Industry Working Group will meet in Magdeburg on June 17, 2009 during the 12th IFF Science Days. More information and the registration form are available online at www.wissenschaftstage.iff.fraunhofer.de

Photo: Deutsche Post AG
One of the Fraunhofer IFF’s first industry projects was completed in collaboration with a company in Wernigerode in 1993. The automation specialists developed a process and special sensor for a robot. Combined force and position control make it possible to effectively debur castings even in small production runs.

Fast control of robot movements is especially important for stable process control. The researchers managed to do this with a six component force/torque sensor with fully integrated signal processing distinguished by its extremely high scanning rate.

In the presence of Minister of Economics and Labor Reiner Haseloff, Vattenfall Europe Transmission GmbH commenced operation of the first segment of the approximately 210 km long Halle-Schweinfurt (Bavaria) extra high voltage transmission line in December. At the commissioning ceremony, Haseloff presented the Saxony-Anhalt Center for Renewable Energies (ZERE) and the Agentur für Technologietransfer und Innovationsförderung (ATI) an official letter of notification of 500,000 euros in funding. The funding will support the establishment of the “Renewable Energies” cluster’s management. It will also concentrate on the recovery of energy from biomass and biowaste, energy storage and supply, cogeneration plants, wind energy converters, photovoltaic, solar and geothermal energy and energy efficiency. In his welcoming remarks, Haseloff said, “Saxony-Anhalt and the other new states are assuming a leading position in Germany in renewable energies, especially wind power. This ought to remain so in the future too.”
Prototyping with Industrial Robots

Ship’s propellers, parts for wind energy converters, turbine housings – such large volume castings can only be produced with special molds. The procedure is elaborate and cost-intensive because foundry workers must still perform most of the work steps manually.

In the future, industrial robots will support skilled workers when they fabricate molds: Together with their partner firm Modell- und Formenbau GmbH Sachsen-Anhalt MFSA, researchers at the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg have developed a procedure for this. “The robots produce large-volume models and molds faster and less expensively. Depending on the process, this can cut costs by up to a third. Various tools can be combined flexibly with one another,” explains Torsten Felsch, Research Manager at the Fraunhofer IFF. The molds are milled directly out of a block - without losing time on a product model. KUKA Roboter GmbH in Augsburg is supporting this project: Thus, among other things, a standard KUKA robot is being utilized. The Fraunhofer researchers are scrutinizing the basics of robot use: Which milling path is optimal? How can algorithms be used to calculate it? What tools are best for robot use? Their colleagues at MFSA are implementing the findings directly in production.

Another method is often more cost effective for large quantities than direct milling: Since a mold is destroyed when a finished casting is extracted, workers first fashion a model of the casting to be produced, which serves as a pattern for molds. “The models are built up in layers. Usually, a worker saws out the individual sheets, bonds them atop one another and then machines the shape with a milling machine. Industrial robots will be able to take this over in the future,” says Felsch. How exactly does that function though? First, the KUKA robot mixes a liquid two-component foam and applies one foam layer after another to the machined surface. Since an average layer is two centimeters thick, a relatively rough model of a casting is produced. Just as in direct milling, the software then supplies the milling parameters to the robot: Where must how much material be removed? What tool is best to use? The robot machining processes are currently still in development. They could be supporting foundries in their work in one to two years.

The researchers at the Fraunhofer Institute for Factory Operation and Automation IFF are experts in robotics – regardless of whether to clean facades, inspect sewer lines or assist humans. Their latest helper is RIWEA, a robot that inspects the rotor blades of wind energy converters. Primarily made of glass fiber reinforced plastics, rotor blades have to withstand a great deal: wind, inertial forces, erosion, etc. Until now, humans have inspected wind energy converters at regular intervals – not an easy job. After all, the technicians must closely examine large surfaces - a rotor blade can be up to 60 meters long - in airy heights. “Our robot is not just a good climber,” says Dr. Norbert Elkmann, Project Manager.
Manager am Fraunhofer IFF and coordinator of the joint project. "It is equipped with a number of advanced sensor systems. This enables it to inspect rotor blades closely. Are there cracks in the surface? Are the bonded joints and laminations in order? Is the bond with the central strut damaged?

The inspection system consists of three elements: An infrared radiator conducts heat to the surface of the rotor blades. A high-resolution thermal camera records the temperature pattern and thus registers flaws in the material. In addition, an ultrasonic system and a high resolution camera are also on board, thus enabling the robot to also detect damage that would remain hidden to the human eye. A specially developed carrier system ensures that the inspection robot is guided securely and precisely along the surface of a rotor blade. "It is a highly complex platform with sixteen degrees of freedom, which can autonomously pull itself up ropes," explains Elkmann. The advantage of this system: It can perform its job on any wind energy converter - regardless of whether it is large or small, on land or offshore. The robot always delivers an exact log of the rotor blades' condition, keeping humans safe and not missing any damage.
In a Flash

16-18, June 2009. The program will include presentations on logistics, robotics, digital engineering and biotechnology. Many top speakers have already accepted our invitation to provide insight into their success strategies. Conference attendees are sure to profit from their unique experiences and the latest findings. The professional atmosphere is perfect for discussions. The evening event where all attendees gather together is especially an opportunity for personal networking.

Information and registration at: www.wissenschaftstage.iff.fraunhofer.de

Impulses and Inspiration

These impressions from the summer of 2008 provide a glimpse of the IFF Science Days, a recognized forum for experts from research, academia, business and government. Its recipe for success is the successful mix of speakers on the one hand and the fascinating insights into current research work undertaken by our researchers together with their industry partners on the other hand.

The Fraunhofer Institute for Factory Operation and Automation IFF will be hosting its 12th IFF Science Days in Magdeburg on June 16-18, June 2009. The program will include presentations on logistics, robotics, digital engineering and biotechnology. Many top speakers have already accepted our invitation to provide insight into their success strategies. Conference attendees are sure to profit from their unique experiences and the latest findings. The professional atmosphere is perfect for discussions. The evening event where all attendees gather together is especially an opportunity for personal networking.

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Photos: Viktoria Kühne und Dirk Mahler
Manufacturing More Efficiently with Virtual Engineering

Dr. Stefan Robert Deibel, BASF SE

Surviving Times of Crisis

In terms of sales and market capitalization, BASF SE is the world’s largest chemical concern. The company has more than 95,000 employees at some 400 production facilities throughout the world. Its headquarters in Ludwigshafen am Rhein is its largest production facility.

BASF SE and the Fraunhofer IFF have united in an interesting collaborative project: The research institute in Magdeburg is supporting the concern’s implementation of virtual technologies in its planning and engineering of process plants for the chemical industry.

IFFocus editor Anna-Kristina Wassilew spoke with BASF engineering expert Dr. Stefan Robert Deibel about the new developments the industry has to adjust to and BASF’s implementation of virtual technologies.

Machinery and plant manufacturing is one of Germany’s leading branches of industry. So far, businesspeople could be content: Order books were filled for the coming years. Now, everyone is talking about a global financial crisis and worried about its impact on the economy. Is the euphoric mood among plant manufacturers changing? What awaits the industry?

The crisis will alter existing points of view – companies will have to withstand considerable cost pressure. Much like the crisis of 1983-84 – but far more serious. I think a definite recession awaits us. Many projects will disappear and many investment projects will be put on hold. Afterwards, a concentration process will begin. Only the companies that manufacture fastest and cheapest will be able to survive the market.

Only those who manufacture cost effectively and rapidly will survive. Is that really the whole secret?

