IFF

Fraunhofer
Institut
Fabrikbetrieb
und -automatisierung

Achievements and Results
2006 Annual Report

logmotion lab
RFID system for metallic environments

Achievements and Results
2006 Annual Report

Contents

Foreword

Dear Readers,

The Fraunhofer IFF's biggest outwardly visible success in 2006 was the ceremonial opening our Virtual Development and Training Centre VDTC. We are proud of already being able to move into a second new building in our short, dynamic history. With our main building on Sandtorstrasse and the Virtual Development and Training Centre VDTC on Joseph-von-Fraunhofer-Strasse, we now have two outstandingly equipped, state-of the-art institute facilities. At the same time, it demonstrates that we have adopted a successful and promising direction with the substantive orientation of our institute. Since our beginnings in 1992, we have been pursuing the goal of planning and operating factories and production systems more efficiently. To do this, we bundle research and development services from different disciplines in our institute.

The new VDTC building in Magdeburg's Port of Science marks a milestone in the history of our research. It symbolizes our efforts since the founding of our institute to continually improve and refine simulation and visualization methods and tools. With its worldwide one-of-a-kind laser projection in the Elbe Dom - combined with our research partnership with Jenoptik AG - the VDTC is a technological highlight. The VDTC houses state-of-the-art labs for research in the field of virtual technologies we have been advancing for years, especially the use of virtual environments for qualification and competence development and for virtual engineering.

This enables us to research both further advances in virtual technologies and foundations and applications of virtual engineering and virtual-interactive training. We are working on having virtual models available throughout the entire life cycle and efficiently employing them in every stage.

To achieve these goals, we have established the VDTC as an international network node for virtual technologies. Our management of the ViVERA Network of Competence for Virtual and Augmented Reality bundles the competencies of twelve research institutes and universities here in Magdeburg. We pool previous research findings and experiences and expedite the transfer of this future technology to companies. What is more, we have also been a member of the international INTUITION Network of Excellence since 2006. On a European level, INTUITION is likewise pursuing the goal of systematizing the manifold and fragmented VR technologies in order to obtain an overview of the current state of development and practice, to promote its integration of all VR activities and to thus create synergies.

With our research on so-called interoperable distributed systems, we in Magdeburg are picking up a trend that will grow in importance in the future. As the globalization of economic systems increases, simultaneous work on and development of new products or systems geographically distributed over the entire globe are also heavily mounting. The long-term vision here is, for instance, that several members of a development team distributed over several continents meet in virtual space.

Thus, they can jointly develop new products and simulate processes, every interaction being available to all the partners involved in real time. With its approval of the project to establish a "Center of Innovation Competence" (ZIK INCENTIVE) in this field, the BMBF is supporting research work on interoperable distributed systems, which has been being advanced in Magdeburg for years with great success. In addition, the approval of the run-up project VIDET, has enabled us at the Fraunhofer IFF to establish the Fraunhofer Innovation Cluster "Virtual Development and Training" here in Magdeburg.

Power systems process simulation and plant engineering labs are also located in the VDTC. In cooperation with the Max Planck Institute for Dynamics of Complex Technical Systems in Magdeburg and the Fraunhofer IKTS in Dresden, we at the Fraunhofer IFF are researching the utilization of biomass to run fuel cells. In the research project "ProBio" researchers from Magdeburg and Dresden are exploring how renewable raw materials can be used to generate power effectively and environmentally compatibly

With our move into the VDTC on Joseph-von-Fraunhofer-Strasse, we are creating space badly needed in our institute building on Sandtorstrasse. We are predominantly using the freed up floor space in our testing facility for projects in the fields of logistics, robotic systems and measurement and testing technology. With the LogMotionLab, our development, testing and certification lab for Auto-ID and telematic technologies, we already have one of Europe's best equipped RFID labs at the Fraunhofer IFF. We will use the capacities being freed up in our testing facility to expand this lab further.

We develop groundbreaking logistics concepts and solutions by combining intelligent carriers and the enhanced potentials and services being generated by the Galileo satellite navigation system. Challenges we will be facing in the logistics sector in the future are continuously increasing global flows of goods as customer demands mount with regard to in delivery time and punctuality. At the Fraunhofer IFF, we research solutions that, on the one hand, make such global chains of goods more reliable and more secure by applying I&C technologies in logistics and, on the other hand, contribute to organizing logistics to reduce traffic and thus conserve resources and the environment.

In the project LISA supported by the BMBF, our researchers are working on developing, constructing and testing a mobile assistant robot suitable for everyday routines, which will interact with the lab technicians in labs of life science companies. Along with their research projects funded by the BMBF and the BMWi, one of the Robotic Systems Business Unit's major projects is the cleaning and inspection systems for the Emscher sewer system. With a total length of 51 km and depths of up to 40 m beneath the surface, the Emscher sewer system represents the largest residential water management project in Europe. With this development of automated cleaning and inspection systems, the Fraunhofer IFF is developing an entirely new and revolutionary technology for the inspection of continuously operating sewer systems. The Fraunhofer IFF is the Emschergenossenschaft's general contractor and, with this contract, is carrying out one of the largest industry projects in the Fraunhofer-Gesellschaft.

In the field of measurement and testing technology, the Fraunhofer IFF received the Deutsche Bahn's accreditation for an optical measurement system for train wheelsets in 2006. The measuring machine is the first contactless optical 3-D measuring system that meets the Deutsche Bahn's strict standards. Inquiries about cooperation have already been received from train maintenance units in several countries including China, Russia and South Africa.

I invite you to learn on the next pages how we have jointly developed innovative products and services with enterprises and I hope that you take away stimulating ideas for yourself and your projects. We are glad to be there for you to further develop your ideas and turn them into reality together with you.

In closing, I would like to express special thanks to our partners and clients who place their trust in us and our staff who make these services possible in the first place.

Prof. Michael Schenk

Off to New Shores: The Institute's Expansion in the Port of Science

Prof. Michael Schenk
Dr. Gerhard Müller
Dr. Eberhard Blümel

The Fraunhofer IFF Virtual Development and Training Centre VDTC in Magdeburg's Port of Science was ceremoniously opened in November of 2006. After over ten years of successful applied research in the field of virtual engineering, a vision had become reality: Users, service providers and researchers are collaborating in a building with state-of-the-art virtual-reality technologies and infrastructure to develop innovative solutions for the real world, to test them and transfer them to use.

Technological Infrastructure

The VDTC has a worldwide one-of-a-kind 360 degree laser projection system (the Elbe Dom) with six projectors that project onto a cylindrical surface with a height of 6.5 meters and an inner diameter of 16 meters. Users have space to move on a 70 centimeter high platform with an area of 48 square meters. The rounded off bottom of the projection wall increases a presentation's level of immersion. All this makes it possible to present large objects such as airplanes, factories or logistics systems on a scale of 1:1. At their maximum resolution of 1.600 x 1.200 pixels (UXGA), the laser projectors from Jenoptik achieve a refresh rate of 60 hertz. The color spectrum generated by the lasers, which covers two thirds of human color vision, sets new quality standards compared to conventional projectors that only cover one third of human color vision. It additionally has excellent color contrast, which makes autostereoscopic effects possible in visualization, and a very high depth of focus, which generates sharp images regardless of a projector's distance from the projection surface.

Virtual reality image data is computed by a cluster of six PC and transmitted to the projection system. Users interact through a high-performance tracking system
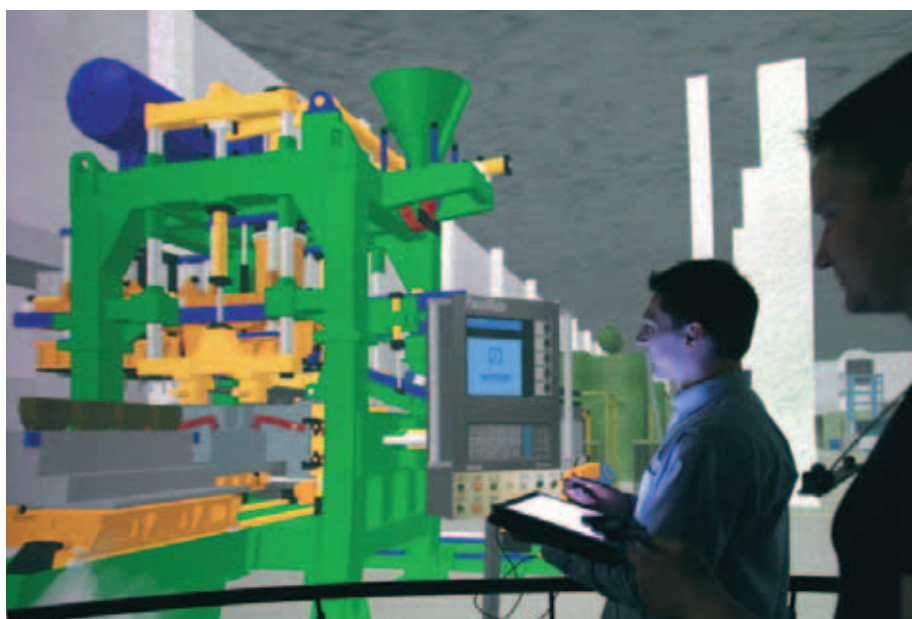

Figure 1: Laser projection of Rautenbach AG Wernigerode's foundry in the Elbe Dom.

consisting of twelve high resolution cameras that, at a frame rate of 484 hertz, achieve a resolution of 1.3 megapixels. Thus an object's location and orientation in the motion space can be determined with an accuracy of 1 millimeter. Up to 500 marking points are used to support whole body motion capturing of several individuals.

The Elbe Dom commenced operation in October 2006 after a cooperation agreement between Jenoptik AG and the Fraunhofer IFF had been signed.

Fields of Work

The Joint Engineering Lab provides a platform for applied research on integrated product and process engineering. It features a range of training programs for students, industry partners and employees in virtual product development. The Joint Engineering Lab's services - from CAD data migration through the formulation of complete concepts for product life cycle management (PLM) - are geared toward the needs of SME.

In the Computational Mechanics Lab CML, products and their components, including both their shapes reproduced by 3-D models and their performance or function, can be made available during their development and utilized for a multitude of mechanical, mechatronic and fluid mechanical tasks. In the transition to real prototypes, interconnecting already really existing components and virtual models (hardware-in-the-loop) enable virtually supporting development up through the finished product.

A mixed reality testing facility measuring 210 square meters is on hand to do this. Real and mixed reality systems can be installed there as demonstrators or experimental setups. Real machine tool control systems and operator controls that have been coupled with virtual prototypes make safe function tests possible.

A hexapod motion base for visual interactive motion simulations are being used to develop a simulator to support ergonomic tests or driver training. Test environments for the realistic use of augmented reality systems support the development and evaluation of vision systems and tracking systems.

The development of thermal plant systems is being researched in the labs of the Process and Plant engineering Business Unit PAT. Key emphases are the recovery of energy from biomass, biogenic residues and high caloric waste fractions. Two new development labs based on virtual engineering supplement experimental operation of already existing experimental plants for combustion and gasification processes. New process system components and control concepts are being developed, engineering work completed and innovative product service offerings devised at the VDTC.

For thermal plant engineering, research work on the optimization of plant components with CFD process simulation directly coupled with 3-D-CAD tools constitute the starting point for new, complex plant maintenance operations. Experimental lab tests are used in parallel, to collect the base of process engineering data for novel active principles of

instrument engineering. This thusly obtained foundation for modeling and innovative measurement sensors are used to apply model-guided control concepts.

The new infrastructure at the VDTC is supporting research in the fields of plant engineering, process engineering, electrical power systems and plant service.

Range of Services

Our range of VR based services is geared toward client processes and not only covers the development of virtual engineering solutions but also their implementation and user support. The VDTC held its first "Virtual Engineering" day for medium-sized enterprises on December 6, 2006. The specializations of virtual product engineering, virtual product engineering/digital factory and qualification and training were presented to the seventy attendees. Measures for implementing and introducing VR technologies in SME were discussed together with the attendees from the medium-sized enterprises.

The VDTC works in an international network of universities, research organizations and commercial enterprises. In Magdeburg, the VDTC cooperates with Otto von Guericke University, the Max Planck Institute for Dynamics of Complex Technical Systems and the Leibniz Institute for Neurobiology.

The VDTC is the ViVERA Network of Competence for Virtual and Augmented Reality's development partner for networking basic technologies and their demonstrators. By taking advantage of the VDTC's infrastructure. the demonstrators support the dissemination of ViVERA's results to small and medium-sized enterprises. At the same time, new fields of application are being developed for VR technologies.

The VDTC is a central point in the European Network of Excellence INTUITION, which coordinates the activities of over sixty enterprises, universities and research organizations in the field of virtual reality. Thus, the VDTC is associated with the leading European VR centers.

The VDTC hosts ResearchTraining@VTDC as part of the Marie Curie training project. Over a period of four years, this project will provide twelve foreign guest researchers the opportunity to conduct applied research in the fields of virtual reality based training and virtual engineering.

The conditions on hand for its staf, its technological infrastructure and the manifold collaborative relationships have already made the VDTC an important node in the network international centers of VR/AR competence.

Figure 2: The Fraunhofer IFF Virtual Development and Training Centre VDTC in Magdeburg's Port of Science on the day of its ceremonial opening, November 22, 2006.

Greeting

Dear Ladies and Gentlemen,

An exciting and momentous year lies behind you and I am thrilled that Jenoptik had quite a hand in it. Your specialists and ours jointly designed a laser-based large projection system with a design that is unique worldwide and that you inaugurated at the Virtual Development and Training Center (VDTC) in Magdeburg in November of 2006 after eight months of intensive work between us. After further intensive talks and contacts, we continued this collaboration last year when we signed a cooperation agreement between our two organizations.

The heart of the system in the VDTC is our laser projection system that will support you in your applied research in the field of virtual development for the engineering, testing and operation of technical systems. You give our technology room for development and open brand new fields of application for it apart from its use in flight simulation and in planetaria. For that and for the confident collaboration in 2006, I would like to thank you on behalf over every member of the Jenoptik staff involved.

Simulation and the optimization of factories and operations building upon it are becoming ever more significant in the run-up to investing in large factory facilities. Costs for new production facilities are rising steadily. Investment volumes in the billions are no longer a rarity. A state-of-the-art chip factory illustrates this well: Nearly three fourths of the roughly two billion euros that a new chip factory roughly costs today are incurred for equipment and its intelligent networking for the production process.

Planning and thus realistic simulations of the highly complex production process matter all the more. Such simulations in the run-up to making an investment are plainly save your clients scarce time and valuable money. The reception the VDTC has experienced since its opening demonstrates this strikingly.

This center for virtual reality demonstrates that laser projection is superior to the representation of virtual scenarios with conventional technology. RGB lasers (red-green-blue) are the basis for projecting moving images in highest quality and on differently shaped projection surfaces. Brilliant colors with maximum saturation and projections with incomparably high depth of focus create spatial effects.

I am exceptionally pleased however that this new center is located in Magdeburg and thus in the eastern German states. You, we together are not only demonstrating the efficiency of Eastern German high-tech innovations with this. Investments in science and research and thus in high-tech are what strengthen and makes our economy sustainable. The Fraunhofer IFF is a prime example of the meshing of research and business. This is precisely where future opportunities grow, whence Germany draws economic power.

I wish you and our common challenge to develop ever newer fields of application and make ever more realistic representations possible much success in the coming years .

Your,

Alexander von Witzleben
Chairman of the Board JENOPTIK AG

Mission

The Fraunhofer Institute for Factory Operation and Automation IFF is an autonomous research institution in the Fraunhofer-Gesellschaft's network.

As a regional, national and international partner, the Fraunhofer IFF's mission is to make a contribution with its applied research work to the direct benefit of the economy and in the interest of society.

The institute is technologically oriented toward conceiving, engineering and producing innovative and customized solutions in the fields of

– Logistics and Material Handling Engineering and Systems,
– Robotic Systems and Measurement and Testing Technology,
– Process and Plant Engineering and
– Virtual Engineering and Virtual Training.

Work at the Fraunhofer IFF is market driven and global.

To meet the demand for holistic solutions, the Fraunhofer IFF is integrated in an international research network of partners from scientific and business communities.

In order to take advantage our own creativity and external impulses to guarantee an ongoing exchange of knowledge and experience, a network of associated academics and representatives of leading industries actively supports the work of the Fraunhofer IFF.

The Fraunhofer IFF actively represents interests on national and international bodies in specialized fields and thus fundamentally shapes the processes of innovation in the state of Saxony-Anhalt.

As a research service provider based in Saxony-Anhalt, one important concern is developing future generations both for regional business and for challenging positions in academia and research. Thus, the Fraunhofer IFF fulfills a valuable social responsibility.

Striking a balance between economy and ecology as well as implementing the rules of excellent scientific and technical practice are the basis for all our researchers' work and an individual responsibility.

Our researchers' combination of technical and technological expertise and soft skills typify the quality of our products and services.

Our researchers work in interdisciplinary teams and cooperate closely with our clients. Such collaboration is characterized by mutual trust, integration as partners, practical application and user orientation.

The Institute in Numbers

Mio Euro

Operating Budget
Total Revenue
Business Revenue

Employees at the Fraunhofer IFF
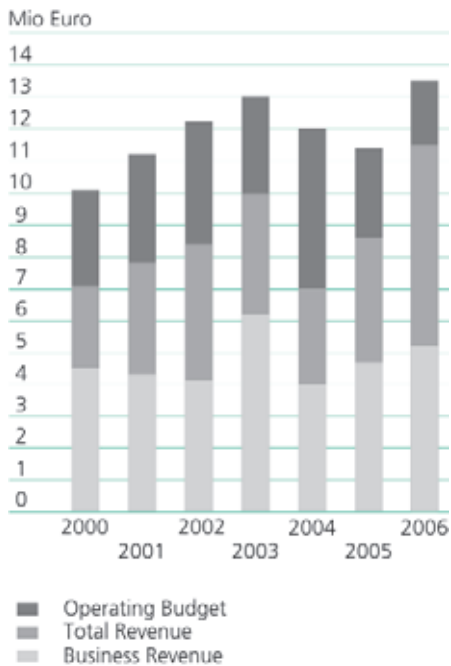
Operating Budget and Earnings Trend

In 2006, operating budget expenditures amounted to 13.5 million euros. Total revenues rose to 11.5 million euros. Business revenues totaled 5.2 million euros.

Investment Budget

Investments totaling 0.8 million euros were made in 2006.

Personnel Development

At the end of 2006, the Fraunhofer IFF had 125 employees. Our researchers are predominately engineers and industrial engineers. Degree holding computer scientists, mathematicians, physicists and business people ensure our work is interdisciplinary.
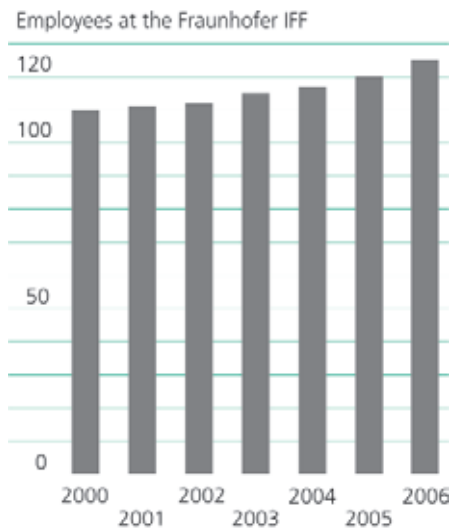
Training and Qualification

270 student assistants and interns support the institute's work.

In 2006, 22 Diplom theses were completed and given advising at the Fraunhofer IFF mostly in collaboration with Otto von Guericke University Magdeburg.

We offer internships for institutions of continuing education and high schools.

Facilities

In its main building on Sandtorstrasse, the Fraunhofer IFF in Magdeburg utilizes 5.000 m² for office space and high-tech EDP labs and conference rooms. A testing facility of 1.300 m² provides technologies – alternative energy production, industrial image processing, rapid prototyping, virtual reality, robotics – for research and development.

At the VDTC in the Port of Science, the Fraunhofer IFF additionally has 2.755 m² of floor space (including the testing facilities, labs and offices) for technologies of virtual and augmented reality as well as process and plant engineering.

Hardware and software at the Fraunhofer IFF encompasses tools and environments for the application of geographic information systems, for idea generation and evaluation, for information and communications management, for interactive factory and systems engineering, for multimedia communication and for software development.