From now on, it will be even more a matter of cost than before. We will experience competition like never before. We will only achieve ambitious goals when we dare something new. Hence, it is also important to keep looking ahead and be open for innovations. We will survive when we are innovative.

Can virtual engineering help?

Virtual engineering is the cornerstone! Plant manufacturers and operators will no longer be able to manage in the future without this advanced technology. Virtual engineering is a fundamental tool – for us, particularly in the construction phase. Bear in mind, plants, especially plants for the chemical industry, are always unique items. Thus, for example, we must comply with different standards and factor in unique geographic features in every country. For instance, we need different cooling water concepts on the equator than in the Siberian tundra. Such plants must be planned in great
detail and this requires great expertise. Virtual models enable our engineers to perfect plants with their future operators before they are built. That means finalizing customized designs before they really cost money.

**For what work does BASF use virtual technologies?**

We recently instituted new standards according to which every BASF plant will now be virtually engineered. We implemented this together with the virtual reality experts from the Fraunhofer IFF. We now have two virtual reality workstations where we complete our “virtual pipe design”, meaning our engineers use it to plan piping.

**What is more, engineers at BASF also use virtual technologies for other work. In what other domains have they additionally paid off?**

To plan and upgrade existing plants. If you intend to implement an elaborate labyrinth of winding pipes, you have to be certain what the consequences are. Many questions have to be clarified in advance: Are collisions a threat? Are shut-off devices within arm’s reach for employees? Issues of industrial safety crop up as well. All this can be resolved better and with more certainty when one works with virtual engineering in such planning processes. Comparable to a player in the computer game SimCity, the planning team downright immerses itself in a plant and inspects and tests its various functions.

**Do you also use the virtual models for training purposes?**

Our commissioning is also a kind of training. Future operators have to know how to commission their plants. We use virtual models for this as well as for quality control. The question of a material’s hydrodynamic characteristics, namely how high the loads in tanks are, is especially interesting to us. In the future, we intend to spend more time on how to simulate this with virtual reality.

**How much do you estimate virtual engineering methods save you?**

We are still in the implementation phase – when all goes right, we will certainly be able to cut two to three months from the planning process. We normally need around twelve months. If we manage to shorten this process step to ten months, we will be able to save around fifteen percent in time alone.

**When one imagines the sheer unlimited opportunities virtual technologies open, one has to wonder how we used to get by without them. How did BASF formerly engineer plants?**

When I started at BASF in 1989, plants were still being planned two-dimensionally: The engineers were still drawing linear pipe plans with pencils on big tables. These served as the basis for constructing wooden stick models. Later, the wood models were replaced by plastic models. Afterward, the piping engineers laid the lines directly in the plastic models and then made new drawings. This method was unable to allow for small parts though. This meant, for example, that every pipe with a diameter of less than 25 millimeters could only be planned and inserted at the construction site. You can imagine that such models could not be very accurate. Many difficulties didn’t appear until a plant had already been built. Later, we exclusively used 3-D CAD models and were thus able to generate isometries. Today, virtual engineering can represent so many things. Back then, when CAD data models were being introduced, we were already happy for the tremendous increases in profits and productivity. Today, we expect even fewer turnarounds times from virtual engineering.
Virtual reality (VR) and augmented reality (AR) are playing an ever greater role when surgeons test operations on a realistic patient model des on a computer. These technologies can be employed wherever complex or even dangerous operations are simulated to already eliminate problems before the start of production. To advance this technology and practicable applications the Federal Ministry of Education and Research (BMBF) is supporting three new joint projects as part of its Virtual Technologies Innovation Alliance with around 39 million euros through 2011.
On the occasion of the announcement of the Innovation Alliance at the 11th IFF Science Days, Minister of Education and Research Annette Schavan emphasized that “With these virtual reality technologies we are establishing an important basis to strengthen the competitiveness of our business. Without efficient production, Germany would be unable to be the world’s leading exporter.” Along with the support from the BMBF, the industry partners will invest 170 million euros in these technologies over the next five years.

The Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg will be the research and technological hub for the three projects AVILUS (Applied Virtual Technologies in the Product and Production Equipment Life Cycle), AVILUSplus (Applied Virtual Technologies Focused Long-range on the Product and Production Equipment Life Cycle) and VIERforES (Virtual and Augmented Reality for Maximum Embedded System Safety, Security and Reliability). The institute is a partner to clients from medium-sized enterprises, industry, research and government. Together with its clients, it develops and optimizes solutions in the fields of logistics, virtual engineering, automation and plant engineering.

"Magdeburg is an outstanding center of virtual technology research and development and therefore also suited for us to support the pilot project VIERforES as part of our program Advanced Research and Innovation in the New States," according to Schavan. The VIERforES project is one of six pilot projects in the BMBF’s program Advanced Research and Innovation in the New States, which builds upon regional strengths. Support is intended to boost the capacity for innovation and thus the economic power in the eastern states.

In the AVILUS project, a consortium of twenty-eight leading German industrial companies, small and medium-sized enterprises and research organizations is developing and testing efficient technologies, e.g. from the field of information management. The objective of the project is user friendly technology, which can be used to create VR systems without great effort. Volkswagen AG has assumed the coordination of AVILUS.

In the research project AVILUSplus, nine research organizations are working on fundamental aspects of technology research, emphasizing visualization and interaction as well as data management and methods of measurement.

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Head of Division of Vehicle Production Technology

2008
Virtual Technologies Innovation Alliance Spokesman
Virtual Technologies as Engines of Growth

AVILUS Applied Virtual Technologies in the Product and Production Equipment Life Cycle

Dr. Werner Schreiber, Volkswagen Konzernforschung and Virtual Technologies Innovation Alliance Spokesman
Virtual Technologies Present Potentials for Saving Energy

German economic growth increasingly depends on the speed at which innovative product developments are launched on the market. What is more, customers are imposing ever more customized demands on products but are unwilling to pay higher prices for them. In order to be able to survive international competition, German enterprises are banking increasingly on virtual technologies because computerized product development opens considerable potentials for savings. However, commercially available software products reach their limits when it comes to realistic representation, processing larger amounts of data, natural interaction in virtual environments, real-time compatible simulation and suitable input devices. Thus, a complete virtual representation of a complex product or an entire factory is an impossibility.

Therefore, a consortium of leading German industrial companies, small and medium-sized enterprises (SME) and well-known research organizations has set itself the goal of developing and testing efficient virtual and augmented reality technologies in the AVILUS technology network. This project is the mainstay of the Virtual Technologies Innovation Alliance. Twenty-eight highly successful partners from key German industries such as car making, aircraft manufacturing, shipbuilding and plant manufacturing represent all the fields of expertise necessary for the project’s success. Thus, the entire process from product development to manufacturing up through marketing and maintenance is efficiently covered with resources.

Virtual Technologies Focused on Specific Users

The project is squarely focused on people. It intends to integrate them in all of product development with the aid of virtual technologies and enable them to make decisions in different stages of development considerably faster and more reliably. Developers will already be able to step into the role of later users or consumers at an early stage to evaluate the function of a virtual product and optimize it where necessary. The completion of more complex tasks requires being able to experience and operate a virtual product and its environment as realistically as possible. Users will be able to intuitively act in a scene, e.g. a car interior or an aircraft cabin, and operate the relevant equipment.

More effective utilization of digital information supporting products and manufacturing holds another economic potential. To this end, an information management system shall be developed, which maps the entire life cycle of a product or production equipment and combines and processes all data from development through disposal and provides it to other users and applications.