Advisory Board

The individual Fraunhofer Institutes' advisory boards support institute management and the Fraunhofer-Gesellschaft's executive board in an advisory capacity. Members include prominent figures from academia, business and government.

Chairman of the Advisory Board
Prof. Burghard Scheel

Vice-Chairman of the Advisory Board
Prof. Uwe Dombrowski
Director, Institute for Production
Engineering and Corporate Research
(IFU), Technical University Braunschweig

Mr. Guido Brassart
Managing Director, Georg Maschinentechnik GmbH & Co. KG

Dr. Frank Büchner
Siemens AG

Mr. Peter Claussen
BMW AG

Ms. Susanne Clobes
Department of Production Systems and
Technologies, Federal Ministry of
Education and Research

Dr. Udo Häfke
Innovations- und Gründerzentrum
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Prof. Albert Jugel
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Prof. Klaus Erich Pollmann
Otto von Guericke University Magdeburg

Dr. Joachim Welz
Department of Science, Higher Education
and Research, Saxony-Anhalt Ministry of
Education and Culture

Prof. Peer Witten
Otto GmbH & Co. KG

Mr. Thomas Zernechel
Volkswagen AG

Project Reports:

Key Technology: Virtual and Augmented Reality

Fraunhofer Innovation Cluster VIDET:
Virtual Development, Engineering and Training for Regional Machinery and Plant Manufacturing

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The Fraunhofer-Gesellschaft encourages efficient cooperation in new product research, development and manufacturing by establishing innovation clusters. The fundamental idea is to regionally network research organizations, businesses and networks to advance the image and awareness of a sector of particular importance to the regional economy (i.e. "strengthen strengths"). Five clusters now exist. The establishment of another cluster is being prepared.

In coordination with regional industry, the Ministry of Economics and Labor and associations, the Fraunhofer IFF developed the concept for the innovation cluster "VIDET" to develop and utilize virtual engineering and virtual reality methods and tools for the regional machinery and plant manufacturing industry. Research on and the application of virtual tools to design, develop and operate machinery, products and plants, the expansion of already existing networks of industry and academic and nonacademic research organizations and work on concrete industrial pilot projects are intended to produce an effective platform with a long range impact, which enables regional enterprises to access VE and VR technologies for their products and services and consequently contributes to boosting and sustaining their competiveness.
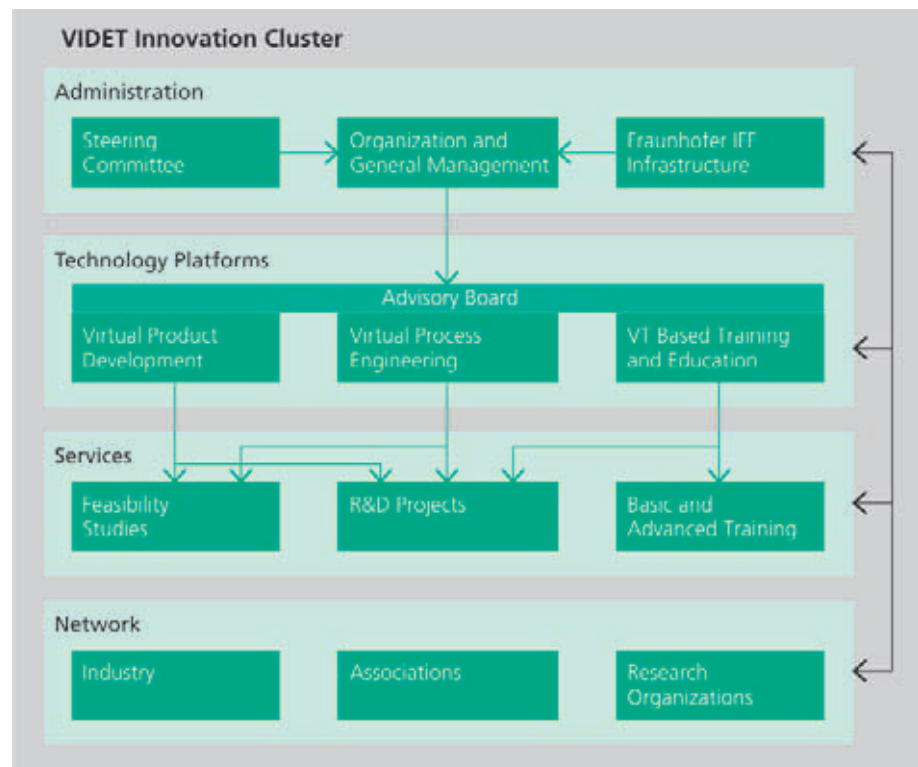
Figure: VIDET Innovation Cluster structure.

Building upon the Fraunhofer IFF and its research partners' know-how, the innovation cluster VIDET intends to set up three technology platforms relevant to machinery and plant manufacturing:

– Virtual Product Development,
– Virtual Process Engineering and
– VR Training and Education.

These platforms will support the development, testing and application of methods and tools of virtual technologies for the different phases of the product life cycle, namely:

– Product Development
– Product manufacturing (manufacturing processes and equipment) and
– Operation (training, operator training).

These phases will not be treated discretely and independently but rather developed with the tools and methods of integrated virtual technologies being engineered, in particular for the needs of SME. The illustration presents the structure of the innovation cluster VIDET.

Along with its research, development and application work on the technology platforms, the innovation cluster's work also involves organizing and managing a network of research organizations and industrial users. The cluster is able to draw on existing networks (see above) in which the Fraunhofer IFF plays an active role.

Another aspect is qualifying regional industry partners to apply virtual technologies to their problems. To this end, it develops appropriate basic and advanced training programs. By finding the optimal partner or consortium for specific customer requirements, the innovation cluster also acts as a contact for services in the areas mentioned, e.g. contract research, development, studies, etc..

ViVERA

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ViVERA means "Live long!" in Portuguese. The Network of Competence for Virtual and Augmented Reality really is full of life as the wide variety of activities carried out by twelve cooperating Fraunhofer Institutes and universities in the second project year attest. The Fraunhofer IFF completed subprojects that concentrated on basic technologies, specific applied research and networking.

Basic technologies include self-contained virtual reality functionalities that can be used as the foundation for development in different fields of application. Two of the total of seven basic technologies developed in the ViVERA consortium are being implemented at the Fraunhofer IFF.

The basic technology "Generation of Models for VR Applications" employs a new method to create virtual models, which not only automatically captures geometry but also coloration (texture). This method is used especially in areas of applications where 3-D CAD models of the objects being treated do not exist, e.g. to capture tissue structures in medicine or a building's historical structure for its restoration in architecture. This method was already presented in the 2/2005 issue of IFFocus.

The second basic technology developed at the Fraunhofer IFF "Interfaces to Systems for 3-D Model Generation" allows importing and automatically postprocessing 3-D CAD models from commercial CAD systems such as ProEngineer, CATIA V5, Solid Works and UniGraphics NX. This makes it possible to import 3-D objects' geometry and their hierarchic structure into a VR model. In addition, the tool supports different levels of detail used to optimize the representation. Thus, since it can use the 3-D data already available in enterprises, this basic technology is essential if virtual models are to be generated economically.

Along with developing basic technologies, ViVERA also focuses its work on specific industries. The automotive, machinery and plant manufacturing, medical technology and shipbuilding industries are prominent here. The team of ViVERA researchers at the Fraunhofer IFF concentrates on the machinery and plant manufacturing industry. One of the network's stated goals is to enable medium- sized enterprises in particular to access state-of-the-art VR technologies. The basic technologies produced in preceding work packages are intended to be utilized and developed further according to industries' concrete requirements. The end result will be the production of a total of nine demonstrators in the ViVERA network by the fall of 2007. Two of these are being developed at the Fraunhofer IFF: a demonstrator for machinery manufacturing and a demonstrator for plant manufacturing. Each of the demonstrators presents a typical industry application of VR technologies, intended to convince other enterprises to take advantage of the potentials of these new technologies for themselves.,

Work on the "Virtual Control Unit" demonstrator has progressed so far that one machinery manufacturing company has already implemented this solution. The idea is to couple a real CNC[1] with the virtual model of a heavy machine tool. As a result, control unit programs can be tested at a time when the real machine has not yet been produced. What is more, combining the real control unit with the virtual model allows training machine operators in an extremely realistic environment. The demonstrator was presented at one of the world's largest trade fairs for CNC machine tools in Shanghai in early 2006 and at the leading trade fair for innovations in the computer sector, the CeBIT in Hannover..

The second demonstrator "Virtual Plant" is presently still in development. To this end, process parameters, i.e. dynamic properties such as temperature and pressure, are being visualized. In addition operations essential to the process are being represented in a VR model. A moving bed reactor that reforms biogases is serving as an example. A system of mathematical equations was devised to describe its functional performance. This system of equations can be built upon to simulate the moving bed reactor's behavior. The visualization of the processes that occur in the moving bed reactor is being optimized at this time. What is more, work is being done on integrating the simulation results from a flow simulation system (Fluent). A system to describe the components and their related simulations is being devised to ensure the components and their connected models are interchangeable. A fluidized bed combustion reactor will serve as the validation model. The outcome of the developments will make it possible to overlay the visualization of process parameters on the 3-D model of a plant. Such a representation is intended to facilitate communication between plant designers and operators so they are better able to collectively coordinate and optimize process parameters.

Another emphasis of ViVERA's work is partner networking. The Fraunhofer IFF has pursued two cooperations in particular in recent years. The Fraunhofer IFF is taking advantage of the experiences of its partner from Stuttgart to work on a "VR Aided Engineering Workstation", which integrates virtual reality in an engineer's work process. Computer and projector concepts with particularly low noise emissions are employed, eliminating any distraction even in the quietest of offices. Another component is a low cost optical tracking system that detects the position of new, lightweight interaction devices. The VR software developed at the Fraunhofer IFF to present visual-interactive training contents is presently being modified for new hardware so it can support extended interaction systems.

The second cooperation covers the use of the OpenSG visualization library and the application Avalon based upon it. The software developed by the ViVERA partners in Darmstadt was tested at the Fraunhofer IFF. Thus, in the future, it will be possible to use the basic technology "Photorealistic Image Generation in Real Time" developed at the Fraunhofer IGD in Darmstadt in combination with the laser projection system at the Fraunhofer IFF. Introduced at the computer trade fair CeBIT in March 2006, the Darmstadt researchers' technology can interactively present photorealistic representation. This not only makes the technology interesting for design reviews but also for the representation of interactive, functional 3-D models.

A continuation of the work, especially on the applications, is planned for the coming year. Another emphasis will be the documentation of accumulated experiences in a knowledge base so that other enterprises can also put the ViVERA network's output to use.

[1] Computer numeric control.

INCENTIVE: Innovation and Research Center for Distributed, Interoperable Virtual Reality and Simulation in Industry and Education

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Strategic Objectives

INCENTIVE is one of the Fraunhofer IFF's strategic and pioneering projects and goes beyond traditionally supported individual or collaborative projects. With its innovation initiative "Entrepreneurial Regions", the Federal Ministry of Education and Research (BMBF) has created various strategic and sustainable support instruments for the eastern German states with the objective of strategically developing regional competencies with potential for innovation into regional clusters on a high technological level and on the basis of business criteria. The BMBF is making nearly 500 million euros available for its program "Entrepreneurial Regions" for the period from 1999 to 2007 alone.

The "Centers for Innovation Competence" (CIC), in which INCENTIVE is positioned, are one cornerstone of "Entrepreneurial Regions". CIC are established with the goal that they become sustainable, internationally highly competitive research centers.

Their international orientation, corporate strategy and innovative approaches to securing young researchers are intended to generate sustainable impulses in the eastern states. Typically, CIC are established at host organizations (INCENTIVE was established at the Fraunhofer IFF VDTC) but should largely pursue their research work autonomously..

A sustainable research concept and substantial preparatory work are needed to establish a CIC. This enables the centers to be internationally competitive and work on the same level as researchers from all over the world. The BMBF is supporting the INCENTIVE CIC with up to 250,000 euros during a one-year strategy development phase to prepare such a research concept. Once a strategy has been successfully developed, one or more groups of young researchers (of up to seven individuals each) will be established in INCENTIVE, which the BMBF will fully fund for five years.
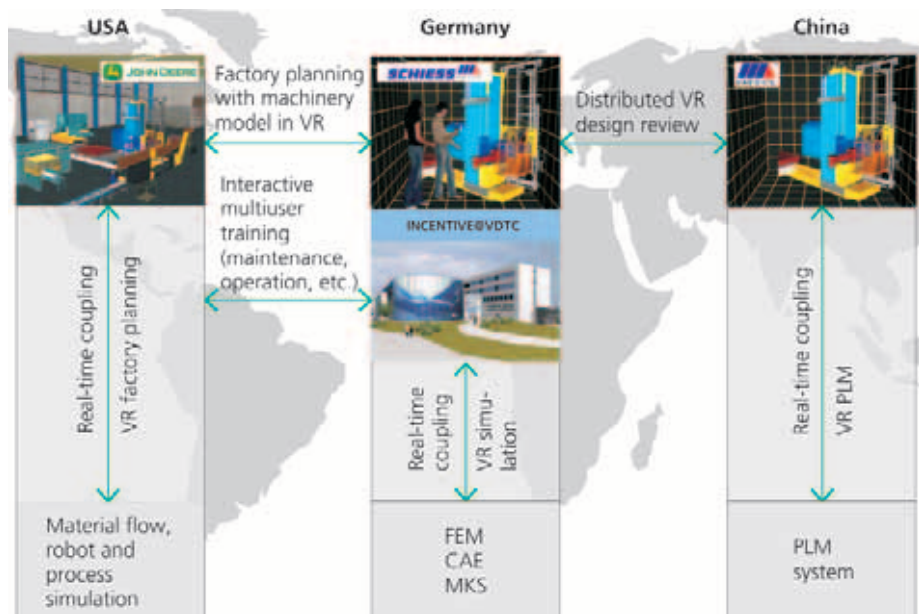
Figure: Model application scenario for INCENTIVE technologies.

Research Orientation

The Innovation and Research Center for Distributed, Interoperable Virtual Reality and Simulation in Industry and Education (INCENTIVE) will concentrate its work on methods and applications of distributed interactive and interoperable simulations and visualizations.

The increasing complexity of products and processes in the industrial value added process and the internationalization of the companies involved make such methods and applications a necessity. These basic conditions demand new distributed simulation and visualization systems that surpass the functionalities of present expert tools. Interoperable and integrable systems will have to be created in the future. Such tools will respond to the requirements of globally operating companies and their suppliers by supporting such application scenarios as the following:

1. **Distributed Simulation of Entire Process Chains** with Different Levels of Analysis and Detail
   A plug-und-play standard is needed to interface different simulation tools. A model application could be the integrated simulation of an OEM with its individual stages of manufacturing in various levels of detail.

2. **Systematic Integration of Special Software (Expert Tools)**
   This will improve access to special simulation software such as sequence, process or dynamic simulations and foster interdisciplinary understanding.

3. **Interactive Virtual Reality Environments for Globally Distributed Users Able to Interact with the Scenario Simultaneously**
   Important model applications could be design reviews in companies with several locations, distributed factory planning, engineering of virtual control centers or VR based training for several users.

The Fraunhofer IFF already has initial studies on distributed simulation, distributed virtual environments and the High Level Architecture for Modeling and Simulation standard.

Outlook

The the consulting firm Roland Berger is coaching the one-year INCENTIVE strategy development phase currently being supported by the BMBF. A series of workshops on various aspects of the INCENTIVE strategy will be held in 2007. These will include professional events with international guests and industry workshops. Among others, topics will cover the recruitment of young researchers and networking with local and national partners as well as the establishment of an overall concept for the INCENTIVE innovation and research center that will be remain sustainable long after the end of the support phase.

Short Commissioning Times by Engineering Control Systems on a Simulation Model

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Figure 1: Controller simulation for a cleaning robot.

Motivation

Businesses intent on surviving on the market have to be able to respond to the constantly mounting demands for shorter innovation cycles, wider ranges of variants and greater product complexity. The time spent developing and manufacturing new products is evolving into a crucial competitive factor

A product only fully functions once several subtasks have been completed. Among others, these include mechanical design, electrical design and programming of control systems. These subtasks are frequently completed sequentially in development, especially in the machinery manufacturing industry. Control systems are programmed at the end of the development processes and tested for the first time on the finished machine. Identified flaws, e.g. in the engineering, incur follow-up costs and delay delivery.

Potential tests, particularly of fatal accident situations, on the real machine are also limited. Not least, a developer is under great pressure and a control system is often developed and tested directly at a client's facilities. All in all, this approach makes it extremely difficult for manufacturers to calculate the outlay of time and money and the quality of the results.

The use of digital design as well as modeling and simulation of system performance are intended to counter these demands. Thus, engineering can be parallelized and the results verified by simulation. Control system engineering can already be integrated in the design process. A control system is developed and tested before the machine has been built and not on the client's premises first. The fundamental objective of developments is to shorten commissioning time and assure the quality of control system engineering.
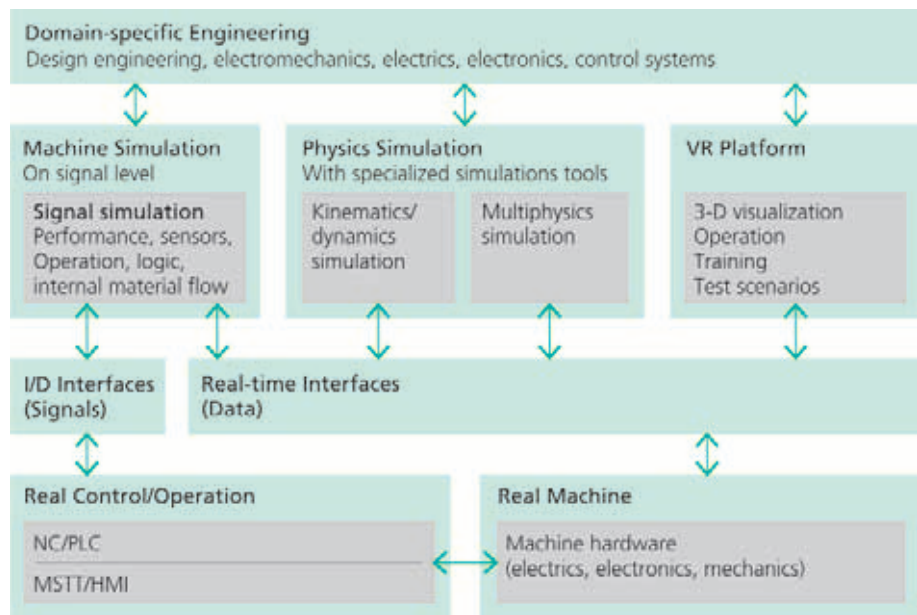

Figure 2: Components for virtual commissioning.

Design Development/Implementation

A concept that supports virtual commissioning was developed for the outlined tasks (Figure 2). Real control systems are developed and tested on a simulated (virtual) machine. Already carrying out the development on the target platform ensures that all the controls system's functions can already be programmed. There is no need to further convert the control code.

Using a real control system requires the simulation be real-time compatible. Hence, the simulation must be configured to guarantee real time. The Fraunhofer IFF has developed concepts, tools and methods based on real-time communication to develop such system models. The following questions related to complexity and attendant real-time compatibility play a key role.

– What concrete machine features/ functions have priority?
– What components have to be simulated?
– What level of detail must a system model have?

The level of detail is critically important to the work that goes into modeling. Therefore, different forms have been implemented in the simulation. On the one hand, system software (WinMod) for machine simulation is integrated on the signal level (Figure 2), making a real-time connection available for different control systems. Extensive tests options can convert the simulation of the I/O signals' time response in little time. A technically challenging task, e.g. a complex control engineering problem, requires detailed modeling and simulation. A physics simulation with different specialized simulation tools (Matlab, Dymola, etc.) is integrated for such a case.

Model Application

The Fraunhofer IFF is developing solutions to this problem in a research project. A functional model of the cleaning robot for Berlin Central Train Station developed at the Fraunhofer IFF is serving as a demonstrator. An interface to a VR model enables testing the cleaning system's performance in a virtual environment and optimizing the control software (Figure 1).

A signal simulation of the robot's behavior was implemented and the control system was expanded with real operator elements. Thus, a complete environment is available to develop and commission the real control system.

The project group's work involves

– Analyzing the technical components,
– Converting the components into a realt-time simulation and modeling them,
– Analyzing the depth of simulation,
– Recreating operational and fault characteristics and
– Enabling specific tests in the system model.

Apart from the applications outlined, the functional models being created can also be integrated for machinery operation, realistic training and marketing (Figure 3).

Development	Operation	Training	Presentation
– Validation – Reduction – Commissioning	– Optimization – Diagnostics – Retrofitting	– Operator – Programmer – Service technician	– Concepts – Function – Design

Figure 3: Integrated utilization of functional models.

The VITECMA Project: Virtual Reality (VR) Based Technology Development and Machinery Configuration

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The VITECMA project is providing solutions to simplify and shorten concept and product development based on VR. The project partners are developing a tool to support the domains of machinery configuration and technology development. The target groups for the tool are marketing experts and technologist in machinery manufacturing companies. The project will contribute to holistic product development.

VITECMA is based on methods of virtual engineering for the development of technologies and the configuration of machinery and plant systems. VITECMA combines several aspects of product development such as configuration, simulation, scheduling and visualization on one platform.

An extension of the Fraunhofer IFF's tried and tested Virtual Development and Training Platform (VDT Platform), this new tool has been specially developed for the machinery manufacturing industry.

The configurator is based on a modular principle, the configurable and extensible module facilitating customization to market requirements. Various newly designed support functions integrated in the platform (e.g. guided mode, snap-lines, distance measurement, screenshots) simplify and accelerate the configuration process and can significantly shorten a bid phase by more quickly providing potential buyers information on the feasibility and potential follow-up costs of a new purchase.
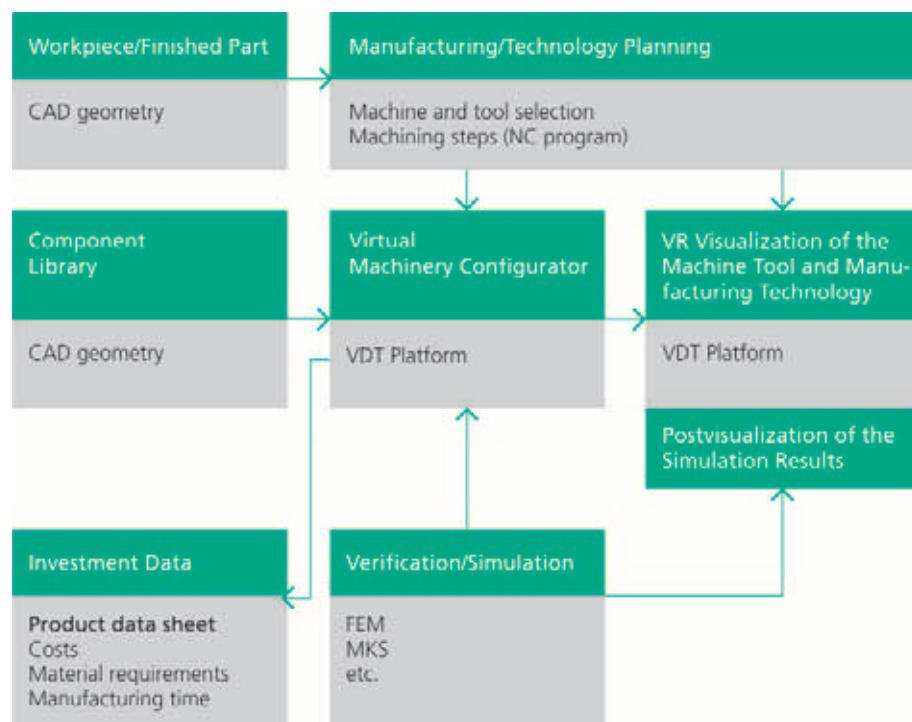
Figure 1: Concepual design of the configurator.

The principle behind the configurator's extensibility not only makes it possible to present configured machinery or manu-facturing lines but also additional extern-ally generated information such as the results of FEM calculation and simulation or machining operations. Thus, the visu-alization can provide additional informa-tion.

A visualization is supported by structured documentation of the requisite system and tool components as well as support-ing data (times, costs, energy consump-tion, etc.). In addition, the system can automatically issue a product data sheet compiling all the system's most important information, including every installed component.

This approach to configuration has been successfully tested on a single-column milling machine made by SCHIESS GmbH.

Figure 2: Virtual model of a heavy machine tool in an interactive 3-D environment.

VIRTHUALIS: Virtual Reality and Human Factors Applications for Improving Safety

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Initial Situation

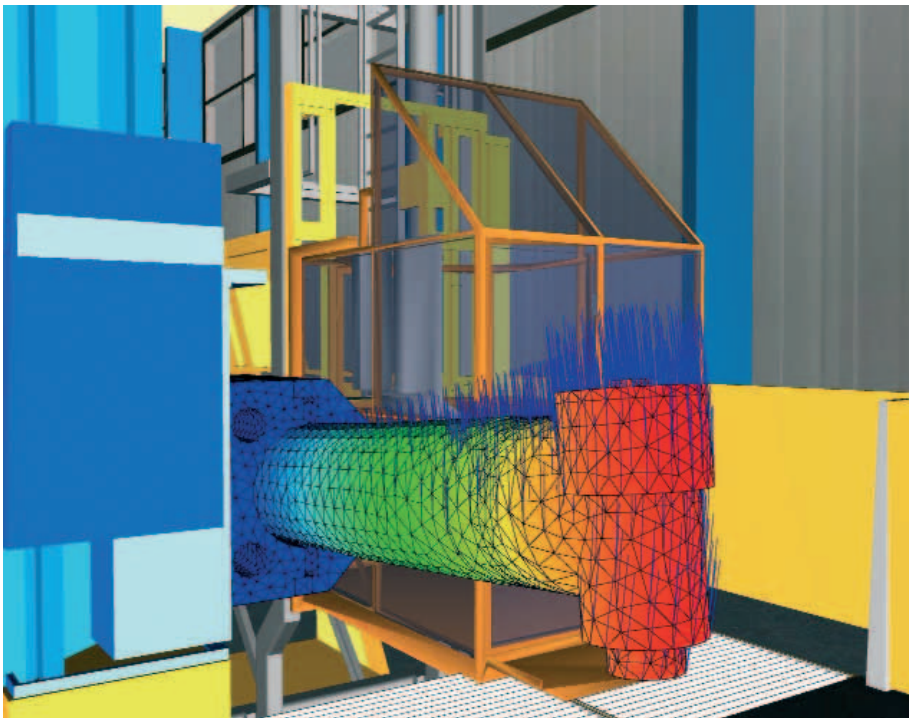In high risk industries such as the chemical and petrochemical industry, human errors are one of the chief causes of risks and accidents that incur enormous losses. Implementing or enhancing safety precautions with new standards and laws is not enough to increase the safety of processes in these industries. An integrated safety concept that incorporates human factors and behavior must be developed for the entire production life cycle.

Such a concept has to make it possible to visualize different safety scenarios and analyze potential causes of human errors. This would allow making necessary changes or decisions.

Solution

Supported by the EU, the project VIRTHUALIS is developing a VR based technology that incorporates human factors to increase safety in manufacturing companies. The solution concept is based on two steps: Identifying industrial requirements by making an on site inspection and analyzing human factors. This uncovers operational weaknesses. Eliminating them enables increasing safety and implementing requirements in a VR platform .

The VR platform is designed for future extensibility. External technological components such as process simulators, AR components, authoring tools, etc. will be integrable.

Deliverables (Current and Planned)

The solution was initially implemented in four application scenarios based on predefined requirements from the industrial setting. The first application scenarios serve as examples covering the following domains of safety:

– Risk assessment,
– Accident investigation,
– Safety management and
– Safety training.

This implementation serves to visualize and deal with safety-critical problems in the field of application. Errors are indentified in advance, decision making is supported and productivity is increased.

Project data:

– EU instrument:
  Integrated Project (IP)
– Runtime:
  4 years (May 2005 – April 2009)
– Number of partners involved:
  43
– Field of application:
  Chemical process industry

Figure: The VIRTHUALIS project: Humans – technology – process safety.

Interactive Modules for Implementing the Machinery Directive in Machinery and Plant Development and Utilization (IMMMA)

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Machinery and plant manufacturers on the European market have to orient themselves toward current EU Machinery Directives and relevant standards for industrial safety, ergonomics and health hazards. The documentation of hazard analyses and instructions for residual risk prevention are the requisite materials for a manufacturer's engineers' communication with later user-operators.

While an industrial safety expert completes the safety acceptance, users have to compile operating instructions and minimize residual risks with appropriate measures.

A study conducted by the Berufsforschungs- und Beratungsinstituts für interdisziplinäre Technikgestaltung (BIT) identified an abundance of deficits and transfer errors in this analysis, organization and communication chain.

While procedural problems exist, suitable communications and simulation media are lacking, which allow integrating everyone involved in overall company innovation management in prevention and developing new transfer methods and strategies.
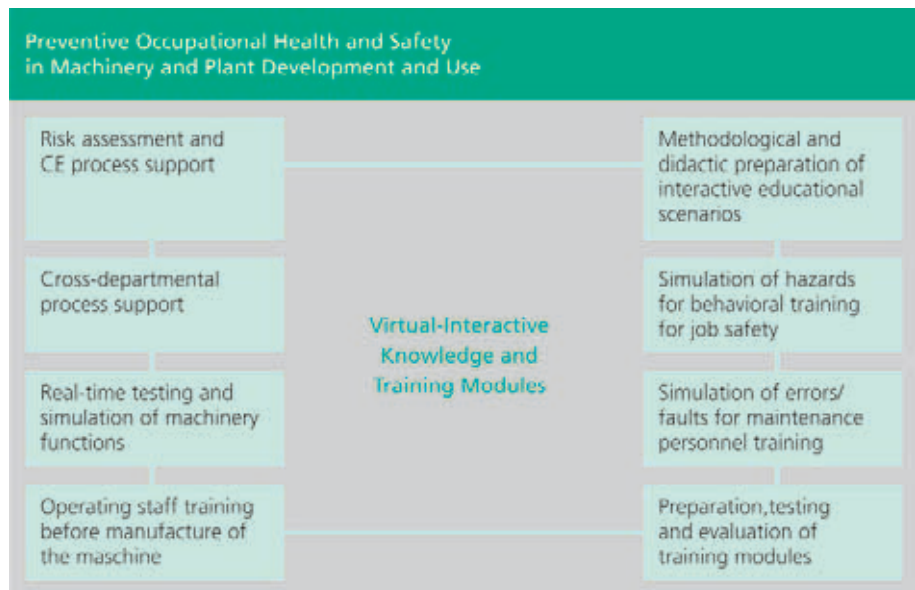

Figure 1: IMMMA project objectives and deliverables in overview.

Approach and Objective

Together with the participating industry partners, company processes are analyzed to apply model cases to implement methods and technology on the basis of identified requirements.

The virtual-interactive knowledge and training modules being produced are prepared methodologically and didactically. They are intended for use in product development and manufacturing, commissioning, operator training, production and even maintenance and repair. This facilitates effective prevention in the sense of the EU Machinery Directive during the entire operational process and the machinery life cycle. The project will, for example, deliver virtual-interactive action aids to implement risk assessment and evaluation. Furthermore, new development, utilization and training concepts incorporating virtual modules will foster an increase of personal skills at the workplace. Moreover, this will contribute to optimizing relevant business processes and cooperation between manufacturers and users for the purpose of "customer innovation". A committee of experts drawn from the most important associations, organizations, institutions for statutory accident insurance and prevention and the Saxony-Anhalt Ministry of Health and Social Welfare, will present, reflect on and secure the results in given intervals. Concepts will be developed for standardization and transfer and networks initiated to disseminate the results beyond the end of the project.

Results and Utility

In the first stage of the project, tests and analyses were performed at the facilities of the participating industry partners. For instance, new development of an imprinting system was supported at Staedtler Mars GmbH & Co. KG. Parallel to engineering the system, an interactive module was created with which the real prototype's functions were simulated before manufacturing. This revealed potentials for optimizing interdivisional and interdepartmental processes. The easy comprehensibility and clarity of the visualization of the machinery's modes of operation made it possible to analyze dangers in the process by involving various actors. Thus, for example, design engineers were able to reach advance agreements with control systems engineers and make additions to the flowcharts. What is more, it was possible to perform a risk analysis with electricians before the control system was completed.

It will be essential to identify and appropriately implement these potentials in the course of the project (ending in May 2009). The objective is to employ interactive modules to establish an optimized, standardized and complete approach and to improve company processes. The time needed to meet the Machinery Directive's requirements ought to be reduced, for instance. The communication and participation of every individual involved in development and operation will make machinery and plants substantially safer.
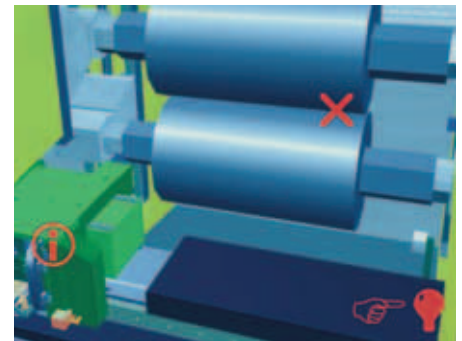

Figure 2: Visualization of information and critical points on a virtual model.

Westermann Verlag Is
Banking on e-Learning

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Vocational school students are well versed with computer games in virtual worlds. They navigate them with ease and confidence. The executive editors at Westermann Verlag want to take advantage of young people's enthusiasm for this technology to teach them complex lessons.

In an e-Learning project for vocational school students, the Fraunhofer Institute for Factory Operation and Automation IFF in Magdeburg and school book publisher Westermann in Braunschweig jointly developed educational modules to support first year vocational programs in metals technology. An interactive CD supplements the primary product line of print materials such as a textbook and workbook. Taking real job orders as its starting point, the CD provides students and teachers 3-D animated machinery on which they can, for instance, visually learn what actions to take when they are machining metals.

The concept of learning fields is pursued rigorously. These are didactically grounded and prepared fields of activity that condense complex tasks worked on in action-driven learning situations.

The completed metals technology educational modules cover the following topics:

– Manual production of components with a mixing tank as example,
– Mechanical production of components with an adjustable stop as example,
– Production of assemblies with a drilling jig as example,
– Production of simple controls with a gluing jig as example.

In the future, the CD-ROM will expand Westermann Verlag's range of materials for vocational training in the field of metals technology. Along with the conventional materials such as a textbook and a workbook, trainees in their first year of metals engineering are now able to use the interactive job orders from these computerized educational scenarios to complete the exercises from their work materials and "grasp" the solutions in a virtual environment. Trainees are not the only users of the CD-ROM however.

The interactive educational material also provides metals technology instructors many options to organize their lessons more understandably. They can work through model solutions for a job order step-by-step and reconstruct these on a virtual model. Best practice solutions support discussions of ideal approaches, the virtual model enabling exploration of equipment and models as well as processes.
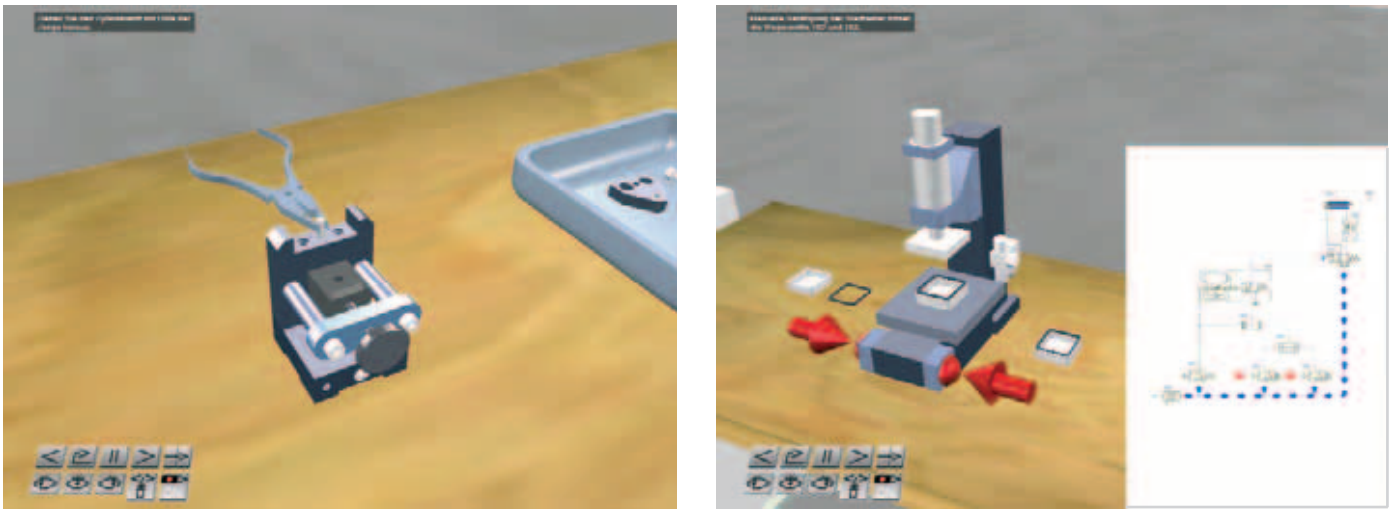
Figure 1: Examples from the interactive scenarios –
Left: Constructing assemblies with a drilling jig as an example. Right: Constructing simple controls with a gluing jig as an example

A complex disassembly order is executed on a model drilling rig. The lesson and the assignment lay the theoretical groundwork, which can then be applied to and tried out on the virtual model of the drilling rig.

In another exercise, the virtual model of a gluing jig is coupled with the pneumatic diagram of the jig. Students can then understand every position of the pneumatic switches as well as their transitions in a clear visualization. Simple machining procedures such as the drilling of holes are consistently reproduced comprehensibly in every step of work, including workpiece marking, clamping and machining.

The project was implemented with the Fraunhofer IFF's virtual reality platform. The challenge was to prepare the tasks in the virtual scenarios in such a way that first year trainees are not overwhelmed and sustainably retain the educational contents by interacting with the model and the processes. The educational scenarios now available for vocational education were the outgrowth of many discussions with the experts from pertinent departments of Westermann Verlag.

Figure 2: The interactive CD-ROM.

The CD-ROM is available at http://www.westermann.de/suche/artikelansicht.xtp?id=978-3-14-364203-0 or in bookstores.

Case-specific Virtual Organ Models for Future Endoscopy Simulators in Medicine

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Initial Situation

A new field of research at the Fraunhofer IFF is the development of realistic virtual organ models implementable in medical simulators. Such simulators are intended to support physicians when learning certain surgical procedures.

Surgical techniques in operative medicine have been significantly improved and refined in recent years. One milestone was the introduction of minimally invasive surgery. A great advantage of this surgical method is the lower level of stress on patients, i.e. they experience less pain, recover mobility rapidly and have short hospital stays.

Successful minimally invasive surgery not only requires the appropriate medical technology but also sound professional skills on the part of the operating physicians. Operations are performed, for instance, by inserting various endoscopic devices through several small incisions. An endoscopic camera supplies physicians a live picture of a patient's insides on a monitor. This two-dimensional monitor picture is the basis for navigating three-dimensionally, making a diagnosis and taking treatment steps during an operation.

While the training of such procedures on simulators does not replace an experienced surgeon's guidance, it is however a meaningful addition to surgeons' training to optimally prepare them for operations. Apart from enabling young physicians to train their manual and diagnostic skills, another potential use is the planning of surgery in particularly difficult cases.

Acceptance of such simulators depends on numerous technical constraints. Very high demands are made not only on realistic haptics that supply users tactile feedback on tissue properties and organ contact but also realistic visualization of virtual endoscopic images.

Approach

In a joint interdisciplinary project, the Fraunhofer IFF together with several regional partners is developing technologies that meet these stringent requirements. It is cooperating with Otto von Guericke University Magdeburg's Medical School and departments of its schools of engineering .