Technology Development

The AVILUS project will refine and holistically linked technologies for information management, digital information-supported manufacturing, virtual information presentation, tracking-systems, visualization systems (renderers), mobile information recording and display equipment and information generation and processing (engineering and authoring systems) so that they are also suitable for implementation in small and medium-sized enterprise.

To enable users to optimally access digital information and to provide networked information, the units of information must be weighted. Only an integrated, semantically described information space (ontology) that incorporates the entire product life cycle and every manufacturing process allows a vision of a digital factory or a digital product to become reality.

Ever more complex operations, parallel product development and shortened development times necessitate further development of available simulation and presentation technologies and improvement of their interaction with 3-D environments. What is more, digital data will increasingly also be presented in real environments. This opens diverse options for user interaction such as haptic feedback and makes virtual environments extremely realistically experienceable.

Project Partners

| Bauhaus University Weimar     | Carl Zeiss AG, Oberkochen                  |
| CeBeNetwork GmbH, Bremen      | Daimler AG, Ulm                            |
| EADS Deutschland GmbH, Munich | Flexilution GmbH, Cologne                  |
| Forschungsgesellschaft Karlsruhe | Fraunhofer IFF, Magdeburg                 |
| ICIDO GmbH, Stuttgart        | INDEX-Werke GmbH & Co. KG, Esslingen      |
| KUKA Roboter GmbH, Augsburg   | KUKA Systems GmbH, Augsburg                 |
| KUKA Systems GmbH, Augsburg   | metaio GmbH, Munich                        |
| Otto von Guericke University Magdeburg | Rittal GmbH & Co KG, Herborn               |
| RWTH Aachen                   | Siemens AG, Nürnberg                        |
| Technical University Clausthal | Technical University Munich                 |
| HDW GmbH, Kiel                | Bauhaus University Weimar                  |
| University Koblenz-Landau     | Volkswagen AG, Wolfsburg                   |
| 3DInteractive GmbH, Ilmenau   |Fraunhofer IFF, Magdeburg|
Virtual Technologies for Training and Everyday Operations

The information age is opening new forms of effective learning and marketing for specific target groups. Thus, technologies employed for computer games will be developed further to utilize them for basic and advanced employee training. Rather than standard solutions, customers are increasingly demanding products tailored precisely to their needs. This makes it essential to develop new presentation technologies that facilitate the customization of presentations and configuration of products. The methods and technologies being developed in AVILUS are intended to link virtual technologies with the real world of work in Germany. They shall be directly integrated in everyday operations in near real-time and tested in real user situations.

Some of the applications being developed in the subprojects include:

- Realistic vehicle representation in an early stage of development that dispenses with physical prototypes,
- Benchmarking of digital data from manufacturing facilities with plants constructed later (feedback for the digital factory),
- Employee support in order picking or service and
- Product presentation in the customer setting.

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We’re Developing the Future

AVILUSplus Applied Virtual Technologies Focused Long-range on the Product and Production Equipment Life Cycle

Marco Schumann

The project AVILUSplus is closely related to the AVILUS technology network, which, as a consortium of business and research partners, is developing efficient virtual and augmented reality technologies. Once AVILUS had started, it quickly became apparent that demand exists for technologies requiring longer-term research. Since the scientific and commercial success entails more risks, nine well-known research organizations focused more on basic research joined forces to take on this challenge in the project AVILUSplus. Preliminary work was contributed by the ViVERA Virtual Network of Competence for Virtual and Augmented Reality. Its partners are already able to look back on successful collaboration in this field.

ment promises substantially higher efficiency and considerable potentials to save time and resources. However, commercially available software products reach their limits when it comes to realistic representation, processing larger amounts of data, natural interaction in virtual environments, real-time compatible simulation and suitable input devices.
Long-range Technology Development

The thematic foci of the AVILUSplus subprojects correspond to the AVILUS-partners’ given technologies. Additional research expected to hold great potential for future use was identified in direct consultation with the AVILUS partners. The technologies in AVILUSplus have been matched to five thematic foci:

Information Management in the Product Life Cycle: Virtual reality is primarily associated with the presentation of visual representations. However, this additionally requires information that describes the characteristics of virtual objects and their responses to user interaction. Therefore, a significant goal of technology development is to design automated solutions that can generate multimedia instructions for action. The future goal is to automatically generate virtual procedures based on real procedures and thus significantly reduce development work.

Simulation and Rendering: The extent to which virtual technologies can be productively implemented and are accepted depends on the level of realism, detail and physical accuracy of simulations of complex models and object characteristics in virtual or mixed reality environments. Among others, methods to simulate object characteristics physically accurately in real time are being developed. Virtual commissioning of a manufacturing process requires the development of a solution that links real control components and virtual scenarios. For rendering, i.e. the calculation of a realistic graphic volume model or an animation from a computer model, this means reproducing products and attributes, e.g. coated surfaces, physically accurately and with maximum quality. Altogether more realistic and detailed image calculation is the goal.

Tracking: Tracking real objects to obtain information on the course of their movements and their position is a crucial prerequisite for virtual and augmented reality. Until now, tracking solutions have only functioned in environments with special markings for them and under restricted lighting conditions. A fundamental goal here is to improve the reliability of markerless tracking.
Interaction: As new hardware components are developed, new conceptual models are being researched, which enable people to interact with virtual environments. Research is being done on image-based interaction for instance. Sensors transmit information on the environment to a head-mounted display (HMD) that displays computer generated images on a monitor close to the eyes or projects them directly onto the retina. Other research is being done on completely new options for interaction between humans and virtual objects, e.g. the development of a tactile artificial skin. In the future, this could allow direct human-machine interaction in a mixed reality environment.

Geometry Capture: Rapid and precise capture of the geometry of real objects is essential for the detection of planning errors in the superimposition of CAD data and real models. Research is being concentrated on methods of 3-D measurement that can be combined with augmented reality technologies. Other methods are being developed to identify and inspect objects. Thus, the correctness of the sequences of a maintenance or assembly procedure can be tested and a warning signal triggered when a work step is incorrect. Differential geometries present any discrepancies that result when real captured and digitally designed 3-D objects are aligned.

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Fraunhofer IESE, Kaiserslautern
Fraunhofer IGD, Darmstadt and Rostock
Fraunhofer IPK, Berlin
Fraunhofer IWU, Chemnitz
German Research Center for Artificial Intelligence DFKI, Saarbrücken and Kaiserslautern
Technical University Munich

Reference No.: 01IM08002
Confidently into the Future with Reliable Technology

ViERforES Virtual and Augmented Reality for Maximum Embedded System Safety, Security and Reliability

Prof. Michael Schenk and Prof. Gunter Saake, Spokesmen of the Digital Engineering Center in Development
Marco Schumann, ViERforES Coordinator
Virtual Technologies for Safety, Security and Reliability

Computer technology plays a dominant role in everyday life. Embedded systems are increasingly controlling and monitoring equipment used every day without a second thought. In Germany, the proportion of products that contain embedded systems makes up approximately 80% of the total value added. To compete internationally, German companies in this sector are increasingly banking on virtual technologies to meet their needs to cut time and resources and shorten development and testing times as demands for product functionality and customization continue growing.

As the complexity of systems increases so do the demands for safety, security, availability and reliability. In the project VIERSforES, researchers from Magdeburg specialized in virtual and augmented reality and from Kaiserslautern specialized in embedded systems are jointly working on concepts intended to help enterprises optimize their products in this respect. Properties that normally remain invisible will take on form in virtual environments and visualize the performance of software in machinery and equipment with the goal of making DVD recorders, cars or entire power plants function more safely, securely and reliably.