The Fraunhofer IFF is working on the generation and interactive visualization of high optical-quality organ models and the realistic representation of various symptoms and attributes of diseases in the simulation.
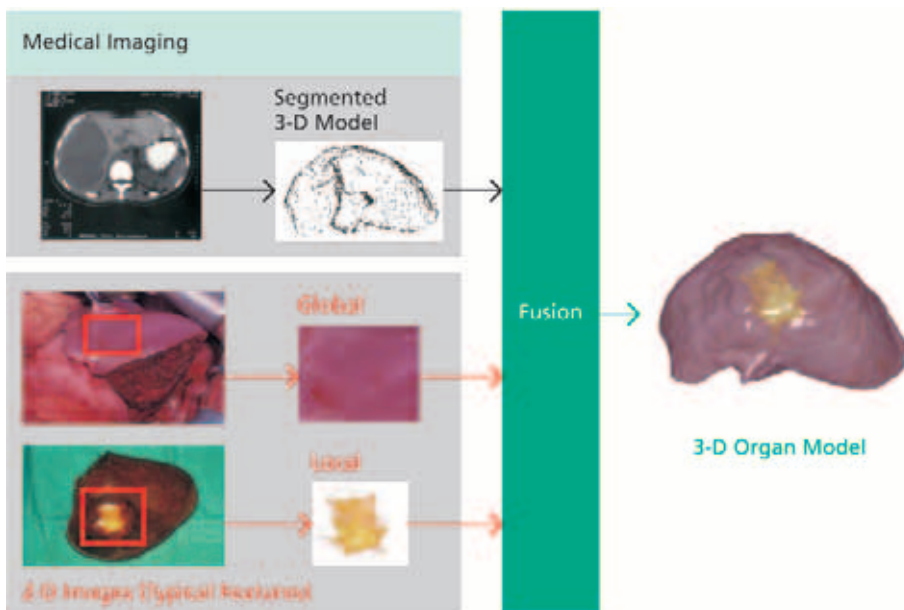
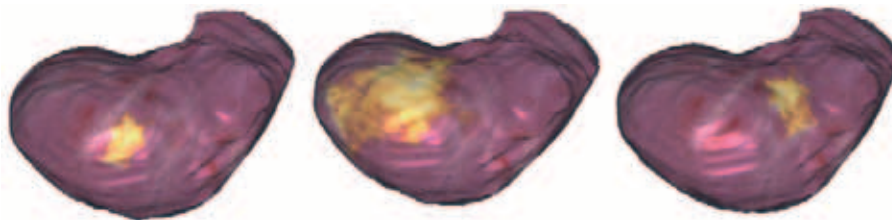Figure 1: 3-D geometry and typical case-specific features of images fused by shader technologies.

Figure 2: 3-D models of a liver with various local ysmptoms of disease (varying location and size of a tumors.

First, photographs with relevant case-specific features of the organs' surface textures are collected and processed. Global features (pertaining to large portions of organ surfaces) and local features (distinctive surface features, tumor characteristics) can be differentiated. Shader technologies can be applied to fuse the characteristics of these different features and export them into the previously segmented 3-D model. The basic texture is comprised of photos of the case-specific global features. Local features (e.g. local textures) are also projected onto the 3-D model for the specific case. These features may be positioned anywhere on the geometry and varied in size.

Shaders also enable applying more precise illumination models such as the Phong illumination model, which simulate illumination relatively well. As a result, real surface reflections of endoscopic camera light on an organ can be reproduced realistically.

In the future, it will be possible to interact with these organs by using endoscopic devices. Appropriate deformation models will be applied to obtain the most visually plausible behavior of organs possible. Interaction would make it possible to make an incision anywhere on an organ to remove malignant tumor tissue for instance. Among other things, doing this, will entail researching the organs' physical reactions and developing interaction with the endoscopic devices.

3-D segmenting extracts the initially static geometries of the organ models to be simulated from medical imaging (computer tomography) datasets by means . Photographs of the real organs taken at the Surgical Clinic deliver additional case-specific 2-D image data that can be utilized for the visualization.

Advanced shader technologies are applied to produce the visualization. Used with state-of-the-art graphics hardware, these make it possible to replace areas of the standard rendering pipeline with one's own program code to thus take advantage of more flexible options for realistic real-time visualizations.

The "INTUITION" European Network of Excellence (NoE)

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Initial Situation

Its rapidly growing fields of application make virtual reality (VR) technology a varied field of research. The ongoing process of research and development has reached a point that demands structuring and integrating of the efforts encompassing VR European-wide. VR technologies are already being widely used for different industrial applications. This is being done in an unorganized fashion - through case-by-case scenarios and without long-range visions.

There is a need to simplify the adaptation of virtual environments (VE) in industrial processes and assess the effects of VR use in the workplace and daily life. Such an assessment ought to incorporate aspects of cost effectiveness, health hazards and side effects of work environments on individuals and companies.

Figure: The Fraunhofer IFF presented the coupling of a real CNC unit with the virtual model of a heavy machine tool at the 3rd international INTUITION workshop in Fellbach on November 30 - December 1, 2006.

Conceptual Solution

The INTUITION European Network of Excellence (NoE) is bundling Eurpoean competence in VR. Its main objective is to bring together experts and key actors in the domains of VR and VE development, testing and application. Industry representatives, SME, research organizations, universities, international organizations and associations are collaborating in INTUTUION to structure fragmented European VR know-how and better establish VR and VE in product and process design.

Furthermore, INTUITION is integrating European resources and VR equipment, structuring European VR research and promoting Europe globally as a leading region in this field..

Results

Integrating and bundling the VR activities of the partners involved is envisioned and has in part already been done in the following fields of specialization and application:

- Aviation
- Augmented reality (AR)
- Automotive and transport
- Building and architecture
- Energy
- Design and engineering
- Entertainment and culture
- Evaluation and testing
- Education and training
- Haptic interaction
- Medicine and neuroscience
- VR and VE technology in general

Project data:

- EU instrument:
  Network of Excellence (NoE)
- Runtime:
  4 years (September 2004 – August 2008)
- Number of partners involved:
  58

Project Reports:

Logistics Intelligence from Magdeburg

LogMotionLab: Current Trends in RFID and Telematics

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LogMotionLab is a lab for the testing and development of RFID, Auto-ID and telematic technologies. The radio frequency identification (RFID) specialists at the Fraunhofer IFF test the suitability of RFID technologies for use in specific business processes and evaluates them neutrally.

Customized solutions for secure and reliable supply chains are developed here for companies and then implemented where they need them. In addition to the extensive equipment at the Magdeburg facility, the lab's mobile components allow conducting function tests directly at clients' facilities under real operational conditions.

RFID and telematic technology development is advancing rapidly at present and LogMotionLab is therefore constantly being expanded. The developments and research at the Fraunhofer IFF can be subsumed under two major headings: Secure chains of goods and RFID technology integration in technically difficult environments.

In addition to the various types of active and passive RFID technology, research and development of secure chains of goods also involves satellite-supported telematic solutions. Researchers at the LogMotionLab supplement these with solutions for indoor localization based on various radio technologies, options for wirelessly coupling indoor and outdoor localization and integrated sensor technology for monitoring and inspection.

The second specialization at the LogMotionLab is the integration of RFID technology in technically difficult environments. In particular, metallic environments in industrial applications are examined. Foundations already developed a few years ago can be reverted to and these findings can be transferred to new frequency ranges as well. One such solution is the "Alubox" developed in 2006, which, with a frequency of 868 megahertz, has a nearly 100 percent read rate in metallic environments.

LogMotionLab is expanding to different locations in Magdeburg because, on the one hand, more space is needed for individual fields of development and, on the one hand, LogMotionLab is integrating new fields of work related to localization technologies, thus making expansion to a variety of locations an absolute necessity. Attention will especially be directed toward the integration satellite, radio and optical localization technologies.

Figure: The LogMotionLab is one of Europe's leading labs for the development, testing and certification of RFID and telematik technologies. (Photo: Siemens Press Foto)

Germans Call It Funk: Technologies for Secure Chains of Goods

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The market for emergency logistics and same day logistics, i.e. transports that have to be fast (a maximum of 72 hours), secure and transparent, is a growing. Late arrivals can cause tremendous harm when they delay the start of production or bring production to a stop. Hence, the industry is demanding new IC solutions to safeguard business.

The management of information on the identity, current position and condition of goods, loading equipment and means of transport as well as the real-time availability of this data in expediting systems is assuming a key role in the unaccompanied transport of goods.

The trend toward miniaturizing devices as costs are falling at the same time is opening a new market for autonomous logistics assets equipped with sensor systems and communication modules to optimize operational and logistics processes. At present, the coupling of RFID systems for object identification with telematic modules is producing new products subsumed by the "secure chain of goods".

The functions the Fraunhofer IFF combines in its Smart Box and Smart Pallet constitute a paradigm change from observing logistics assets at fixed measuring points to continuously monitoring logistics assets in supply chains and even multimodal supply chains when necessary.

Figure: The Smart Metal Box functions reliably even in metallic environments and with such objects as metal cans filled with liquid.

Smart Boxes are reusable metal or plastic containers with RFID antenna structures and self-contained power supplies. Goods outfitted with HF or UHF RFID labels are automatically logged as container contents for the purpose of running inventory. A communication module transmits the container's continuously identified GNSS position and every loading and unloading to headquarters. Additional sensor elements determine the condition of goods. After the plastic Smart Box and the Smart Pallet had been presented at the 2006 CeBIT, the first prototype of a metal Smart Box was introduced at the BVL's German Logistics Congress in 2006..

As a security concept for logistics, the IT infrastructure of the IFF Smart Box is suitable for specifying new requirements for guaranteed value added services on the basis of localization, communication and identification technologies.

RFID Based Container Management
in Production Logistics

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The availability of suitable containers is the prerequisite to a functioning material flow. The intensive planning, control and monitoring of container cycles enables cutting inventories considerably and organizing processes more reliably.

Intelligent container management aims to:

– Connect material and information flows,
– Track containers online,
– Provide transparent information on the location and status of material and containers,
– Ensure the return flow of containers remains on schedule and
– Increase the accuracey of material planning.

A user scenario illustrates this subject's relevance for manufacturing logistics.

Initial Situation

Gas turbine blades essential for generating energy in power stations later lie in gray plastic boxes. Yet, what appears so unspectacular is less than ordinary: "A single blade can cost roughly as much as a compact car," explains Günter Rademacher from Siemens Power Generation (PG) in Berlin.

Siemens Power Generation uses big plastic containers that were specially developed to transport turbine blades yet are nonetheless standardized, which measure roughly one cubic meter and are able to hold up to seventy-two components.

The blades that are precision cast parts from foundries in Germany, England and the USA are deposited into these containers and stored in a central logistics warehouse.

Figure: Siemens AG gas sturbine plant on Motardstrasse in Berlin.

The containers are then transported from the warehouse to the manufacturing plant approximately five kilometers away where the blades are finished for their particular ultimate purposes.

Managing the containers presented this Siemens division with challenges. In the past, the company had difficulty providing information on the current inventory, storage site and status of its blade boxes.

Approach

Together with the Fraunhofer IFF in Magdeburg, Siemens PG has started the project Transponder Integrated Processes for Containers (TIP4Boxes). The objective of the project is to use RFID technology to improve the situation of operational organization of internal and external container logistics at its Berlin location. To this end, the transparency of container location and condition is being increased and, in a second step, container content is being linked with the container.

TIP4BOXES Part I

In part one of the Tip4Boxes project, a potential analysis of the actual conditions of container logistics was performed at Siemens PG. Among other things, this analysis incorporated RFID technology and its dependence on the environment and product range. This resulted in a feasibility study and a preliminary concept with a draft approach to implementing the RFID technology for container management at Siemens PG.
Relevant technologies were tested in advance at the Fraunhofer IFF's RFID lab, LogMotionLab.

The concept developed by the Fraunhofer IFF so impressed Siemens PG that it was converted into a test installation. The basic goals of optimization were achieved. The results of the test established that RFID transponders were a suitable foundation for integrated container management at Siemens PG beyond the pilot project. High transparency for the transport containers tagged with 150 Smart Labels was already achieved during the pilot project.

Although a link between the transport container and its contents had not yet been established at this time, the Web-based information on transport container location and status already created tremendous transparency.

TIP4BOXES Part II

Given the positive results of TIP4Boxes Part I, Siemens decided to continue the project. TIP4Boxes Part II and Part III was started. On the one hand, every transport container is being tagged with transponders and, on the other hand, the IT infrastructure with more optimized control points, a monitoring system and more mobile readers is being installed. This made the location, availability and status transport containers completely transparent internationally.

TIP4Boxes Part III

The third part of the TIP4Boxes project dealt with planning and piloting the linkage of transport containers and their content as well as connecting SAP master and order data. To do so, the data model was developed into a finite concept, the interface between the RFID system and SAP was created and a comprehensive test run was executed. This part of the project prepared everything to better allocate transport containers and their particular contents.

Doing so involved optimizing the original pilot application on the one hand and taking more substantial action in the logistics on the premises of a large plant on the other hand. Intensive consultations with the local Siemens IT department were essential if Web server, SQL database server, possibly WLAN conntection were and options for remote maintenance were to be implemented in short time. Since data security is an imperative, the wireless transmission of data was especially met with great skepticism. Resolving this problem was a significant step toward to creating a new system landscape in the ongoing subprojects.

RFID Aided Asset Management

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Initial Situation

Programmable mobile data storage units (RFID transponders) allow directly integrating information processes in physical processes. Thus, they can be directly mounted on assets too. The linkage of distributed and centralized information establishes the conditions for an organizational solution that transparently maps logistics processes and is able to evaluate and better monitor them. This can be built upon to establish process-oriented control loops in supply chains. This optimal supply of information ensures logistics process are high quality and reliable. This and in particular the programmability of the data storage units and their ruggedness in harsh environments sets it apart from conventional storage media.

Approach

RFID technology enables keeping track of and monitoring the widest variety of assets, making it possible to more transparently organize and simplify entire processes related to asset management.

Unique identification of assets enables providing fundamental information on their condition and - when the RFID systems have been adeptly implemented - their position. In principle, this enables taking running inventory and continuously managing inventory. The distributed information stored on assets serves as the basis for this. It allows continuously tracking assets. The result is transparent material flows. Information on condition can be retrieved directly on a component.

Figure: A handheld can be used to retreive and update information directly on an object.
(Photo: Siemens Press Foto)

Time-consuming inquiries and waits for information are eliminated because a direct connection to a central database is unnecessary.

Usually, mobile terminals similar to commercially available handhelds are used to exchange information between assets and the central databases or control center. This enables reading out and modifying the data of a component tagged with RFID.

Systems that monitor tools, components or complete systems (e.g. engines) throughout their entire lifetime have already been developed together with various partners (e.g. VEM Motors). To this end, assets were outfitted with RFID tags and relevant data, e.g. calibration or servicing data, was stored on the asset. The resultant availability of such data with a tool dramatically improved the monitoring of individual assets. Distributed data storage enabled eliminating individual process steps and better monitoring others. This yielded a shorter and thus faster and more transparent process chain. Data was acquired with mobile terminals to ensure tool or component identification was unique. Web-based software made it possible to monitor assets cross-company and throughout the world.

Results

Implementing the RFID technology in asset management makes it possible to uniquely identify assets. Moreover, the widest variety of information can be stored directly on an object. The technology applied today allows storing up to 64,000 characters on a component. Furthermore, this is nudging along processes to standardize the data structure, which are not only necessary for RFID technology but can also be used to advantage in other domains in companies or among companies.

The availability of distributed information makes it possible to intensively exploit potentials for success in cycle times, cost, quality and security or even recognize them in the first place. Likewise, RFID technology can help implement rapid and effective control loops in supply chains to initiate status-driven workflows and forced sequence. Thus, gaps can be localized and logistics processes actively controlled.

RFID Based Construction Site Logistics

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This project developed innovative logistics concepts based on RFID technology for medium-sized plant manufacturers. The construction, retrofitting and shutdown of complex plants are projects that require lengthy preparation and must be wrapped up as quickly as possible. In such a project at a construction site, plant operators must organize human and material resources as well as plant manufacturers simultaneously and in parallel. If the budget or schedule are not kept, small and medium-sized enterprises involved as equipment suppliers or service providers particularly run the risk of losing market and competitive advantages through additional costs or contractual penalties. This situation holds potentials to utilize RFID technologies and thus improve the quality of information and logistics processes related to plant construction projects.

A cross-industry study analyzed and evaluated the status quo and added value of drivers behind and obstacles to the use of RFID solutions in small and medium-sized plant manufacturing enterprises. In addition, a cost-benefit analysis examined the cost effectiveness of RFID systems developed as prototypes.

To this end, the Fraunhofer IFF assembled a project consortium of five companies in which three industrial plant manufacturers, one RFID technology provider and one systems integrator are members.

While each of the three plant manufacturers analyzed the use of RFID in one process relevant to them, the other two companies together with the Fraunhofer IFF provided the plant manufacturers support when they were implementing the RFID technology in these processes and modifying their range of services as a result.

Figure 1: Structural steel elements at a construction site.

Tasks relevant to RFID were identified and implemented with the partners in the field as technical RFID demonstrators:

– Guaranteeing a secure transfer of goods with objects or loading equipment tagged with appropriate RFID,
– Managing asset information relevant to certification with RFID on assets,
– Localizing and managing inventory of plant components at construction sites (open air storage) and
– Managing tools with RFID.

The demonstrators developed were tested under real conditions. The partners jointly analyzed the potentials for further improvements and aspects of cost effectiveness. The demonstrators are part of the Fraunhofer IFF's own RFID lab, LogMotionLab.

Project Partners

– SIGMA Maschinenbau GmbH
– Stahlbau Magdeburg GmbH
– tkb Technologiekontor Bremerhaven GmbH
– Condat AG
– Meshed Systems GmbH

Figure 2: RFID scan with a mobile terminal.

Innovative Telematic Technologies and Services in Forests and Meadows

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Motivation

Raw materials for the wood processing industry or the generation of renewable energies are distributed over large areas in forests and meadows. Their widely differing species and forms require different means of transportation. This presents logistics with a major challenge. Conventional methods of logistics controlling and measurement only capture these processes incompletely. Innovative developments in mobile information technology are opening tremendous potentials to improve logistics here.

In the interconnected processes of wood logistics, the individual and unstandardized business processes of the multitude of buyers and predominantly medium-sized service providers with different cooperative and business relationships cause frictional losses at the junctions of processes and make logistics encompassing every actor difficult.

Innovative RF and telematic technologies will help cut wood logistics costs in the future. Cost pressure and structural adjustments are particularly an impetus for forestry operations to intensify use of telematic technologies. These are intended to bring about savings by minimizing redundant data acquisition, time spent searching for and being directed to sites, time and the labor required to inspect and the time to store stem wood and biomass. Mobile services such as deck and order management, off-road navigation and condition monitoring are the focus.

RFID technology for marking timber assortments provides more potential for rationalization. Electronic marking and identification makes the wood supply chain significantly more efficient up tho the factory. RF marking allows identifying individual trunks with certainty and additionally allocating data important to the wood processing industry, e.g. quantity, quality and owner. Mobile terminals transmit this data to central databases and internal systems where it is immediately available for others involved in the process.

Particularly in light of the heterogeneous structure of the interacting partners, new technological solutions will only lead to business success in wood and biomass logistics when a maximum number of partners have access to them.

Figure 1: PDA with the Fraunhofer IFF's solution.

Approach

Optimizing timber transports with suitable routing and navigation options simplifies the planning and execution of timber transport logistics operations and can cut transport costs considerably. The forest especially holds developable potential for optimization since the time needed for the distance from the road to timber storage is approximately quadruple that needed for the distance back to the road.

Previous approaches to navigation off public roads met with little acceptance among target groups because of their high costs for end users and the foreseeable follow-up costs to keep data up-to-date.

Taking identified deficits as the starting point, the Fraunhofer IFF in Magdeburg developed an application that provides a solution that is just as simple and pragmatic as cost effective. This new off-road navigation system's unique feature is that data on forest roads collected by state forestry agencies has not been integrated in existing navigation systems but rather supplements them.

The navigation solution is easy to operate and its route guidance is limited to essential functions such as directions and distances. At first, one or more target points are entered. The system then calculates the route and guides the user over jumping off points determined in a special procedure (junctions from the public roads into the forest, see Figure 2) to the destination. The route guidance system uses commercial navigation systems on public roads and switches to the auxiliary off-road components from the Fraunhofer IFF in the forest. A user does not have to input anything separately since the applications switch between the networks of public and private roads in the background. Thus, is navigation not interrupted and changing devices or applications is unecessary. The use of commercially available devices (laptop, tablet PC or PDA) and commercial software only incurs minimal costs while maintaining the optimal functionality of the overall application and, because it is regularly updated, ensures data on public roads is the latest. The option to integrate and individually use additional, specific forest information in the off-road map is especially lucrative for use in wood logistics.

Results

This solution has been field tested by selected users in Saxony-Anhalt. They were especially impressed by the scope of user functions and the ease of operation, the interplay of single applications and the option to utilize and process additional, individual information in conjunction with minimal costs. In Saxony-Anhalt, the test results led to a thorough evaluation of forest road datasets. Its widespread use in the internal operations of the state forestry company and its service provider starting at the end of 2006 is being prepared.
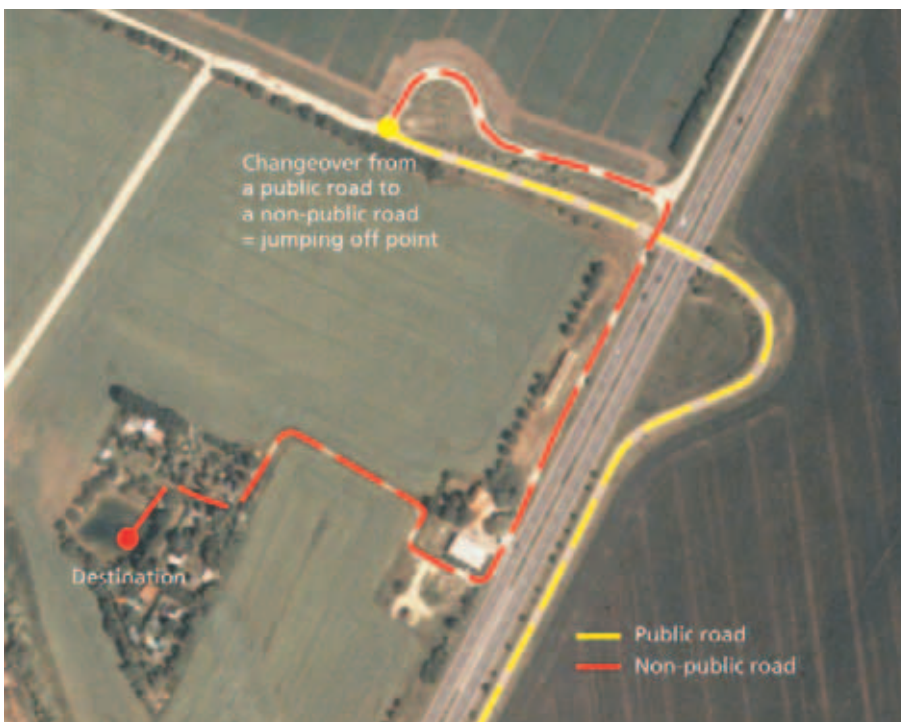

Figure 2: Junction from public to forest roads at jumping off points.
(Graphic: Fraunhofer IFF using an aerial photograpph from GeoContent GmbH Magdeburg.)

Innovation Coaching for Small and Medium-sized Enterprises

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Initial Situation

Small and medium-sized enterprises (SME) typically find it difficult to profit from European funding for innovation and research. A lack of resources, language barriers, insufficient knowledge about funding opportunities and international partners as well as the fear of losing their creative edge often prevent SME from participating in projects intended to benefit them specifically. For years, the EU, the federal government and state governments have been trying to counter this unfortunate situation with measures and initiatives - usually with less success than desired. Databases with corporate profiles, search machines and online project calls are not well known and hence seldom taken advantage of.

"Matchmaking events" predominantly have a regional or national impact - and only when systematically organized.

The general tenor is that many innovative companies would indeed be interested in EU projects yet fail to find the proper support to overcome the hurdles connected with preparing a proposal:

They desire information but only when specifically tailored to them. They desire cooperation but only when based on trust. They desire coaching as a means to self-help but do not want to pay for off-the-shelf "consulting".
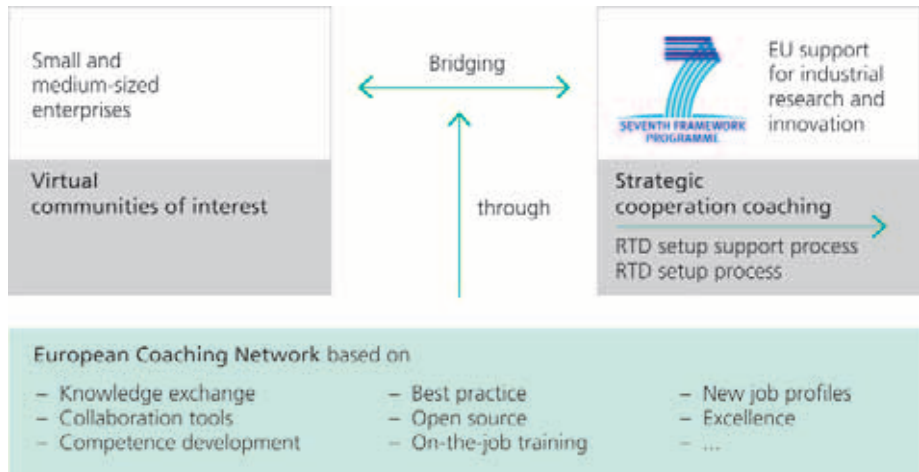

Fifure: smE-MPOWER: Bridging the divide between SME and FP7.

Approach

Under these conditions, the Fraunhofer IFF developed and is now coordinating the EU project smE-MPOWER with the stated goal to strengthen a "people-oriented" approach to regional innovation coaching - as frequently pursued by innovation relay centers - and develop it further in international collaboration.

Ten project partners from Germany, Great Britain, France, Ireland, Israel, Lithuania, Romania, Cyprus, the Slovak Republic and Switzerland - all of them SME support organizations - have been working to realize this goal since November 2005. Along with direct SME services, a European network of innovation coaches is being established, which intends to continue collaborating to share knowledge beyond the end of the project.

Results

In the course of the first project year, twenty national workshops - some of them at the Fraunhofer IFF - have sensitized over four hundred companies to funding opportunities. Some one hundred SME have expressed further interest. Forty have already participated in initial orientation talks and twenty have joined forces in twelve project proposals. Moreover, the smE-MPOWER partners are moderating the development of seven international thematic groups to specify projects as preparation to proposal writing. These thematic groups can be viewed on the project website http://www.sme-mpower.net/ and are open to interested experts and companies.

Outlook

Companies may take advantage of smE-MPOWER until October 31, 2007.

Fraunhofer IFF Gets Thai Enterprises Into Shape

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Background/Need

Thailand's economy recovered from the effects of the Asian crisis (1997-1998) relatively quickly. Thailand has experienced annual economic growth of five to six percent since 2002, its small and medium-sized enterprises (SME) contributing approximately one third of the gross domestic product.[1] Furthermore, over ninety percent of the companies registered in Thailand by the Ministry of Labor can be classified as SME.[2]

An analysis of these figures reveals that these SME decisively influence Thailand's economic power, employment rate and thus its standard of living too. Boosting the competitiveness of SME by optimizing costs and developing companies' potentials for efficiency would have a perceptibly positive effect on the socio-economic situation in Thailand because of scale effects. Yet, as the findings of the project on Information Technology and Communication in the Field of Sustainable Environmental Protection for Resource Intensive Enterprises (ASIA IT&C FORCE) carried out by the Fraunhofer IFF in cooperation with Karl Franzens University in Austria and the Asian Society for Environmental Protection (ASEP) in Thailand revealed, SME in particular still have deficits when it comes to the use of innovative business management tools.[3] Consequently, potentials for cutting costs and boosting efficiency largely remain unused.

Objectives/Approach

The primary objectives of the twelve-month project on Technology Partnership and Training Cooperation in European Management Information Systems to Enhance the Competitiveness of Thai SME (TEAMS SME) being supported by the European Commission in its Small Projects Facility (SPF) program are enhancing the competitiveness of Thai industry and advancing bilateral partnerships and cooperation between Thai and European companies and institutions. The Fraunhofer IFF is completing the project in cooperation with the Federation of Thai Industries (F.T.I) in Thailand and the Asian Society for Environmental Protection (ASEP) in Thailand.

Training and pilot implementation projects are serving to familiarize decision makers from different target groups (SME, consulting firms, government organizations and universities) with the potential applications of selected methods and tools of corporate controlling, focusing on management information systems based on company indicators. This enables them to identify potentials for optimization throughout the operational value added chain (e.g. weak point identification and process optimization based on transparent process chains) and to transfer applications to their own companies.

Fugure: TEAMS SME project kick-off workshop in Bangkok, Thailand, April 2006.

The objectives of the TEAMS SME project include:

– Enhancing the competitiveness of Thai SME by qualifying and training decision makers from different target groups in corporate management information systems,
– Transferring European know-how and select IT applications and adapting them to this specific country by piloting them locally (generation of local reference models) and
– Initiating and establishing international expert and cooperation networks.

The project is one of the numerous project activities the Fraunhofer IFF has been carrying out in Asia, specifically China, Thailand, Vietnam, Indonesia, Malaysia and the Philippines, since 1999.

Given the networks, partnerships and contacts established through these project activities, Fraunhofer IFF sees itself as a contact or "matchmaker" for companies interested in being active in Asia in the future.

To this end, user training programs on the efficient use of innovative management information systems are being conducted in various centers of industrial concentration in Thailand (e.g. Bangkok, Rayong, Chonburi or HatYai). Knowledge and know-how transfer, network building and prospective bilateral cooperation are also being emphasized. Thai and European organizations are closely collaborating on the organization and implementation of these actions.

To ensure know-how is sustainably disseminated beyond the end of the project, train-the-trainer workshops are training local experts from various Thai organizations (e.g. Thai-German Institute (TGI), Industrial Estate Authority of Thailand (IEAT), SME Promotion Office, Ministry of Industry's Department of Industrial Works (DIW), SoftwarePark Thailand) who will conduct industry training programs in the future.

The goal is to develop and consolidate networks of experts to provide for nationwide to transfer know-how of select corporate controlling methods and tools based on management information systems. Implementation projects being carried out in select medium-sized enterprises are demonstrating the practical relevance.

[1] Economic Review in Bangkok Post, Thailand 2006.

[2] Small and Medium Enterprises in Thailand – Recent Trends", World Bank Institute.

[3] Information Technology and Communication in the Field of Sustainable Environmental Protection for Resource Intensive Enterprises ASIA IT&C FORCE, 2002-2004, www.asia-itc-force.de

Statelogger: Reliable and Cost Effective Equipment Operation through Condition-based Decision Support in Maintenance Planning

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Motivation

Every technical system wears out from use. Dependable information on the current and expected condition of equipment in use and any changes over the time of its entire service life is essential to operate technical assets reliably and cost effectively. Both technical and business disciplines related to plant management base important decisions on such information on condition. It is the basis for the following tasks:

– Comprehensive **value management** of technical assets incorporating condition-based equipment value and reviewing the attainability of the service life planned for capital equipment

– Formulating a **condition-based maintenance strategy**, i.e. optimizing maintenance intervals largely by fully utilizing the service life of components while simultaneously improving equipment availability and reducing maintenance costs

– Establishing **objective evaluation criteria** to assess maintenance strategies and the internal and external maintenance service providers' work

To support equipment management, BMW AG and the Fraunhofer IFF initiated a joint project in 2003 to determine the rate of wear of technical assets in the BMW Plant Leipzig and incrementally implemented it with the active collaboration of different operators, manufacturers and maintenance service providers.
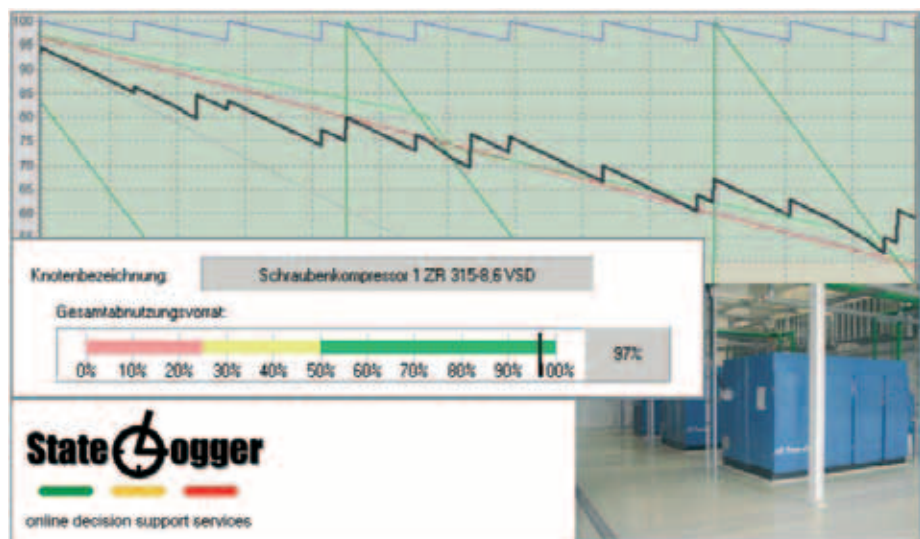

Figure 1: Analyses of pneumatic systems' reserve of wear.

Approach

The objective of this project is to develop a method and a tool that quantifies rates of wear in technical assets as characteristic values allowing for fluctuating loads. The method is based on rigorously applying the empirical knowledge of many technical experts involved in the equipment development process. The experiences of plant operators and service and maintenance providers are additionally stored and utilized.

Empirical knowledge of complex cause and effect correlations of parameters of equipment operation and resultant stresses on individual components is reproduced as a set of linguistic rules in fuzzy controllers (Figure 2).

The advantage of this form of knowledge storage system is the ease with which even complex correlations can be reproduced. Many experts' a priori knowledge is preserved and made available.

The methods ascertain fluctuating stresses through an asset's service life, converts this into consumption of components' rates of wear and visualizes it in near real time. The influences of maintenance actions are also factored in. Along with evaluating historical events of equipment operation and maintenance, forecasts of operating and failure behavior incorporating planned operating parameters can be generated and evaluated for effects on the future condition of equipment.

Results

This method has been integrated in the Statelogger software system and tested jointly with equipment operators, manufacturers and maintenance service providers. Experiences with technical assets are available for pneumatic systems, automatic guided vehicle systems and wind energy converters.

The basic results of the project are:

– Identification of potentials for cutting maintenance costs by consistently taking advantage of the advantages of a condition-based maintenance strategy
– Near real-time information on equipment condition
– Simplification and acceleration of the planning of dynamic maintenance budgets
– Optimzation of spare parts stocking and labor scheduling
– Demand-driven request for external service providers, evaluation of their ranges of services and the work they perform
– Forecast of life cycle costs
– Sustained safeguarding of equipment know-how in the form of individuals' empirical knowledge and the combination of various experts' different levels of experience
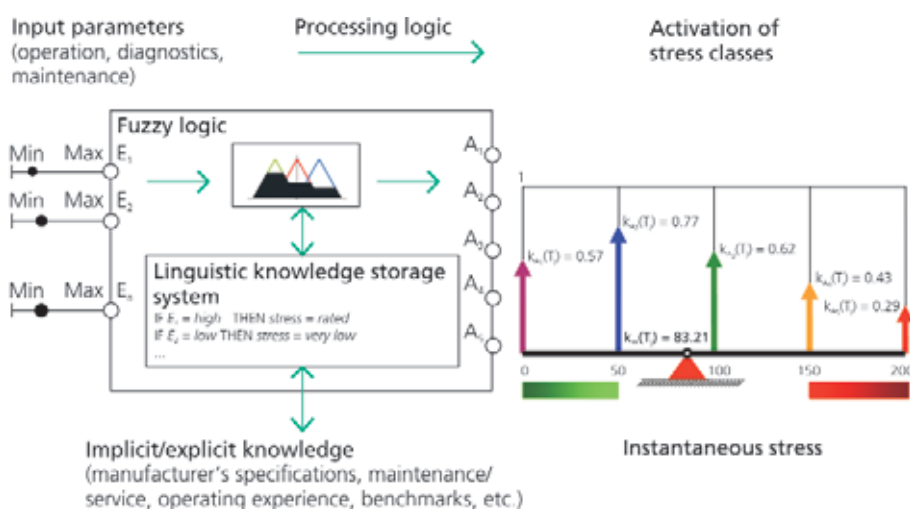

Figure 2: Method to empirically determine stresses.

Conclusion

Quantifying the rate of wear of technical assets by means of the method described supports operative equipment management and supports near real-time decision making. The evaluation system preserves individuals' know-how and supports the analysis and collection of complex data. Particularly in times of rapid decision making and increasing cost pressure, this system can enhance operative synergies. It can be customized for operative requirements and additionally strengthen equipment manufacturers, operators and industrial service providers' competitive position by offering demand-driven maintenance services.

In joint projects, the Fraunhofer IFF tests this methodology and the evaluation system for customized equipment direct on site at an operator's facilities and integrates the results in company processes.

Outlook

The Statelogger software system is an excellent basis for implementing new maintenance strategies in companies, which guarantee technical systems run efficiently, cost effectively and, above all, reliably. This approach captures empirical knowledge and provides it for reuse. In the future, the combination of this implicit knowledge with technical knowledge - for example, from technical documents of product documentation - will represent an expedientl extension. This extension will generate a unified and integrated knowledge storage system that supports the operation of technical systems with the knowledge on hand. This challenge is being met by the Plant Maintenance and Operation Services (PMO Services) developed at the Virtual Development and Training Centre VDTC in Magdeburg. PMO Services encompasses the requisite supporting products and services to design, implement, provide and operate machinery and plants.

Collaboration

– BMW AG, Werk Leipzig, Gebäude und Energie
– HSG Technischer Service GmbH, Niederlassung Leipzig
– Atlas Copco Kompressoren GmbH

Figure 3: Dynamic budgeting incorporating equipment utilization.

Project Reports:

Dependability and Quality from Robotic Systems
and Measurement and Testing Technology

SEK: Floating Inspection Unit
for Large, Partially Filled Sewer Lines

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Motivation

The Emschergenossenschaft in Essen is currently planning the emscher:kanal, arguably the largest residential water project in Europe. Large parts of the sewer system will be constructed as a one line gravity sewer system that continually drains sewage from the catchment area. This will make walk-through and manual inspection of the sewer system impossible.

In 2002, the Fraunhofer IFF was engaged as the general contractor to develop automatic sewer cleaning and inspection systems. It is essential to be able to inspect the sewer lines with diameters of 1,400 to 2,800 millimeters that are partially filled at least 25 percent during operation. The sewer system has a total length of approximately 51 kilometers and lies between 5 and 40 meters underground.

One objective of the project was to prove the feasibility of the damage detection unit (SEK) that rapidly executes a primary inspection of the sewer lines.
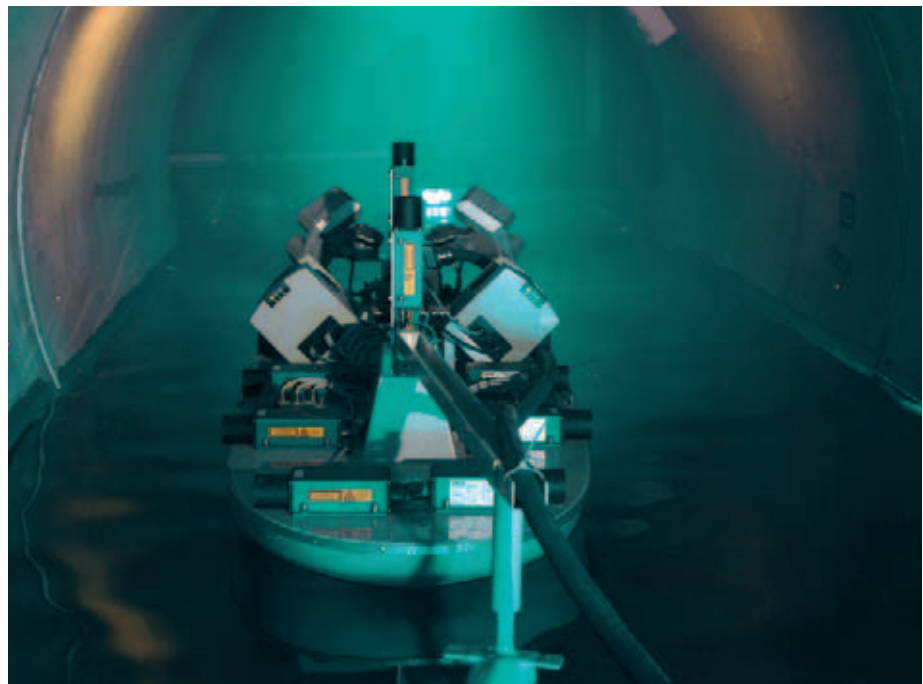

Figure 1: Sewer inspection with a prototype damage detection unit.

Concept Development

The damage detection unit pre-inspects the entire sewer. Attention was principally given to detecting major abnormalities such as material removal, deposits, obstructions and leaks in the gas space.