Visualization of Properties

Many systems’ safety, security, availability and reliability are controlled by their software. Virtual technologies with different attributes are interconnected to provide these properties during product design, testing and operation. Established representations of real products based on virtual 3-D models are being connected with novel, easily learnable and/or intuitively comprehensible visualizations of properties without a physical counterpart, e.g. safety and security.

Humans’ pronounced sense of sight allows them to quickly take in complex information, identify what is relevant at a glance and disregard what is irrelevant. Given humans’ ability to do this, it seemed expedient to employ human sight for the analysis of important data. Representing such abstract information as safety, security and reliability with virtual technologies so that they are clearly perceptible will be essential.

Embedded systems are virtually never stand-alone systems. Rather, they communicate on various levels with mechanical, hydraulic, pneumatic, electronic or IT systems. They greatly influence the properties of safety, security, reliability and availability and are a crucial competitive factor for the automotive, pharmaceutical, utilities, manufacturing and material handling industries.

Applications

Industrial Engineering: Enabling humans and robots to interact in increasingly more flexible manufacturing processes will necessitate assuring that individuals cannot be injured. Apart from safe and secure robot control systems, a technology is needed that reliably captures individuals and their movements in a robot’s work space. This might require a complex multisensory system consisting of laser scanners, ultrasonic sensors, tactile sensors, thermal and PMD cameras. The individual sensor systems are embedded systems intended to communicate according to defined timing and identify unclear situations. Virtual technologies will represent a particular situation so that it is intuitively comprehensible and identify potential hazards.

Material Handling Systems and Logistics: Operations and communication in international logistics are largely virtualized and automated.
All available process data, e.g. transport management, will have to be provided on mobile objects and in control centers to monitor autonomous logistics processes.

Medical Engineering: Virtual technologies are being developed for effective training systems for surgeons and for future intelligent surgical instruments to assure the quality of minimally invasive surgery. These technologies simulate a realistically experienced surgical procedure. The intention is to visualize any plane of preoperative slice images (CT, MRT) as a function of a user’s gaze and position and to superimpose them onto the real scene by using suitable displays.

Power Engineering: New virtual technologies will enable operators of electric power systems and energy conversion plants to visualize information to fully monitor their plants, promptly detect faults and initiate necessary maintenance measures if necessary.

Automotive engineering: Methods and systems at the interface between mechatronics, software engineering and virtual technologies will be developed to address complex safety issues that ensue from the widespread use of embedded controllers in the automotive industry. System safety, security and reliability shall not only be evaluated but also incorporated in the design process at an early stage.

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Turning Ideas into Products Faster

VIDET Innovation Cluster Is Boosting the Innovative Capability of Saxony-Anhalt’s Small and Medium-sized Enterprises with Virtual Technologies

Dr. Reiner Haseloff, Saxony-Anhalt Minister of Economics and Labor and Innovation Commissioner
Prof. Michael Schenk, Director of the Fraunhofer IFF
The use of virtual technologies has become a decisive factor for the development and manufacturing of innovative products. They help save important resources and simultaneously establish the basis for more intelligent innovations. Thus, they themselves have become important resources in international competition. A project supported by the Fraunhofer-Gesellschaft and the state of Saxony-Anhalt to develop a regional innovation cluster, VIDET is intended to facilitate regional small and medium-sized large machinery and plant manufacturing enterprises' access to innovative research services that employ virtual technologies. They shall profit from research organizations' developments and thus boost their own competitiveness.

Saxony-Anhalt’s economy is developing excellently. Our region is well on its way to emerging from the most radical structural transformation in recent history behind it. After the regional economic structures collapsed in the early 1990s, it took some time before visions evolved, ideas could be translated into action, new industries could establish themselves and old ones could recover. Apart from such future technologies as biotechnology and renewable energy recovery technologies, primarily traditional branches of industry in the region have profited from this development. Machinery and automotive manufacturing, the processing industry, the chemical industry and chemical plant manufacturing now account for every third job.

That is extremely good news. Yet in times of globalization, resting on our laurels would be the wrong strategy. The conditions change too quickly. Serious competitors spring up elsewhere. Technological advances force obsolescence. It is never too late to unfurl a few more sails to catch the fresh wind. This is the only way to set a sustained course.

Not least, such sails include novel, innovative methods of industrial development and manufacturing. Their core function is to help respond to fast-paced global markets. Most enterprises are being compelled to provide ever better and even newer products faster and faster. Hence product life cycles are growing shorter everywhere. Manufacturers must routinely present new innovations and the competition is constantly striving to gain the upper hand. This means costs have to be reduced, time saved and processes optimized.

A new achievement will particularly be able to help meet these twenty-first century challenges: Virtual technologies. They have already entered routine industrial manufacturing processes. Initially and primarily utilized for virtual prototyping in carmakers’ development units, their potential uses now extend throughout the entire product life cycle in industrial enterprises.

Virtual technologies can now not only three-dimensionally represent products in detail but also entire manufacturing processes, simulate plant functions and plan complete factories in no time. New products and machinery are produced in virtual reality where they can be disassembled, tested and improved even before they have actually been constructed at all. They support the optimization of plant control systems before plant construction is finished, better organization of scheduling and operations and more extensive and faster training of employees. These are important advantages in international competition wherever resources have to be conserved and time, money and energy saved to be able develop and launch one’s products on the market even faster.
However, keeping up with the times requires enterprises appreciable investments from time to time. Expenditures are particularly high in the machinery and plant manufacturing industry where extremely expensive and complex products are normally developed. Yet, this is precisely where the use of virtual technologies particularly pays off. When complex individual plants or small lots are produced, i.e. high value capital goods, any design failure is painfully reflected in the budget. Digital engineering makes it possible to largely avoid such errors from the start while simultaneously enhancing quality and dependability.

However, hardly any of the small and medium-sized enterprises that make up the major part of the business scene in Saxony-Anhalt are able to cover such expenditures on their own. To this end, the state initiated the project Virtual Development, Engineering and Training VIDET together with the Fraunhofer-Gesellschaft. VIDET is a research and innovation cluster that concertedly provides regional SME support to implement and utilize virtual technologies, particularly emphasizing large machinery and plant manufacturing. The project has been established at the Fraunhofer IFF and is part of the Pact for Research and Innovation – one of the Bund-Länder Commission for Educational Planning and Research Promotion’s support programs.

Regional enterprises are cooperating closely with such research organizations as the Fraunhofer IFF and Magdeburg’s Max Planck Institute as well as Otto von Guericke University in VIDET to implement their objectives. Everyone involved is working jointly on applied solutions to implement virtual technologies in industry in order to make advanced technologies accessible to local enterprises for their own production and product development. Moreover, the interdisciplinary approaches expand the services offered to firms to train their own R&D staff to work with virtual technologies. The cooperation with enterprises from the key industries and R&D organizations is being specifically supported with public funds.

On the one hand, this is intended to overcome any potential barriers to contact between the two and, on the other, guided by the motto “strengthening strengths”, regional fields of technology are being supported with the goal of delivering results that are transferrable to practice and of utility for local businesses.