During the project, the following main components of the SEK were designed, tested for feasibility and further developed to meet requirements:

– Carrier system to position the SEK in the sewer line
– Sensor and measuring systems to inspect pipe condition above and below the waterline and to detect deposits
– Media supply system (power, data communication)
– Control system, navigation, operator control

The SEK floats autonomously and maintains its centric position in the sewer line during inspection. A media supply cable connects the SEK with the control station. The flow of sewage carries the SEK passively along the longitudinal axis of the sewer line. The media supply cable is used to control it.

For test and demonstration purposes, the SEK was designed to be deployable in conventional sewer lines

Implementation

Two SEK prototypes were built and then tested under real conditions in different sewer lines.

The SEK employs a multi-camera array. It visually inspects the gas space with greater accuracy than conventional commercial steerable tractors. The multi-camera array is additionally extended with a light sectioning system to detect features in the gas space such as joint width and pipe offset. An ultrasonic sensor detects deposits and mechanical wear in the water space. Additional video cameras supply the operator more visual information on the sewer's condition.

A pilot series of the SEK will be built, tested in the real sewer system and optimized by the end of 2007.

Figure 2: SEK damage detection unit for preliminary inspection of large sewer lines.

Cleaning System for the Exterior Surfaces
of the Roof of Berlin Central Train Station

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Initial Situation

In April of 2005, the Fraunhofer IFF was contracted to develop a semiautomatic cleaning system for the glass roof of Berlin's new Central Train Station. The Fraunhofer IFF had submitted a technical concept beforehand and, after bidder discussions and contract negotiations, was awarded the contract.

Deviating from the bidding specifications, the concept proposed utilizing one device for nearly all the roof surfaces to be cleaned, including those supposed to be cleaned manually. This was the reason the inspectors of vertical access and safety equipment gave the submitted concept an excellent rating.

The roof surfaces to be cleaned encompass the entire glass roof from the ridge to the eaves. The length of the roof from east to west is 278 meters with a maximum width of 66 meters. The slightly curved tubular shape that tapers at the ends gives every pane a different dimension. The otherwise continuous glass surface is interrupted around the main girder by prestressed arches that emerge from the point of zero tension in 13 meter intervals.

The surface has a maximum gradient of nearly 90 degrees. Diagonally running snow guards are mounted at three heights. Approximately 17 centimeters high, they constitute a particular obstacle for the cleaning system. The north-south roof, not yet complete at the time the contract was awarded but finished in April 2006, runs perpendicular to and intersects the east-west roof at an angle of roughly 17 degrees, thus producing a parallelogram-shaped crossing in the overlapping area and wedged shape secondary surfaces (pie slice) on the east-west section. The north-south roof only inclines to a gradient of approximately 20 degrees. Nearly 200 meters long and 42 meters wide, it has significantly smaller surfaces. The roof has a total area of approximately 28,000 square meters.

Gantries and smoke and heat vent flaps are located in the area of the roof ridges. Other gantries for maintenance and supply and fresh air flaps are located in the area of the eaves of the east-west roof. The gantries facilitate the transport of individuals and material along the entire length of the roof without having to step upon its surface. Travelling hoppers bridge the distance between the two roofs' gantries running transversely to one another.

Figure 1: The glass roof of Berlin Central Train Station.
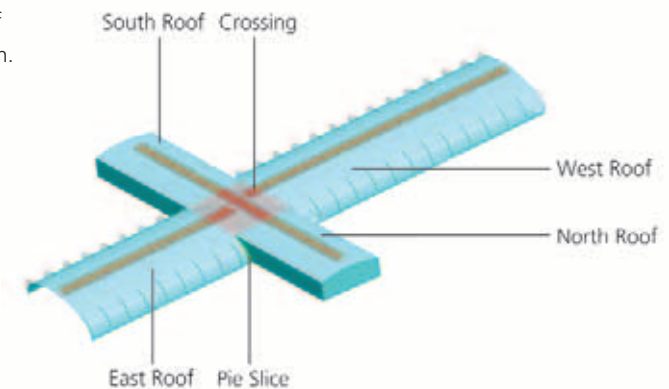
Approach

The submitted concept for cleaning the roof areas described was refined and implemented in the course of the project. The finished system was named Filius.

The key feature of this radio controlled cleaning system is its big balloon tires that enable it to drive over the snow guards. All-wheel drives also enable Filius, with the help of ramps, to navigate the gantry rails and expansion joints between the roofs and clean in the roof ridge. This made it possible to later eliminate tilting rails for the east-west roof, which were intended to set the unit down.

A project team of design engineers, electrical engineers and control systems engineers rapidly implemented the proposed concept. Two cable winches that lower the system to a right angle were integrated. Located in a particular area, the gantry secures and supplies Filius. A roller brush with extremely long bristles (similar to those in a carwash) cleans the building gently and effective with softened water.

Apart from internal coordination, project management included the compilation of documentation for technical inspections, external coordination with the on site construction firm and consultation with the construction site supervisor, safety supervisor and pertinent subcontractors, e.g. the gantry manufacturer.

Results

Tests of Filius' functionality on the roof of the train station and of partial cleaning were conducted in spring of 2006.

After a lengthy approval phase, the functionality was demonstrated in the most difficult to reach, wedge-shaped sections of the east-west roof and accepted in October.

The Filius cleaning system will commence regular operation in 2007. Thus, the management of Berlin's new Central Train Station will have a highly efficient cleaning tool operated by one to two staff members of DB Services AG. This will greatly reduce the costs incurred for manual cleaning, normally in the mid five figures.

The client already presented the system at work in a television reportage.

Figure 2: Performance tests on the roof of Berlin Central Train Station. The client has already presented the unit's at work in a television reportage.

Figure 3: Filius at the uppermost snow guard.

Wheelset Measuring Machine: Automatic Geometry Measurement of Train Wheelsets

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Motivation

The interaction between wheel and rail stresses the wheels of rail vehicles tremendously. Wheel geometry, the wheels' radial and axial runout tolerances, the distance from the inner wheel faces and the quality of bearing surfaces are critical quality parameters for safe and reliable rail vehicle operation and riding comfort. As train speeds continue to increase, using objective measurements to assure quality parameters is extremely important both when wheelsets are manufactured and in operation.

Wear on wheelsets' running surfaces limits their useful life. After several thousand kilometers, a worn wheel profile must be measured and reprofiled on the basis of the measured data.

Manual inspection, which cannot ensure every quality parameter is reliably and fully measured and documented, is still frequently employed to measure wear on wheels and wheelsets.

On the other hand, automatic scanning of all of a wheelset's geometric quality parameter enables objectively and fully capturing and documenting data in just a few minutes. Once this data has been analyzed, the setpoint values for reprofiling a wheelset can be specified. In a second measuring operation that follows, the newly machined wheelset profiles are compared with the setpoint values calculated beforehand. Thusly reconditioned train wheelsets are significantly safer and more reliable to operate and have considerably longer service lives.

Figure 1: Installed measuring machine.

Procedure and Measuring Principle

The automatic geometry scanner OptoInspect 3-D captures every relevant geometric quality parameter of train wheelsets. This measuring machine picks up a wheelset and sets it rotating and then scans every geometric feature. Data is acquired by clusters of optical line and point sensors that operate without contact and on the basis of the triangulation principle (Figure 1).

The measuring machine has a modular design and consists of a wheelset handling module and a wheelset measuring unit.

The wheelset handling module automatically places wheelsets in and removes them from the elevating position, lifts them into the clamping position and clamps them between two spindle sleeves located on two axially positionable tailstocks so the wheelset can be centered on the machine (or floated into position in the jargon). The spindles are pivoted so the wheelset turns on its own axis.

A friction drive turns the wheelset continuously so every relevant geometric feature can be scanned. The spindles are equipped with measuring systems to ascertain the particular angle of rotation. A PLC controls the operation, monitors all safety functions and communicates with peripheral systems, e.g. the transport system and quality assurance system.

The components of the wheelset measuring unit are mounted on a stable granite slab precisely aligned with the wheelset's axis of rotation (spindle axis). Installed on linear guides, each of a total of five sensor clusters can be adjusted radially to the wheelset axis. These position the sensor clusters precisely regardless what wheel diameter is being measured. The centrically mounted sensor cluster can additionally be designed to be axially adjustable to also scan geometric features on brake discs if present. Optical sensors capture data entirely without contact. A PC controls the motion systems, captures data through the sensor clusters and evaluates and logs the data. PC and PLC communicate through digital input and output and a serial interface.

The wheelset measuring unit performs two jobs. One hand, it determines the wheelset and wheel profile coordinate systems and, on the other hand, all the wheelset's relevant geometric parameters. The wheelset coordinate system is a cylindrical coordinate system and the basis for every dimension pertaining to a wheelset.

Results

The Fraunhofer IFF additionally developed contactless optical 3-D measuring systems that operate faster and more precisely than their mechanical predecessors. These allow online three-dimensional geometry inspection directly in the manufacturing environment.

This wheelset measuring machine has been commissioned at a German railway technology company and certified by the Deutsche Bahn AG's measurement and calibration division.
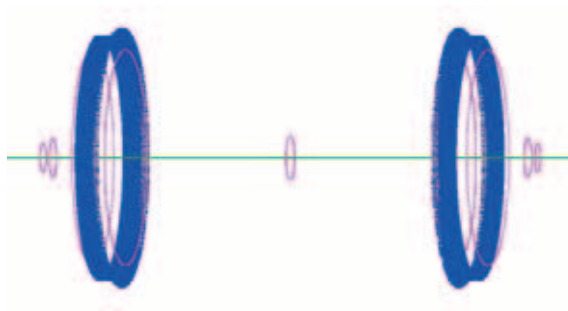

Figure 2: Optical sensor cluster that captures profile characteristics.

Figure 3: Measurement dataset of a typical wheelset.

In-line Geometry Inspection of Automobile Wheels: Automatic Geometry Data Extraction

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An automobile wheel's exact geometry is critically important for driving comfort and safety. The metal parts must be manufactured precisely so that the rubber tires fit perfectly and run true. The high level of automation in industrial manufacturing necessitates just as highly automated procedures in quality assurance. Until now, manufacturers have usually checked wheel quality with mechanical calipers that glide over a rotating wheel in a test bench. New optical measuring technologies and methods of analysis are now making one hundred percent inspection possible here too.

A complex 3-D measuring machine for in-line automobile wheel geometry inspection was developed at the Fraunhofer IFF together with industrial partners. The automatic geometry data extraction system's innovation as well as particular challenge is the variety of wheel designs and dimensions.

In principle, the measuring machine consists of three units: An image-based part identification unit, a 3-D measurement and analysis unit and a mechanical classification unit that sorts wheels based on the result of measurement. After it has been fed in, the wheel is secured by the measuring machine and a sensor cluster captures its geometry. The sensor cluster consists of four light-sectioning sensors that generate 3-D data on the basis of the principle of optical triangulation. Line scanning sensors capture the areas on the bead seat and hub, point scanning sensors the geometries on the bolt holes.

Figure 1: Measuring machine for in-line automobile wheel geometry inspection.

The sensor cluster is mounted on rotary and lateral feed axes positioned according to the type of wheel automatically identified beforehand. Thus, the system automatically inspects the geometry of every type of car, SUV and motorcycle wheel between 13 and 24.5 inches. Roller conveyers integrate the complete system directly in the manufacturing process so that every single wheel can be inspected.

Once the 3-D data has been acquired, all the measurement data is exported to a PC where the measurement data from all sensors is combined in an overall 3-D image typically consisting of more than one million 3-D coordinates. The computer extracts and analyzes the features. Intelligent algorithms determine the

orientations and dimensions of part geometries fully automatically, detecting even the smallest deviations of shape and position, which drivers would notice as unpleasant vibrations and noise. Apart from a wheel's bead seat, the hub bores and bolt holes used to align and secure a wheel on the vehicle's axle are particularly important.

These methods of data acquisition and evaluation can be employed flexibly and are suited for many applications and products, which require the precise measurement and inspection of three-dimensional geometries.

Figure 2: Automatic acquisition of wheel geometry data in the 3-D measuring machine.

Figure 3: Digitized 3-D data of a wheel's bead seat and rim.

Model-based Completeness Check
for Assembly Processes

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Quality assurance in industrial assembly processes represents a great challenge for manufacturers. The methods in use predominantly perform an inspection after assembly and identify defective parts, which are then sorted out as rejects or for reworking. However, widely varying small lots or production runs frequently require more flexible inspection that already intervenes during incorrect assembly. That is why the Fraunhofer IFF developed a novel system that provides workers support during assembly to prevent errors caused by selecting components or assembling items incorrectly.

The system consists of a mobile augmented reality or AR system (see Figure 1) connected with an image processing system. Augmented reality supplements visual perception with virtual information. The mobile AR system inserts information on the ongoing assembly process directly in a worker's field of vision by means of a head mounted display (HMD). This information may consist of both textual information (part numbers and the like) and 3-D elements overlaid in the correct position.

Suitable see-through calibration was developed and implemented in order to always display 3-D elements in their correct positions in the HMD. Since the position of every component installed is known from stored CAD data, the display is generated to match the situation (e.g. a square is in the correct assembly position). As a result, the correct assembly position and sequence is specified at the outset.

CAD data and a continually refreshed camera picture of the real assembly provide the image processing system information on the target state of the assembly being assembled. The CAD data corresponds to the design data and can be imported directly from design programs. A virtual view representing the assembly from the view of the real camera (Figure 2) is generated from the CAD data. Components marked for inspection in the CAD data are extracted from the virtual view and localized in the camera pictures by a rapid and reliable search method. If an object cannot be localized, e.g. because a worker selected the wrong part, the assembly is assessed to be incorrect.

The information on the correct or incorrect installation of a component is forwarded together with the related object position to the AR system, which informs the worker about the incorrect assembly through appropriate visual information (Figure 3). Since this information is inserted directly in the worker's field of vision, the worker can react immediately when an error occurs.

This type of completeness check provides manufacturers the advantage of having workers already inspect quality during the assembly processes and eliminating subsequent downstream inspections. Moreover, the direct import of CAD data makes the system extremely flexible and able to react to design changes promptly.

Figure 1: The worker supporting AR system.
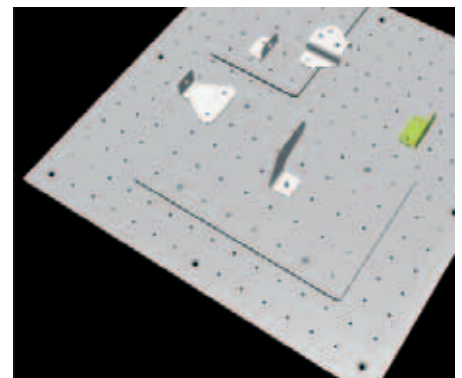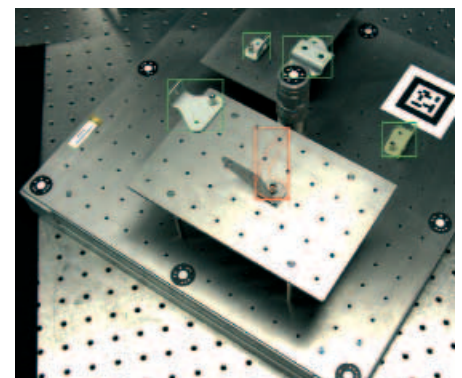

Figure 2: CAD model of an assembly.

Figure 3: Result of inspection with correctly mounted components (marked green by the system) and an incorrectly mounted component (marked red).

PARNASS: Parallel Assembly
of Nanoscale Objects

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Initial Situation

Nanoscale structures are usually manufactured by applying chemical processes such as chemical vapor deposition (CVD) or focused ion beams (FIB) or by systematically manipulating individual objects with scanning probe microscopes.

The outcomes of chemical processes always exhibit a stochastic distribution, which can be tolerated in many applications or is even advantageous (e.g. nanoscale surface coatings). More complex structures consisting of several functionally configured elements cannot be manufactured this way. To a certain extent, this can be done by manipulating individual objects. However, a serial approach is highly ineffective and hardly suited for a production process.

Approach

Self-organization concepts provide one way to effectively manufacture complex nanostructures. Just as gravitation or spring force can be expediently used for macroscopic assembly tasks, forces can, in principle, be used on the scale of a few nanometers to support assembly operations.

On a scale of approximately one to one hundred nanometers, electromagnetic fields and thermodynamic effects basically cause different types of forces act between objects of the same order of magnitude. The range and effect of these forces differ fundamentally from their known macroscopic effects and their nature and interaction have been researched little so far.
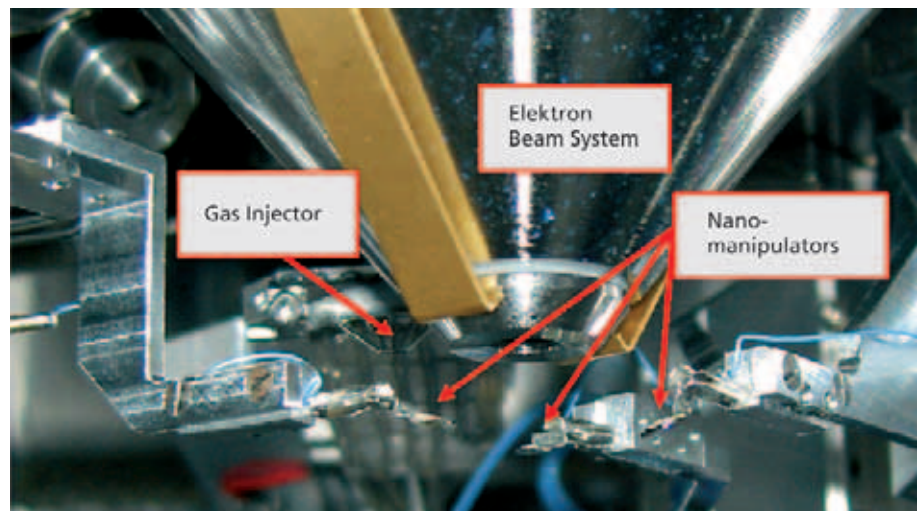
Figure 1: View of the ion beam chamber with integrated nanomanipulators. (Courtesy of Raith GmbH.)

Before these forces can be used for self-organizing and highly parallel nanoscale assembly, the aforementioned mechanisms have to be fundamentally and thoroughly understood.

This is the task the EU project PARNASS (parallel nanoassembly directed by short-range field forces) headed by the Fraunhofer IFF is tackling. The interaction of various nanoparticles and substrates is being tested theoretically and experimentally and special analysis and manufacturing tools are being developed in collaboration with researchers at the Swedish universities of Halmstadt and Lund, the Spanish University of Taragona, the University of Leipzig and the ion beam equipment manufacturer Raith GmbH in Dortmund. Special emphasis is being given to the question of how skilful selection, chemical modification and mechanical structuring of nanoparticles and a substrate can facilitate self-organizing assembly processes. If this approach functions, it will be possible to use state-of-the-art and relatively well established technologies, for example, to manufacture highly selective chemical sensors

with extreme sensitivity up to a single molecule cost effectively and in large quantities.

In the PARNASS project, the Fraunhofer IFF is building upon experiences from a number of projects in the field of micro and nanomanipulation and their metrology to develop systems that handle individual carbon nanotubes (CNT) and carbon nanowires (CNW) and measure the forces interacting between particles and a substrate.

These measurements will serve as the basis for verifying theoretical models of their interactions. These forces acting both normally and laterally to the surface have magnitudes in the range of a few tens of piconewtons (10 - 11 … 10 - 10 newtons). This makes extreme demands on the measuring and analysis systems. The measuring system will be integrated together with various handling systems in an ion beam system's vacuum chamber to structure the substrate and to conduct the experiments (see the experimental setup in Figure 1).

Results

The findings obtained about the forces acting in the nanoscale range will make it possible to develop technology for self-organizing assembly CNT and CNW. The proof of concept will be provided at the end of the project by, among other things, lab prototypes of sensors manufactured by the self-organizing assembly of functionalized CNT and CNW on a specially structured substrate, which are suitable for the selective detection of proteins such as antibodies. Such a sensor has dimensions on a nanometer scale (see Figure 2). Only detectable molecules (green in Figure 2) can bond to the receptors of the functionalized CNT. This alters the current flow through the CNT. Other molecules (red) do not bond and, hence, do not affect measurement.
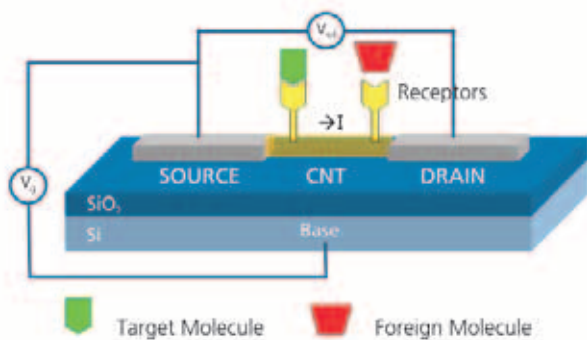

Figure 2: Schematic of a molecule-sensitive field effect transistor with functionalized CNT.

Combined Image and Inertial Sensor Based Gait Analysis

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Initial Situation

Objective motion analyses are extremely interesting in medicine both for diagnostics and the evaluation of the success of therapy. Potential uses of motion analyses exist in out-patient and in-patient treatment, particularly rehabilitation, and medical research.

Existing motion analysis systems are only used in medicine to a limited extent, primarily in research. Reasons for this are the constraints the use of motion analysis systems entails.

The following aspects stand in the way of their practical use:

– Long, personnel-intensive evaluation times
  • Elaborate postprocessing of recorded data
  • Poor evaluation of motion sequences of interest
– High equipment costs
– Complex preparation and operation
  • Application of markers to points on joints
  • Positioning of numerous cameras from various perspectives (to eliminate obscuring)
– Major influence of errors on reconstructed trajectory curves

Hence the project consortium set itself the goal of developing a motion analysis system that supports the analysis of motion sequences with little cost for equipment and a concept for easy operation.
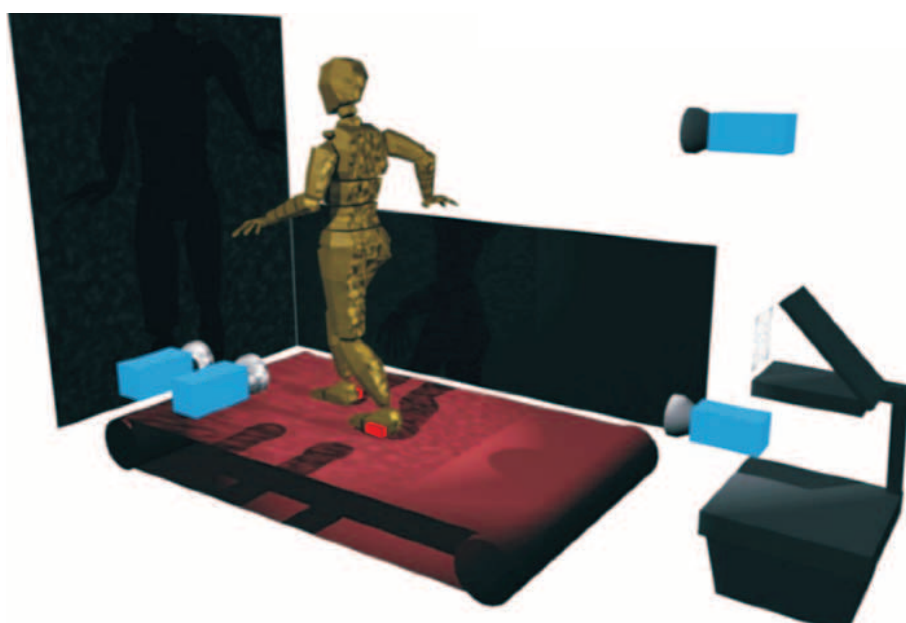

Figure 1: Camera cluster (blue) with inertial sensor system (red).

Approach

The project partners designed a 3-D motion analysis system that applies a novel approach to meet the target requirements. The heart of this motion analysis system is a camera cluster that tracks the positions of joints based on a body model and without target markers. The system's cameras are focused on the scene of the motion sequence from only two perspectives. A kinematic sensor system (inertial sensors) affixed to the subject supports the camera cluster.

The motion analysis system was tested on a medical gait analysis test setup with cameras arrayed alongside and behind the direction of motion and the inertial sensor system (see the schematic in Figure 1).

The system was outfitted with a synchronization and start unit that enables all the sensor units to record data synchronously. The optical and kinematic sensor units supplement one another when data is being recorded. The inertial sensor

system records rotation rates and accelerations with approximately ten times the frequency of the camera cluster. Information from the inertial sensor system compensates when something is obscured from the camera cluster, thus making it possible for the optical sensor system to employ standard cameras instead of expensive high-speed cameras and to reduce the number of cameras needed.

Reference positions obtained from the optical sensor system compensate for the inertial sensor system's weaknesses, e.g. signal drift during data acquisition over several seconds. A picture of a subject equipped with inertial sensors is reproduced in Figure 2.

Among other things, the inertial sensor system's precise determination of gait phases enhances the system's practicability. The times of the gait phases (stance, preswing, midstance, contact) are detected to the precise millisecond and enable the optical sensor system to exactly assign the image sequences to the gait phases. This considerably simplifies the

analysis algorithms for image data processing and serves as the basis for automatic online analysis of image sequences, thus simplifying operation for system users.

Another option to reduce the system's complexity is to apply the "analysis through synthesis principle" to the motion analysis. This principle relatively simply compensates for sensor data missing from the recorded motion sequence. This method is based on a frame model from which joint angles are taken and a body shape model with which recorded motion data is verified. In motion analysis, successive motions from the model are simulated in an interactive process and verified with the real motions recorded. This process no longer depends on the actual motion sequences being recorded absolutely correctly and completely .

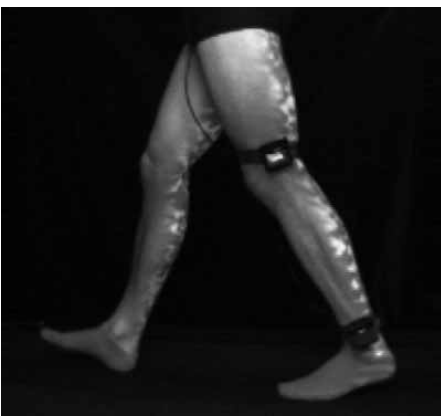The body frame model and body shape model are presented in Figures 3 and 4.

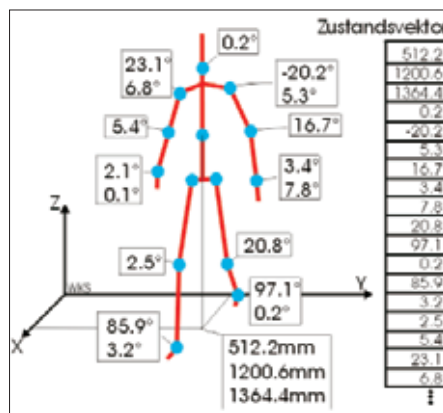Figure 2: Subject with inertial sensors (recorded by one of the system's cameras).
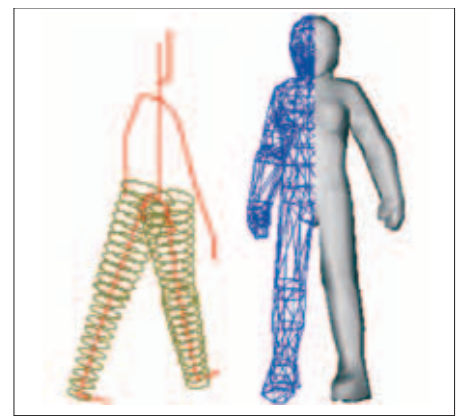

Figure 3: Body frame model.

Figure 4: Body shape model.

Results

The project consortium created a pilot gait analysis system in the course of the project. The system's practicability was demonstrated in principle. In addition, extensive tests were performed, e.g. at a clinic at Magdeburg University Hospital.

Further development of the motion analysis system into a product for a concrete analysis task is planned in other stages of work.

Project Framework

The joint project on 3-D gait analysis in neuromedical technology was carried as an InnoMed project in the InnoRegio program line of the Federal Ministry of Education and Research's innovation initiative "Entrepreneurial Regions". Otto von Guericke University Magdeburg's Department of Electrical Engineering, Signal Processing and Communication Technology (IESK) and the Fraunhofer IFF were involved in the project as research partners and INB Vision AG and SYMACON Bildverarbeitung GmbH as industry partners.

Gas Conditioning for Fuel Cells

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Initial situation

In light of the growing scarcity of fossil fuels, the signatory nations that pledged to protect the climate in the Kyoto Protocol reached an agreement to reduce CO_2 emissions by 2012 by 5.2 percent compared to 1990. Given this background, renewable energies hold great potential for the future.

One potential use of renewable fuels is anaerobic conversion of biomass into biogas with the aid of microorganisms. Its methane content of 50 - 70 percent makes it usable as energy in fuel cells. Fuel cells' direct conversion of the chemical energy from the fuel gases used into electrical power and their particularly high electrical efficiencies, low noise, substantially reduced emissions and ideal conditions for cogeneration will make them extremely important for the production of electricity in the future.

Approach and Results

"High Temperature Fuel Cells for Use in CHP" is a collaborative internal Fraunhofer-Gesellschaft project between the Fraunhofer Institute for Ceramic Technologies and Systems IKTS, the Fraunhofer Institute for Environmental, Safety and Energy Technology UMSICHT and the Fraunhofer Institute for Factory Operation and Automation IFF, which is developing a gas conditioning system.

The system consists of a planar SOFC stack, a gas cleaning and reforming unit and an afterburner and humidifier to generate two kilowatts of electrical power as a scalable prototype for power supply systems powered with biogas with output in the range of one to ten kilowatts of electricity. A prototype to be built by 2007 will then convert pre-cleaned biogas into electricity.

The Fraunhofer IFF is working on reforming biogas with the goal of generating a fuel gas (CO, H_2, CH_4) usable in the fuel cells. A comprehensive simulation study identified the operating conditions that allow stable autothermal operation of a reformer without coking the catalyst and downstream system components.

Building upon this, the researchers from the Fraunhofer IFF engineered the reformer and tested its steady-state operation and startup and shutdown operations on a lab test bench (Figure 1).

Along with its work on biogas reforming, the Fraunhofer IFF is working in the project on developing gas potentiometric oxygen probes (GOP) (Figure 2). When they come in contact with a gas being analyzed, these sensors deliver a voltage signal from which gas composition can be determined. This type of sensor makes it possible to analyze gas mixtures in situ, i.e. where they originate, at higher temperatures (> 800 °C) without sampling. The probes developed at the Fraunhofer IFF are implemented to control certain system components, particularly those of the reformer and the afterburner.

In addition, the Fraunhofer IFF is developing the complete control system for the prototype with a computer unit to record and archive the quantities of data that accrue during test operation. The collected data can be utilized for a detailed analysis of a test.

The hardware being employed for the prototype is split into two separate subunits:

– A control cabinet with programmable logic controller and
– 19 inch rack components for process visualization and data archiving.

The control unit is designed for real use and for industry. The computer unit for visualization and archiving has been designed to be redundant and failsafe for the relevant test data. Once a precise estimate of the scope of programming and the connected peripherals has been made, the control unit will be optimized for product launch.
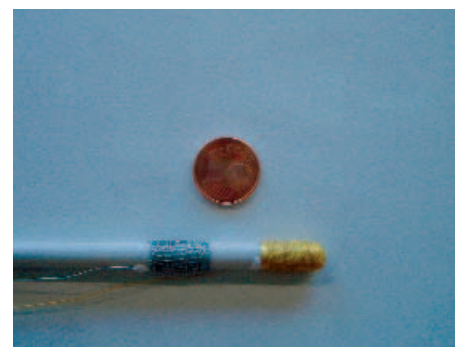

Figure 1: Autothermal reformer lab test stand.

Figure 2: Gas potentiometric oxygen-solid electrolytte probe for gas analysis.

Experimental Circulating Fluidized Bed Combustion Plant for Research and Teaching

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Hanoi University of Technology (HUT) contracted the Fraunhofer IFF to engineer and construct a circulating fluidized bed combustion plant (CFBC). The plant is intended to support both academic training of engineers and scientific research.

In particular, research will emphasize the transfer of knowledge about CFBC technology as well as the testing of burn-off and emissions characteristics of solid fuels in CFBC. Not only fossil fuels but also biomass (rice husks, wood and reeds) are particularly interesting.

The parameters of the CFBC in Vietnam are:

– Thermal power: 50 kW
– Bed dameter: 100 mm
– Height of combustion chamber: 7 m
– Primary volumentric flow:150 Nm^3/h
– Secondary volumentric flow: 80 Nm^3/h

By varying the fuel metering system, the reactor can be charged with fuels with different characteristics, e.g. size, lumpiness, shape and homogeneity, and at a mass flow of a maximum of ten kilograms per hour. The reactor maintains a nearly constant temperature of up to 900 degrees Celsius. Thus, little NO_x is produced and ash is prevented from fusing.

The circulating fluidized bed reactor is equipped with extensive metrology, e.g. volumetric flowmeter, thermocouples and pressure sensors. A programmable logic controller (PLC) displays and stores every measured value. In addition, the PLC can be used to set diverse process parameters such as the quantity or the temperature of the air fed in.

Figure: Erection of the circulating fluidized bed combustion plant or CFBC in Vietnam.

ALFA Growth Core:
Fiber Composites from Saxony-Anhalt

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The Growth Core Allianz Faserverbünde (ALFA) is an association of several manufacturing companies, the Fraunhofer Institute for Factory Operation and Automation IFF Magdeburg, the Fraunhofer Institute for Reliability and Microintegration IZM Berlin, the Fraunhofer Institute for Applied Polymer Research IAP Potsdam and Otto von Guericke University Magdeburg. The Growth Core's goal is to establish mass production of fiber composite materials with a broad range of products in Saxony-Anhalt.

To this end, products and manufacturing methods distinguished by superior functionality and cost effective manufacturing will be developed in numerous projects. The project "Hollow Profiles" in which the Fraunhofer IFF is significantly involved is intended to develop an automated method to manufacture hollow profiles. Since they are constructed from fiber composites, they are particularly strong and lightweight.

Users were already able to convince themselves of the product's advantages in the phase of prototype development. The hollow profiles' properties make their use in the range of products interesting.

Particular challenges in the project are automating the processing of fiber composite materials into a flexibly adaptable hollow profile and developing connecting elements. Intensively optimizing the process and performing a wide-ranging product analysis will be the basis for a broad market launch of the hollow profiles.

Other partners in the project are Otto von Guericke University Magdeburg's Department of Mechanical Systems IFME, H & B Omega Europe GmbH in Osterweddingen and the Innovations-Zentrum Mineralguss BÄR in Haldensleben.
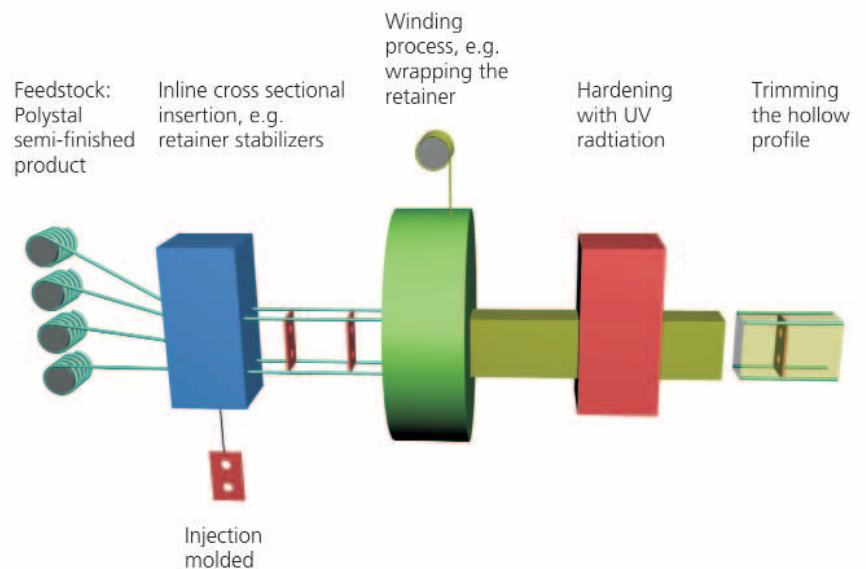

Figure 1: Reinforcing profile for window construction.

Feedstock: Polystal semi-finished product

Inline cross sectional insertion, e.g. retainer stabilizers

Winding process, e.g. wrapping the retainer

Hardening with UV radtiation

Trimming the hollow profile

Injection molded

Figure 2: Concept for hollow profile manufacturing technology.

On the Long Night of Science
in Magdeburg on May 20, 2006,
researchers presented the walking
robot "Katharina" equipped with
state-of-the-art sensors.

Photo:
Andreas Lander/
City of Magdeburg

Leading production logistics researchers gathered at the Fraunhofer Institute for Factory Operation and Automation in Magdeburg on January 13, 2006 to hold a colloquium on the occasion of the seventieth birthday of Prof. Eberhard Gottschalk, founder and former director of the Fraunhofer IFF. Former BVL chairman Dr. Hanspeter Stabenau congratulated the birthday boy and delivered congratulations and a present from the BVL board..

Former Chairman of the Board of the BVL Dr. Hanspeter Stabenau presented the birthday boy the BVL board's present, a sculpture by the Worpswede artist Waldemar Otto.

January 13, 2006, Magdeburg
Colloquium Honoring Institute Founder Prof. Eberhard Gottschalk on his Seventieth Birthday

January 15-19, 2006, San José (USA)
Electronic Imaging 2006 (Conference)
Exhibit:
– Real-time Detection of Elliptical Shapes for Automated Object Recognition and Object Tracking
Contributor:
Christian Teutsch
Dirk Berndt

January, 16-18, 2006, Bilbao (Spain)
SEVENPRO Project Kick-off
Contributors:
Dr. Eberhard Blümel
Heike Kissner
Matthias Strauchmann
Dimitri Giwerzew

February 14, 2006, Kaiserslautern
Cooperation in Applied Research (Workshop)
Fraunhofer Vision Alliance with Partner Enterprises
Contributor:
Dirk Berndt

February 14-16, 2006, Karlsruhe
LEARNTEC 2006 (International Convention and Trade Fair for Educational Information)
Exhibits:
– Virtual Interactive Training
– Virtual Manuals
Contributors:
Heike Kissner
Michaela Schumann
Wilhelm Termath

March 1, 2006, Magdeburg
8th HLA Forum
Direction:
Dr. Steffen Strassburger
Marco Schumann

Plant Engineering of the Future
(Conference)
Key Topics:
– Virtual Reality
– Eastward Expansion of the EU
– Trends in Plant Engineering
Supporting Program:
Exhibition, Cooperation Exchange
Exhibits:
– ViVERA, Coupling Real Controls and
  Virtual Models
– smE-MPOWER Project
Direction:
Prof. Michael Schenk
Contributors:
Dr. Martin Endig,
Katrin Reschwamm
Marco Schumann
Andrea Urbansky

NEAC Conference: Competence
Assessment Slovenia
Virtual Engineering of Products and
Processes (Workshop)
Contributors:
Dr. Eberhard Blümel
Tina Haase

CeBit 2006
Exhibits:
– ViVERA
– Off-road Navigation Solution and
  Smart Pallet
– Presentation of the project "ProWis:
  Process-oriented and Integrated
  Knowledge Management in SME"
Contributors:
Marco Schumann
Heike Kissner
Dr. Ina Ehrhardt
Dr. Klaus Richter
Stefan Voigt

On March 2 and 3, 2006, experts from business and industry, the academic and research communities and government dealt in Magdeburg with the trends, opportunities and challenges in plant engineering. At the fourth conference on "Plant Engineering of the Future", industry experts discussed how to gain competitive edges in plant engineering.

At the accompanying exhibition, Torsten Böhme from Fraunhofer IFF presented a coupling of a real Siemens control system with the virtual model of a heavy machine tool.

The Fraunhofer IFF was represented at CeBit at the joint stand of the Ministry of Education and Research (BMBF), a special satellite navigation stand and a stand for the Ministry of Economics and Technology's (BMWi) initiative "Fit for the Competition for Knowledge" in the SME Forum. ViVERA exhibits at the BMBF's joint stand aroused great interest. After all, virtual reality (VR) makes it possible to run crash tests on a computer or install a new machine tool in an existing production facility even before the first prototype has been built. The ViVERA Network of Competence intends to make this technology accessible to small and medium-sized enterprises too.

Marco Schumann from the Fraunhofer IFF (2nd from l.) shows Dr. Bernd Reuse (m.), then Head of the Software Systems Department at the BMBF, the ViVERA exhibits at the BMBF's joint stand.