Thus, VIDET is intended to generate more important impulses for enterprises from Saxony-Anhalt to survive global competition. Focusing on the machinery and plant engineering and producing industries, it will help enable enterprises to decisively step up their product development by giving them recourse to high-tech tools. This will accelerate the process from an idea to a finished product and facilitate the creation of more innovations. The enterprises’ enhanced performance will ultimately benefit the entire state. Only well-positioned enterprises equal to the international competition will be able to sustain Saxony-Anhalt’s positive economic development in the future too. Thus, the economic significance of such key industries for the region will also be incorporated in the drafting of structural support measures.
other hand, to encourage the formation of networks sustainable beyond joint projects.

Thematically, the specialization in automotive research is closely connected to VIDET. The Fraunhofer IFF and Otto von Guericke University are jointly researching new developments for the automotive industry and its suppliers. The research organizations involved see themselves as providers of input for regional business. The connections established will transfer the basic research findings acquired in the projects to enterprises where they will be implemented in applied solutions. The VIDET project is initially planned through 2010. The success of other already completed projects has made the rounds. Our project is convincing more and more customers. It is a success story in which both partners, business and research, are profiting from one another.

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Weld at Heart

Virtual Controllers for Electron Beam Welding Robots

Prof. Ulrich Schmucker,
Torsten Böhme
Electron beam welding really gets the job done. While it can join metal materials faster and deeper than most other welding methods, controlling the welding robot under the working conditions is a great challenge.

In the Fraunhofer VIDET Innovation Cluster, the Fraunhofer IFF developed new methods for improved and highly efficient robot control for pro-beam, the European technology leader in civilian electron beam welding.

**Great Effort – Great Effect**

Electron beam welding is a particularly demanding and extremely effective process. High voltage electrons are accelerated in a high vacuum and combined by a triode system to be applied to material at short distance. Upon impact, the majority of electrons' kinetic energy is transformed into heat. Since air molecules would decelerate the electrons, welding is done in a vacuum.

The great time and effort required is justified. Its efficiency of approximately 70 percent makes electron beam welding one of the most effective and precise methods to permanently join metal materials. It can fuse metals that would normally hardly bond with one another. Not even refractory metals can resist an electron beam's energy density. Thus, even mixed bonds, e.g. steel and bronze, can be produced.

**Welds Up to 100 mm Deep**

The high welding speeds possible and the capability to produce particularly deep and extremely exact welds is particularly important. Depending on the material, welds can be 0.3 to 100 millimeters deep. In addition, since welds have such narrow widths, material rarely warps despite the high thermal energy. Not least, this benefits the welding of particularly small welds. In addition, electrical fields can be employed to deflect the electron beam, thus making it possible to produce very complex bonds.

All this makes electron beam welding one of the key technologies of the future and particularly interesting for the production of automotive and aerospace components. Other branches of industry such as plant manufacturing are also joining in.

**Complicated Welding Robot Controllers**

Welding in large vacuum chambers has one crucial disadvantage. The entire procedure can only be controlled externally, making it extremely complicated. Cameras and welding robots replace a welder’s eyes and hands. The electron beam is directed along the metal on preprogrammed paths to ensure work is nonetheless precise. However, exactly calculating the entire procedure in advance and then controlling it proves to be extremely difficult. Unforeseen problems crop up again and again, starting with complications induced by design, which planning can only inadequately factor in, up through obstacles the automatic welding system itself places in the robot's path and on which it can get hung up.

Until now, experts had no choice but to program iteratively. Bit by bit, error by error, they worked toward optimal programming for the robot until it ultimately welded a component perfectly. While the procedure yields the desired result, it is extremely time consuming and additionally consumes inordinately many resources.

**The Search for Alternatives**

The European technology leader in the field of civilian electron beam welding, pro-beam AG & Co. KGaA in Burg in Saxony-Anhalt also struggled with this problem. The company specializes in the development, construction and sale of vacuum chambers for electron beam welding and is also a quality contract manufacturer for the large and special plant manufacturing industry. Dissatisfied with present methods and in search of possibilities to improve on them, the company turned to the Fraunhofer IFF in Magdeburg and its specialists to develop virtual system controls.
Virtual Programming and Control
To solve the problem, specialists from the Fraunhofer IFF proposed programming the robot virtually in the future. To this end, they virtualized the entire system and thus made the robot’s work environment and travel precisely calculable. Combined with the like-wise virtualized digital design data of the components to be welded, it is now possible to exactly simulate the robot’s movement in advance. The robot’s programming is now entered into the simulation environment. Incorporating distinctive features of a design and fully independent of the materials, spatial conditions or other influencing factors, the system control engineer can virtually observe the machinery’s performance in the welding chamber based on the programming. Erroneous welding commands, adverse features of robot design or the robot’s suspension, etc. are now revealed at a glance. They can be counteracted without causing any damage by appropriately modifying the programming. Virtual optimization of travel allows flawlessly executing a weld for certain component configurations in one operation.

As part of the VIDET project they fund, the Fraunhofer-Gesellschaft and the state, in association with other research organizations in the state, are actively supporting regional small and medium-sized enterprises’ developments. The goal of the VIDET (Virtual Development, Engineering and Training) Innovation Cluster is to facilitate regional large equipment and plant manufacturing companies’ implementation and use of virtual technologies. This is intended to boost their international competitiveness and help sustainably strengthen their market position.
Exceeded Expectations
This alone is a considerable advance. However, the Fraunhofer specialist’s method is so effective that it not only ultimately eliminated the previous method of iterative work but also so increased system effectiveness that parts previously only producible with great difficulty can now be welded effortlessly. Even extremely small or large complex parts with complicated weld geometries such as turbines can now be manufactured. The results have even exceeded the expectations for the new method of virtual control. Thus, the substantial savings in time and resources and the expansion of the range of products will quickly redeem the higher costs incurred by the development and implementation of the method.

This does not conclude further development of the process. Fraunhofer IFF experts in virtual plant simulation have additionally developed a tool that can be used to virtually engineer the welds themselves. It finally combines robot kinematics data and the CAD data of the component being machined. This again shortens prep time for welding and boosts productivity even more.

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5th Guest Lecture Series
Virtual Reality: Human and Machine in Interactive Dialog

October 22, 2008  Virtual Firefighting: Technical Basics and Market Analysis for a Serious Game, Dr. Uwe von Lukas, Computer Graphics Center, Rostock


November 5, 2008  PLM Based Digital Mockup, Dr. Bernd Reckmann, Siemens Product Life Cycle Management Software GmbH, Cologne

November 12, 2008  Virtual Engineering in Robot-based Logistics, Dr. Albrecht Hoene, KUKA Roboter GmbH, Augsburg

November 19, 2008  VR Technologies in Engineering and Qualification: Motive and Prospects for Cooperation with Applied Research, Jürgen Reiner, STAEDTLER Mars GmbH & Co. KG, Nürnberg; Alexander Kroys, Fraunhofer IFF, Magdeburg

November 26, 2008  Interactive 3-D Visualization for Operations Planning: From Research to the Produkt, Prof. Bernhard Preim, Otto von Guericke University Magdeburg
Earlier, the testing and optimization of a plant that began once it had been constructed was frequently based on the principle of trial and error. Damage could never be ruled out and had to be accepted. Today, that’s a thing of the past. In the TECVICOM project, the Fraunhofer IFF developed virtual functional plant models that already allow optimization and control system development parallel to construction. That saves time and resources and additionally guarantees maximum plant reliability right from the start.
At first glance, Holzindustrie Templin GmbH is a medium-sized company like any other in the industry. It concentrates on business with the natural resource timber and structural elements made of it. Down-to-earth, located in central Uckermark between Berlin and Neubrandenburg, the company does not immediately make the impression of being a consignee and user of high-tech from Magdeburg’s Fraunhofer Institute for Factory Operation and Automation IFF. Appearances are deceiving though. Apart from selling timber and wooden structural elements, timber treatment is also part of the company’s core business. The company uses complex plants for this. They dry the wood and make it more resistant to attacks from fungi and microorganisms. This has been done of late by a high temperature drying kiln in a still relatively unknown process with many advantages over conventional methods of wood treatment. It not only enhances timber visually, making color and grain appear particularly attractive, but also makes treatment with wood preservatives largely superfluous.

As in all branches of industrial manufacturing, cost pressure and the necessity to steadily boost production in plant operation are extremely high. Hence, the company was intent on already meeting the respective demands in this plant’s development phase. Factoring in all the cost factors, Templin staff decided to fully take advantage of every technological option available to produce the drying kiln in the least time possible and to organize its operation as efficiently and reliably as possible.

The TECVICOM Project
To this end, they turned to the Fraunhofer IFF in Magdeburg. The Technology Platform for Virtual Commissioning or TECVICOM project is developing new methods of improved plant engineering and operation. The researchers are particularly focusing on control system development. Among other things, the virtual engineering specialists are generating accurate simulations of operation, which are able to reproduce both plants’ engineering and the resultant functionality. This is the foundation for supporting the development process with optimization and modifying the engineering design for later use as specifically as possible. This will shorten construction and commissioning many times over and additionally validate it. Hence, the Fraunhofer IFF was contracted both to optimize the wood drying process in the plant in Templin and develop its control and protection systems.

Virtual Drying Kiln
The experts from the Fraunhofer IFF received digitized geometric structures of the engineering and its kinematic data to design a detailed computer simulation of the drying kiln. This model served as the basis to calculate the flow characteristics inside the drying chamber to have a basis to optimally modify the overall design. That was not enough though. Parallel to optimizing the plant design and its construction, the virtual model was also utilized to develop and test the control system and process monitoring. This made it possible to begin simulating the flow in the fully virtualized plant without having to wait for real components to be manufactured. Thus, a fully functioning, optimized plant including perfectly functioning control and process monitoring systems were delivered to the facility’s owner, the company, from the very beginning.

Four Advantages of Virtual Plant Engineering
This reveals the first of four key advantages virtually engineered plants generate, namely its use to support development. Without advanced virtual engineering technologies, it is impossible to adequately test control system development before complex plants are fully finished. Instead, parallel construction of such a plant in virtual reality makes it possible to test it and its functions before completion – without having to take any risks. Thus, every step and every phase of development and construction can be virtually tested and validated in advance before real implementation begins. A plant is not only optimally laid out but also much more reliable in terms of design errors and malfunctions.

Another advantage is the option of virtual conversion, for example, should new equipment or equipment with modified functions be integrated in the plant. The equipment can be tested virtually beforehand for optimal integration in concert with the overall
Finally a functional, virtual plant simulation enables project managers to comprehensively grasp the particular situation in the phases of construction. This also allows them to better assess the development situation and thus establishes an optimal starting point for other planning steps.

Modular Structure Enables Cross-Process Use

In their totality, such integrated simulation models are subject to the platform idea and basically pursue an interdisciplinary approach. Virtual models can be coupled with real machinery and freely combined regardless of application. Such flexibility makes the Fraunhofer IFF experts’ approach particularly user and customer friendly. The system can be implemented cross-process and customized to specific needs.

The client in Templin was highly satisfied with the work from Magdeburg’s Fraunhofer Institute. They were able to optimize the wood drying process as desired and already develop the control and process monitoring for the plant directly in the model during construction. Thus, it was commissioned significantly earlier than if it had been developed conventionally. As a consequence, valuable resources were conserved, significant time was saved, the standard of safety is higher and more value added was created.

Virtual Systems Control in the Life Science Sector

The developers at Magdeburg’s Fraunhofer IFF demonstrated the flexibility of their modular approach in another project too. Under the heading “lab automation”, a company in the life science sector contracted them to simplify the control system for an automated test system and make it accessible to non-experts.

Problems Controlling Complex Systems

The task encompassed a widespread problem, i.e. frequent lack of understanding of a system on the part of its actual users. Automated test systems that independently conduct programmed experiments and tests have been implemented in many scientific labs. Normally, such systems are very useful. However, they are just as difficult to operate as they are expensive. The desired effect of relieving lab technicians of work frequently never manifest itself. The system control frequently proves to be far too complex and often requires special knowledge of programming, something for which the well trained and specialized medical technical lab assi-
Comprehensible User Interfaces Thanks to Virtualization
The engineers produced a virtual user interface that reproduces the lab staff’s familiar work environment. It functions as a flexible translation interface between human staffers and the technical system. Medical technical lab assistants can use it to plan experiments just as in their real workplace with familiar instruments such as pipettes and incubators without getting slowed down by complex programming. The system automatically transmits commands to the equipment, which can then perform the experiments independently. Input experiments are not bound by a unique test setup. The virtual engineering specialists configured the system so that it can ultimately be implemented in very different system and lab configurations. Subsequent adjustments to the original planning are unnecessary.

This effective solution is a model of the flexible application virtual technologies even to develop control systems for equipment and technical operating systems.

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Keeping a Sharp Eye on Nature

Automatic 3-D Modeling of Barley Seeds
Prof. Udo Seiffert
To do so, researchers at Magdeburg’s Fraunhofer IFF are developing standardized four-dimensional virtual models of grains. They are intended to help better understand the processes inside such seeds and create new, pest resistant or higher yielding varieties.

A Quest Inside Plants

6.7 billion people now live on our planet. At present, an estimated 220,000 are added per day and a global population of over 8.3 billion people is expected by 2030. This development raises the question of how we will be able to feed such a large number of people in the future without ever more cultivated areas depleting our natural resources for good. The answers are complex. Efforts to make agriculture more efficient (e.g. precision agriculture) and thus produce higher-yielding crops as well as improve methods of cultivation are assuming a key role. Thus, further increases in the yields of cereal grains such as rice, wheat or barley have major importance for a future supply of sufficient food.

Exactly understanding the processes of plant growth and development in biology and agriculture will be instrumental in providing this. Climate change, adaptive agriculture, pest resistance and overcoming the consequences of monocultures are some of the catchphrases that describe the work of researchers from various disciplines interested in the mechanisms of growth and development that take place in the heart of plants. Above all, interest is particularly bestowed on seeds – the principal sources of nutrients and suppliers of energy.

However, many processes during plant growth have not yet been researched fully. When exactly, for instance, does starch accumulate and where and when exactly do the corresponding processes of development proceed? What environmental conditions influence these processes and how? Plants at large are also the object of interest. Growth height, pest resistance or climate resistance are important indicators for their use under different environmental conditions.

Famine, climate change, overpopulation – Famine, climate change, overpopulation – given this situation, precise understanding of processes of plant growth and development is playing an increasingly important role. Therefore, researchers all over the world are working to unlock these secrets of nature too.
Down to the Cellular Level

Merely conducting fields tests and perfunctorily recording the growth of plants have long since ceased to be enough. Therefore, researchers are approaching plants on the cellular and even molecular levels to unlock all their important secrets.

A large number of samples with each of their different growing conditions must be prepared and evaluated so that plants can be subjected to meaningful tests with verifiable results. In particular, the large quantity of complex measured data can no longer be satisfactorily evaluated with conventional, mostly manual methods. However, precisely these methods are particularly indispensable because they enable humans with their outstanding cognitive abilities to flexibly and adaptively apply their expert knowledge and creativity.

Virtual Models Improve Understanding

Therefore, the Biosystems Engineering Expert Group at Magdeburg’s Fraunhofer is working on new solutions that will make precise, scientifically quantitative research of the development processes in grain seeds possible in the future. The researchers are pursuing the goal of developing new engineering methods that objectively identify biologic structures automatically.

They are creating virtual models of a barley seed, which depict an average seed down to its cellular structure in every stage of development, as a representative example. Unlike the creation of virtual models of technical objects, there is no existing computer generated design data to fall back on. Rather, to achieve their goal the researchers must literally take pictures of nature itself. In the end, they obtain a clear, virtual picture of their subject.

Standardized Nature

Technically, this naturally necessitates more than mere observation of a barley seed’s development. Instead, several seeds must each be microtomed and analyzed for every individual stage of development. The evaluation of many thousand slices ultimately serves as the basis to calculate a statistic model that precisely maps the average genesis of a normal seed. The process of analysis itself is extraordinarily laborious. Up to twenty different tissue types are of interest to the researchers during a barley seed’s entire development process. In order to be able to ultimately specify them precisely, they must be identified in every preparation (by segmenting) beforehand.

To do so, every individual ultrathin seed section is placed separately under the microscope where it is are
photographed manually or automatically to reassemble the pictures taken as a correct image stack, the later standardized three-dimensional model (so-called registration). Since they are complex and time consuming work steps, registration and segmentation ought to be automated. The crucial boundary condition is the incorporation of appropriate expert knowledge from biologists about seed histology in the modeling.

Four-dimensional Images
This first produces an exact three-dimensional model of an individual seed so that several individuals can then be applied to further develop a standardized model. Later, this will become a four-dimensionally mapped (standardized) barley seed by adding the development sequence over time. Since any stage of development is observable at any time, random virtual sections can be created and conclusions drawn about the particular stage a seed is in at the moment. Anyone wanting to know where certain development processes occur on a seed during growth (from the blossom to approximately twenty-five days afterward) can now examine this vividly and clearly in the virtual simulation. This furnishes the researchers with a four-dimensional map of their research plant, which as a function of the empirical interest, can be extended with new data as desired. This comparative model provides the basis to conduct automatic, verifiable research on various topics all over the world.

Great Interest
Unsurprisingly, there are already a number of parties interested in the Fraunhofer researchers’ results. Foremost are plant research organizations such as the Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) in Gatersleben that has been cooperating with the Fraunhofer IFF in the field of plant biology for several years. Other potential users such as manufacturers of equipment that produces highly accurate three-dimensional biological preparations (laser microdissection) have also made their interest known. Their equipment relies on data from the Fraunhofer IFF, which is the basis for controllers for the cutting lasers that dissect exact samples of tissues of interest from grain seeds.

Complete four-dimensional grain seed visualization is only intended to be the beginning though. The know-how generated from the model grain seeds will be expanded in the future to automatic modeling of other biological objects and thus made accessible to a large community of users. When one considers the abundance of relevant crops, their different lines, the different constituents to research and the multitude of individual stages of development, it is quickly evident that a great deal of work awaits the researchers. Such work is not only demanding and complex but ultimately also very promising for everyone involved.

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networks, which he also made the topic for his Diplom thesis in 1993. His research later brought him to Scotland and Australia where he also completed his first book "on the side". The researcher is fascinated by foreign countries. The academic traveler manages to combine the pleasant and the utilitarian and thus devote himself to his other passion, photography. He earned his doctorate in 1999 with a dissertation on motion estimation with artificial neural networks.

Seiffert then worked at the Leibniz Institute of Plant Genetics and Crop Plant Research (IPK) in Gatersleben. In a joint project with the Fraunhofer IFF, Seiffert worked on interactive 3-D visualization in plant biology. He thus became familiar with the institute and is thrilled at the potentials of virtual technologies. He will begin working at the Virtual Development and Training Centre VDTC in August of 2008. Prof. Seiffert will head the new Biosystems Engineering Expert Group and research the further development of methods of machine learning and image analysis, data evaluation and pattern recognition in the context of biology.

Maintenance is a big issue in industry. Machinery runs around the clock in some plants and, logically, wear and malfunctions occur after a while. Dr. Frank Ryll is an expert in the field. "A maintenance technician has to know the best time to replace parts," he explains. He devoted his dissertation to the topic, which he successfully defended in June of 2008. Dr. Ryll’s study dealt with the collection of assured information on machinery to subsequently design an evaluation model for proactive maintenance. "Usually, you try to delay maintenance as long as possible to cut costs and keep production running. If maintenance is performed too late though, machinery breaks down and the line comes to a halt," says Dr. Ryll, providing a simple explanation to the secret of maintenance.

Before committing himself to maintenance heart and soul, the native of Brandenburg studied medicine. "Anatomy didn’t go so well," recalls Dr. Ryll with a wink. However, diagnosis, checkups and operations still have a hold on him – today, his patients are made of steel.

Metrology engineer Dirk Berndt has passed a milestone. In the summer of 2008, he successfully defended his dissertation before the examination committee. Dr. Dirk Berndt has a special knack in the micrometer range. Photo: Viktoria Kühne
International Honors for Director Schenk

The dearth of young professionals in the natural sciences is a huge problem, affecting the engineering sciences in particular. Prof. Michael Schenk is intensely committed to arousing young people’s interest in careers in technical vocations.

At the end of last year, Prof. Michael Schenk was recognized twice for his outstanding contribution. During the festivities marking the ninetieth anniversary of the Polytechnical University of Odessa, President Malakhov conferred an honorary doctorate on the logistics expert from Magdeburg for his achievements in research and teaching. Malakhov recognized Schenk’s particular involvement in the sustainable development of and cooperation with the Ukrainian school in the field of engineering sciences.

At home in Saxony-Anhalt, Prof. Schenk was also honored for his contribution. The setting was the Saxony-Anhalt Chamber of Engineers’ 1st Central German Engineers Forum. During the panel discussion, Schenk gave talks on “Engineers and Innovation” and “Education and Young Engineers” to more than 400 attendees. Afterward, President Jörg Herrmann presented Schenk with the Saxony-Anhalt Chamber of Engineers’ Badge of Honor. As Director of the Fraunhofer IFF, State Representative of the Saxony-Anhalt Chapter of the VDI and a member of the chamber, Prof. Schenk has been particularly active on behalf of the engineering profession and the interests of the members of the chamber,” praised Herrmann.

The award underscores the recognition Schenk has earned at home and abroad for promoting the engineering sciences.

"Listening is sometimes better than measuring," knows maintenance expert Dr. Frank Ryll. Photo: Dirk Mahler.

The Manager of the Measurement and Testing Technology Business Unit, Dr. Dirk Berndt is an extremely busy man at the Fraunhofer IFF. Therefore, he was usually only able to put time into his dissertation on "Optical 3-D Measurement in Industrial Applications" on weekends or vacations. An expert in the field, he has completed joint projects at the Fraunhofer IFF with such well known partners as Airbus, VW, Siemens and BBS.

Dr. Berndt knows the institute like the back of his hand. After all, he has been there since its founding in 1992. Upon graduating with a degree in equipment engineering shortly after the Wende, he returned from Ilmenau in Thuringia to his hometown of Magdeburg.

Professionally, the metrology engineer has to be a perfectionist. Naturally, this affects his private life too. Size is relative. The different perceptions of scale became clear when he remodeled his home: “My father-in-law works as a civil engineer. For him, a centimeter is the smallest unit of measurement. As a metrology engineer, that is far too inexact for me since I’m used to working in the micrometer range.”
Sharp Minds

VDI Welcomes Schenk as New Executive Board Member

Prof. Michael Schenk, Director of the Fraunhofer IFF and State Representative of the VDI in Saxony-Anhalt has joined the VDI Executive Board for three years and assumed the chairmanship of the Regional Chapter Advisory Board. The new member of the VDI Executive Board was elected unanimously at the Board meeting in October 2008. Schenk replaces Prof. Rainer Hirschberg in the new year.

2008 Science Award for Logistics Goes to Moritz Gomm

Berlin. Dr. Moritz Gomm from the Technical University Darmstadt received the Science Award for Logistics at the 25th German Logistics Congress in Berlin.

The BVL has been supporting young professionals since 1992 by conferring an annual research award, called the Science Award for Logistics since 2007. Eligible candidates are researchers from any domain of logistics who have authored a dissertation or Habilitation dissertation, project study or monograph. Work is judged according to its practicability and its innovative character.

The First Professor of Wind Power Nationwide

Otto von Guericke University Magdeburg is strengthening its research specialization in renewable energy systems. Germany’s first professor of wind power was appointed in September. At the International CRIS Workshop on Distributed and Renewable Power Generation, University President Klaus Erich Pollmann presented Dr. Antje G. Orths her document of appointment as an Honorary Professor of Renewable Energies and Wind Power. Antje Orths is one of the leading researchers in the field of wind power systems. She currently works as a Senior Researcher at the Danish utility company Energienet.dk where she is responsible for planning future power systems. Prior to that, she headed the Critical Infrastructures Group at the Fraunhofer IFF.
Schulze is convinced that "Most of the regional machinery and plant manufacturing companies are excellently positioned. Many have potential to move up a level. The Fraunhofer IFF is able to provide enterprises valuable assistance when they want to upgrade products and produce innovations."

The native of Magdeburg attended the university in Leipzig where he majored in technical cybernetics and automation. He completed his Diplom degree in Magdeburg. He worked as an IT specialist for databases and networks. The topic of network implementation in machinery and plant manufacturing led to collaboration with the founder of the Fraunhofer IFF, Prof. Eberhard Gottschalk. This connection sustained his contact to the institute for years. In the summer of 2008, Prof. Schenk was able to recruit the IT specialist to manage the central office of the VIDET Innovation Cluster. The cluster’s goal is to make virtual technologies accessible to small and medium-sized machinery and plant manufacturing companies in Saxony-Anhalt.

Interested companies may contact Thomas Schulze anytime (Tel. 0391 4090-820, thomas.schulze@iff.fraunhofer.de )

University President Klaus Erich Pollmann receives wind power expert Dr. Antje Orths in the circle of professors at the university.

Photo: Oliver Heyer

Celebrity cook Ralf Zacherl spoiled the guests at the evening event of the 25th German Logistics Congress with culinary delicacies. The TV chef sent IFFocus readers personal greetings with his autograph: "Cooking is like love — simply boundless."

Photo: Anna-Kristina Wassilew
The Virtual Development and Training Centre VDTC in Magdeburg’s Port of Science. The experts at the Fraunhofer IFF specialize in applying virtual and digital engineering to plan, test and operate technical systems. Interdisciplinarily collaborating specialists, including computer scientists, mechanical engineers and educational scientists, develop customized solutions on the basis of virtual and augmented reality such as virtual-interactive training for specialized staff. The remarkable technical facilities make interactive visualizations possible, for instance, on a large 360 degree laser projection system.
Virtual reality furnishes the plant manufacturing industry many opportunities and tremendous potential for savings. Plant engineers at BASF primarily use the virtual model of a chemical plant in the design and construction phase. Before a plant is built, the engineers and future operator can discuss designs together and, later, even test functions. Pictured here is a visualization in the Elbe Dom, the large circular laser projection system at the VDTC in Magdeburg.
The process and plant engineering lab at the Fraunhofer IFF where, for instance, the effective and environmentally compatible use of renewable raw materials to generate power is being researched in the research project ProBio.
The researchers at the Fraunhofer IFF are experts in robotics – whether for facade cleaning, inspecting sewer lines or assisting humans. Their newest helper is RIWEA, a robot that inspects the rotor blades of wind energy converters.

The materials of wind energy converters must withstand intense forces. The robot inspects converters’ rotor blades for damage more meticulously than humans could. The intelligent inspector ascends wind energy converters to do its job.
Meet up with us:

January 28 - 29, 2009
2nd Annual Condition Monitoring Forum 2009
Düsseldorf

January 28 - 29, 2009
Shutdowns & Turnarounds Erfolgreiche Anlagenbestellungen & Revisionen
Potsdam

February 2009
WSCG 09
Plzen, Czech Republic

February 16 - 20, 2009
Similarity-based Learning of Structures
Schloss Dagstuhl

February 24 - 27, 2009
intec 2009
Leipzig

February 26 - 27, 2009
14th Magdeburg Logistics Conference “Sustainable Logistics”
Magdeburg

March 2009
5th High-End Visualization Workshop
Louisiana, USA

March 3 - 5, 2009
LogiMat 2009
Stuttgart

March 3 - 8, 2009
CEBIT
Hannover

March 17, 2009
Wood Logistics Workshop 2009
Hundisburg

March 25 - 26, 2009
Cergal 2009
Oberpfaffenhofen

March 30 - April 3, 2009
Wasser Berlin International Trade Fair and Congress
Berlin

April 1 - 2, 2009
Holz Innovativ
Rosenheim

April 3 - 4, 2009
Arbeiten-Lernen-Kompetenzen entwickeln
Berlin

April 7 - June 9, 2009
Logistics Guest Lecture Series
Magdeburg

April 20 - 24, 2009
Hannover Messe
“Digital Factory”
Hannover

April 22 - 24, 2009
17th European Symposium on Artificial Neural Networks
Bruges, Belgium

May 5 - 8, 2009
Control: The International Trade Fair for Quality Assurance
Stuttgart

May 6 - 7, 2009
2009 Vocational Education Days
Magdeburg

May 12 - 15, 2009
transport logistic 2009: 12th International Exhibition for Logistics, Telematics and Transport
Munich

May 18 - 22, 2009
LIGNA 2009: World Fair for the Forestry and Wood Industries
Hannover

June 13, 2009
Long Night of Science
Magdeburg

June 24 - 25, 2009
30th VDI/VDEh Maintenance Forum
Leipzig

September 8 - 10, 2009
Federal Armed Forces’ Distance Training Convention
Hamburg

October 2009
Image Processing Technology Day
Kaiserslautern

October 28 - December 2, 2009
VR Guest Lecture Series: Interactive Human and Machine
Magdeburg

October 13 - 15, 2009
MAINTAIN: The Leading Trade Fair for Industrial Maintenance
Munich

November 3 - 5, 2009
VISION: International Trade Fair for Machine Vision and Identification Technologies
Stuttgart

November 5, 2009
12th “Cooperation in Plant Engineering” Industry Working Group
Leverkusen

June 16 - 18, 2009
12th IFF Science Days
Magdeburg

Digital Engineering and Virtual Technologies for Engineering, Testing and Operating Technical Systems

Logistics: Efficient and Secure Chains of Goods

Technologies for Safe Human-Robot Interaction

Workshop on Pattern Recognition, Data Analysis and Modeling in Biomedical Applications

“Cooperation in Plant Engineering” Industry Working Group