The nine speakers at the 9th Logistics Guest Lecture Series 2006 "Logistics as a Field of Work of the Future: Potentials, Implementation Strategies and Visions" illuminated various thematic fields of logistics. They highlighted how their organizations are tackling current market challenges (shorter delivery times, increasing product complexity, increasing diversity of variants, etc.) with the aid of logistics and using logistics as a competitive edge. Altogether 1,200 attendees came to the Fraunhofer IFF to find out about leading organizations' logistics concepts. A highlight of this year's lecture series was the presentation by Jens Wollesen, member of executive management at Kühne + Nagel. Wollesen spoke on the concept "Supply the Sky: Integrated Logistics Concept for the Aviation Industry" for which Kühne + Nagel won the 2005 German Logistics Award. The "Supply the Sky" logistics concept developed over the last ten years by transferring proven methods from other areas of application makes the aircraft the focus of activities in every phase of the life cycle. Thus, Kühne + Nagel provide logistics services of the highest quality standard worldwide, from development and manufacturing to operation up through maintenance and in-flight services. Other highlights included the presentation by Jürgen Hupe (AIRBUS) on aircraft life costing and the presentation on "Logistics Surrounding the 2006 FIFA World Cup in Germany" by Stefan Hans (FIFA WC Organization Committee) and Christian Schultze (SCHENKERglobalsportsevents).

The speakers from industry drew audiences and filled the conference rooms at the Fraunhofer IFF.

March 22-23, 2006, Brussels (Belgium)
EIRAC Project (Workshop)
Contributor:
Dr. Eberhard Blümel

March 30-31, 2006, Shenzhen (China)
China-Europe Forum on eLogistics
(International conference organized as part of the project eLOGMAR-M)
Direction:
Dr. Eberhard Blümel
Dr. Steffen Strassburger
Contributor:
Kay Matzner

March 30-31, 2006, Berlin
6th Service Day of the Federal Ministry of Education and Research
Exhibit:
– Presentation of the project "One-Stop Services for Global Inndustrial Manufacturing"
Contributor:
Jörg von Garrel

April 3-5, 2006, Bangkok (Thailand)
Kick-off of the EU Small Project Facility Programme project "SPF TEMAS SME"
Exhibit:
– Technology Partnership and Training Cooperation in European Management Information Systems to Enhance the Competitiveness of Thai SMEs
Direction:
Dr. Ina Ehrhardt
Ralf Opierzynski

April 11 - June 13, 2006, Magdeburg
9th Logistics Guest Lecture Series 2006 "Logistics as a Field of Work of the Future: Potentials, Implementation Strategies and Visions"
Direction:
Prof. Michael Schenk
Prof. Karl Inderfurth
Prof. Dietrich Ziems
Patron:
Dr. Karl-Heinz Daehre, Saxony-Anhalt Minister of State Development and Transportation

May 4, 2006, Magdeburg
Biomedical Technology (Workshop)
Contributor :
Dirk Berndt

May 6, 2006, Magdeburg
Opening of Europe Week at the
Fraunhofer IFF

May 9-12, 2006, Sinsheim
CONTROL 2006 (Trade Fair)
Presentation:
– Wheel Measuring Machine as an
   Example of Instpection Integrated
   in Manufacturing
Exhibit:
– Wheel Measuring Machine
Direction:
Dirk Berndt

May 15-17, 2006, Lyon (France)
International Conference on Information
Systems, Logistics and Supply Chains
(Conference)
Contributor:
Mike Wäsche

May 16-17, 2006, Lahnstein
27th VDI/VDEh Maintenance Forum
Maintenance Performance in Focus
(Congress)
Exhibits:
– Statelogger: Determination of
   Rates of Wear of Technical Assets
   to Formulate Condition-based
   Maintenance Strategies
– Competence Finder: Establishing
   Service Partnerships
– RFID Applications in Maintenance
Contributors:
Cathrin Plate
Frank Ryll
Tobias Kutzler
Program Committee Member:
Dr. Gerhard Müller
Productivity Enhancement Session Chair:
Dr. Gerhard Müller

Europe Minister Rainer Robra opened Europe Week at the Fraunhofer IFF on May 6, 2006. The minister emphasized the advantages of EU research funding. So far, fifty-nine projects from universities and colleges and non-academic research institutions in Saxony-Anhalt are involved in the current research program. "The opening of Europe Week is completely dominated by research and science," according to Robra. Thus, it fits well into the concept of city of Magdeburg, which is celebrating the "Year of Science" in 2006..

Europe Minister Rainer Robra at the opening of Europe Week at the Fraunhofer IFF.

The "International Conference on Information Systems, Logistics and Supply Chains" highlighted specific applications and research findings in the field of supply chains and logistics management, focusing on information systems and their development.

The Fraunhofer IFF was strongly represented in the program of the convention "Maintenance Performance in Focus" and presented RFID solutions for maintenance in the accompanying exhibition. Dr. Gerhard Müller chaired the session on "Enhancing Productivity". In his talk, Dr. Klaus Richter presented potentials for RFID technology and best practice solutions in maintenance. Richter additionally moderated the workshop on "Maintenance and RFID: Where Are They Headed?" The Fraunhofer IFF has been working on research and development in this field for more than ten years. It already had the know-how in 1999, - long before the current RFID boom - to implement RFID based tool maintenance and management at AIRBUS.

Federal Minister of Economics Michael Glos, Brandenburg Minister President Matthias Platzeck and the Director of the Russian Federation's Federal Agency on Industry Boris Aljeshin opened the exhibition at the International Aerospace Exhibition ILA 2006. More than 1,000 exhibitors from over 40 countries presented their products, systems and processes from every branch of this high-tech sector. The organizers registered a total of more than 250 000 visitors.

The Fraunhofer IFF and its Russian partner, the Russian Institute of Aviation SystemsGosNIIAS, jointly presented new information technologies that guarantee the quality and reliability of manufacturing and logistics processes in the aviation industry. The system "RFID for Aviation Components" for clear and tamper-proof labeling of components was presented. Numerous representatives from Russian industrial companies and airlines displayed great interest in this identification technology.

Over forty cultural, academic and scientific organizations opened their doors in the "Long Night of Science" and extended an invitation to go on interesting, nocturnal voyages of discovery. This major event enabled residents of Magdeburg and their guests to experience more than 150 experiments, activities and presentations and find out what science and research in Magdeburg really look like.

In its testing facility, the Fraunhofer IFF presented highlights from four fields of research: Automation, Virtual Development and Training, Logistics and Process and Plant Management. Highly complex research findings were presented simply and vividly.

In the LogMotionLab, even the youngest came away with an idea of the variety of potential uses of RFID technology. An entertaining race with cars tagged with RFID presented transponder-supported logistics of tomorrow. The walking robot "Katharina" outfitted with advanced sensors showed visitors how automation can simplify life. A cleaning robot that cleans the glass facade of the Fraunhofer-Gesellschaft's headquarters to a shine every day demonstrated that technology never wearies.

Automatic Inspection of Painted Surfaces
(Workshop)
Contributors:
Dirk Berndt
Erik Trostmann
Silvio Sperling
Christian Teutsch

European Innovation Supporn: New
Opportunities for SME (Workshop)
Direction:
Katrin Reschwamm
Andreas Wolf

2. Fraunhofer Knowledge Management
Forum
Presentation:
– Presentation of the Fraunhofer IFF's
  industry knowledge management
  project in a lecture on "Instruments of
  Integrated Knowledge Management
  at Basler AG" by Elke Dullweber,
  Knowledge Manager and Head of
  Documentation, Basler AG
Exhibit:
– Organization and Methods of
  Knowledge Management
Contributor:
Stefan Voigt

ISPIM 2006 Conference
Networks for Innovation
Exhibit:
– A Novel Approach to Empowering
  SME for Long-term Research Interests
  and Increased Participation in EU RTD
  Activities.
Direction:
Katrin Reschwamm
Andreas Wolf

In May 2006, not only Janez Potocnik, EU Commissioner for Science and Research, made clear that knowledge and innovation have top priority for growth. According to leaders from all over the world, the capacity to innovate is the most important prerequisite to prosperity. Reducing costs and developing new markets is no longer enough in today's competition. Companies ought to focus attention on continuously improving products, services and processes.

The figures are sobering however: Over two-thirds of the projects planned by German development units fail to reach market maturity. Of those that do overcome the obstacles, many end as failures. Innovation means a healthy dose of creativity and curiosity as well as a willingness to take risks. Failure should be understood as a normal part of the development process. Janez Potocnik looks positively into the future though. The EU is on its way to establishing the best conditions for innovative SME. With its workshop "European Innovation Support: New Opportunities for SME", the Fraunhofer IFF provided SME support in their innovation processes by highlighting funding opportunities and eliminating potential obstacles through reports on experiences.

Together with State Secretary Valentin Gramlich, Prof. Michael Schenk welcomes the attendees to the 9th IFF Science Days.

With more than 400 attendees from industry, academia and research, attendance was higher than ever before. The large number of attendees from commercial enterprises demonstrated that the IFF Science Days are tailored to companies' needs.
The Fraunhofer thus IFF creates a functioning interface between research and business. The themes of this year's conference focused on virtual reality (VR) and augmented reality (AR). VR denotes a computer generated three-dimensional and interactive environment in which users can immerse. Augmented reality entails inserting information into a user's field of view. To do so, special goggles are, for instance, equipped with a projection system.

High spirited discussions among experts: Prof. Thomas Schulze, Dr. Gerhard Müller and Prof. Peter Lorenz.

More than 400 attendees from the business, academic and research communities came to Magdeburg for the 9th IFF Science Days.

June 16, 2006, Magdeburg
Imaging Measurement and Testing Technology in Railroad Engineering (Workshop)
Direction:
Dirk Berndt

June 21-22, 2006, Magdeburg
9th IFF Science Days
Virtual Reality and Augmented Reality for Engineering, Testing and Operating Technical Systems

Direction:
Prof. Michael Schenk

Program

June 21, 2006

– Opening Remarks and Impulse
   Lectures

– Sequence 1

   Virtual Engineering in Vehicle and Aircraft Development
   Chairs:
   Prof. Martin Eigner
   Prof. Ulrich Gabbert

   Applications in Factory and Plant Planning
   Chair:
   Dr. Ulrich Schmucker

– Sequence 2

   Methods for the Virtual Factory
   Chair:
   Prof. Bernhard Karpuschewski

   Applications in Medical Technology and Biotechnology
   Chairs:
   Prof. Bernhard Preim
   Matthias Pross, M.D.

June 22, 2006

– Sequence 1

Safer Production with Integrated VR:
Human Factor Solutions (VIRTHUALIS)«
Chair:
Dr. Simone Colombo

Technology-based Qualification in
Industrial Application
Chairs:
Ass. Prof. Michael Dick
Prof. Klaus Jenewein

– Sequence 2

Foundations of Virtual Engineering
Chair:
Prof. Roland Kasper

Virtual Engineering Applications
Chair:
Prof. Karl-Heinrich Grote

Humans and Technology
Chair:
Prof. Winfried Marotzki

Interaction Techniques in VR/AR
Environments
Chair:
Dr. Eberhard Blümel

Supplementary Workshops/Events

June 21, 2006

– Workshop
  Innovations from Central Germany.
  Telematics and RFID
  Chair:
  Steffen Fröhlich

– Industry Working Group
  Cooperation in Plant Engineering
  Chair:
  Andrea Urbansky

The conference on "Virtual Reality and Augmented Reality for Engineering, Testing and Operating Technical Systems" opened with two presentations of research and a real example from the automotive industry. The ViVERA Network of Competence and the INTUITION European Network of Excellence reported on the current state of research in the field of virtual reality. The carmaker AUDI presented the challenges confronting an international company with global production networks and the virtual logistics and production planning solutions that have already been implemented. The aerospace and automotive industries in particular but also other sectors such as machinery and plant manufacturing, shipbuilding and medical technology are already employing virtual technologies. Now as before, there is great need for research. Companies such as AIRBUS, AUDI, BMW, DaimlerChrysler, Lürssen Werft, MTU Fried-richshafen, Opel, Siemens and Volkswagen sent executives, development managers and IT specialists to find out about trends and discuss the need for further develop-ment with researchers.

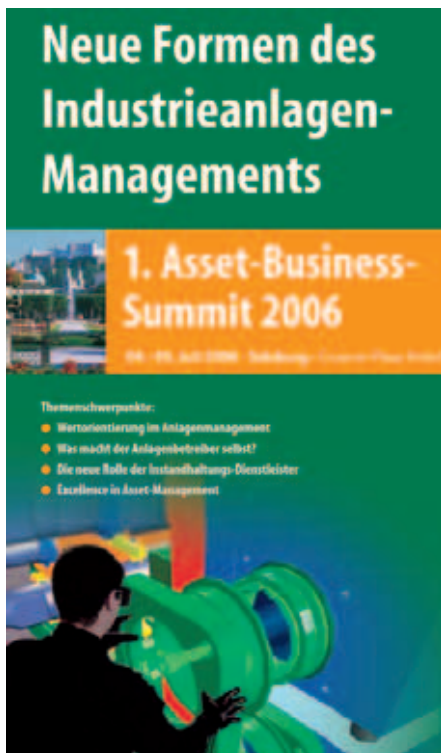Animated discussions with an international flair.

June 22, 2006

– Workshop
  Wood Logistics
  Chair:
  Dr. Hubert Röder

– Workshop
  Product Service for Mechanical and
  Plant Engineering
  Chair:
  Dr. Martin Endig

Interlogistica
Marketing Research in the field of
Imaging Measurement and Testing
Technology (Workshop)
Direction:
Dirk Berndt

GeoForum 2006
(21st Intergraph Users Conference)
Contributor:
Frank Mewes

1st Asset Business Summit
"New Forms of Industrial Plant Manage-
ment" (Convention)
Presentation:
– Service Partnerships: Dividing Expertise
  and Work to Mutual Advantage
Prof. Michael Schenk
Exhibits:
– Statelogger: Determination of
  Rates of Wear of Technical Assets
  to Formulate Condition-based
  Maintenance Strategies
– Competence Finder: Establishing
  Service Partnerships
– RFID Applications in Maintenance
Contributor:
Frank Ryll

The classic division of roles among plant manufacturers and plant operators is changing dramatically. Now more than ever, industrial plants must be monitored and optimized throughout their entire life. This is generating new business models and service offerings. The partners involved have to grow into new roles. Machinery and plant manufacturers are taking over more and more services as part of life cycle optimization. Against this background, discussion at the 1st Asset Business Summit in Salzburg focused on issues of value orientation in plant management, plant operators' own work, maintenance service providers and excellence in asset management.

Interforst (10th International Trade Fair
for Forestry and Forest Technology
with Scientific Conferences and
Special Shows)
Contributor:
Dr. Ina Ehrhardt

Interforst 10th International Trade Fair for Forestry and Forest Technology addressed the issues of forest regeneration and care, forest conservation, timber harvesting and logging, log storage, forest road construction and maintenance, timber transport vehicles, conversion at roundwood yards, woodworking and wood heating, protective and recreational forests, tree care, landscape conservation and agricultural engineering, EDP, surveying, forest management and telecommunication, occupational health and safety, first aid, information, consulting, services and timber harvesting services.

Optical Scanning of Train Wheelsets
(Workshop)
Direction:
Dirk Berndt

Intensified utilization of renewable raw materials for conversion into energy was discussed with a variety of actors. A broad range of information, systems and contacts were on hand.

An international conference was held to mark the tenth anniversary of the establishment of the School of Environmental and Production Technology (Fakulta environmentálnej a vyrobnej techniky – FEVT). Results of current research and practical examples from the field of environmental and production technologies and their applications were presented.

Federal Minister Wolfgang Tiefensee visited the joint stand of the exhibitors from Saxony-Anhalt, Magdeburger Hafen GmbH, Kranbau Köthen GmbH and the Fraunhofer IFF when they presented at Asia's most important transport and logistics trade fair. The Fraunhofer IFF demonstrated its expertise as a developer of intelligent logistics solutions and presented itself as a practically oriented research partner to an international public from more than eighty countries.

Karl-Heinz Ehrhardt, Managing Director of Hafen Magdeburg GmbH, Wolfgang Tiefensee, Federal Minister of Transport, Building and Urban Affairs, Daniel Reh, Research Manager at the Fraunhofer IFF, and Klaus Müller, Managing Director of Kranbau Köthen (l. to .r.).

Dr. Rainer Haseloff, Saxony-Anhalt Minister of Economics and Labor.

At the event "OPEN DAYS - European Week of Regions and Cities" at the Fraunhofer IFF, the institute presented its European research networks, focusing on international careers in research and the opportunities for young researchers in Europe. The event brought together students, graduates, doctoral students, fellows and young researchers, offered presentation on European research projects and allowed researchers to say some words. Project managers from the Fraunhofer IFF and international project partners presented the research organization's currently ongoing projects such as VIRTHUALIS, HILAS, ResearchTraining@-VDTC, CADPIPE and smE-MPOWER. Not only researchers from the Fraunhofer IFF but also Marie Curie fellows from other organizations recountted their biographies as international researchers. At a central ceremonial event in Brussels, the Fraunhofer IFF reported on regional network activities.

September 20, 2006, Magdeburg
Europäische Innovationsförderung – neue Chancen für SME (Workshop)
Direction:
Katrin Reschwamm
Andreas Wolf

September 25-26, 2006, Göteborg (Sweden)
EIRAC Workshop
Contributor:
Dr. Eberhard Blümel

October 12, 2006, Brussels (Belgium) and Magdeburg
OPEN DAYS – European Week of Regions and Cities
Presentation:
– The Role and Working Methods of Regional Networks in the European Union
Contributors:
Prof. Michael Schenk
Dr. Eberhard Blümel
Ralf Opierzynski
Katrin Reschwamm
Tina Haase
Tobias Reggelin
Dr. Rüdiger Mecke
Bartlomiej Arendarski
Antje Plock

Young international researchers at the Fraunhofer IFF find out about career opportunities in Germany.

Maintain 2006 (International Trade Fair
for Industrial Maintenance)
Direction:
Dr. Gerhard Müller
Contributors:
Dr. Martin Endig
Catrin Plate
Veronika Kauert
Frank Ryll
Exhibits:
– Statelogger: Determination of
  Rates of Wear of Technical Assets
  to Formulate Condition-based
  Maintenance Strategies
– Competence Finder: Establishing
  Service Partnerships
– Idasys: Maintenace Data Analysis
  System
– RFID Applications in Maintenance

The Fraunhofer Institute IFF Magdeburg and IML Dortmund, the VDI Society for Production Engineering (ADB) and the Forum Vision Instandhaltung FVI signed a cooperation agreement at the maintenance trade fair Maintain 2006 in Munich. It aims to concentrate the partners' strengths and experiences in the field of RFID (radio frequency identification) related to maintenance and make them usable for industry, especially medium-sized enterprises.

At the signing of the agreement, Dr. Gerhard Müller from the Fraunhofer IFF presented the first generation digital nameplate in use at Airbus throughout the world since 1999.

German Logistics Congress
Direction:
Prof. Michael Schenk
Contributors:
Katja Barfus
Eyk Flechtner
Tobias Reggelin
Daniel Reh
Holger Seidel
Herbert Siegert
Manuela Wahl

The Fraunhofer Institute for Factory Operation and Automation IFF presented an absolute innovation at the 23rd German Logistics Congress in Berlin: An RFID system with a fully functioning radio chip in completely metallic environments. The RFID box operates reliably, even with objects for which the use of RFID was previously considered an impossibility (e.g. beverage cans in metal containers).

Congress attendees find out at the Fraunhofer IFF stand about the new RFID system that reliably reads transponders even in metallic environments.

Dr. Klaus Richter presented RFID solutions for the pharmaceutical industry to an interested audience.

Experts at the 2006 Digital Pharma Conference "Boosting Efficiency in Pharmaceutical Manufacturing" demonstrated first hand how state-of-the-art information technology can optimize manufacturing processes, showing how IT supported optimization of manufacturing operation can be implemented - from order preparation through finished products.

Top experts and speakers from the pharmaceutical industry provided a look at current projects and references.

At a workshop in Barcelona on integrating SME in the EU's 7th Framework Research Program researchers from the Fraunhofer IFF provided information about funding opportunities for SME.

October 25 - December 6, 2006, Magdeburg

3rd Guest Lecture Series Virtual Reality "Human and Machine in Interactive Dialog"
Direction:
Prof. Michael Schenk
Prof. Ulrich Gabbert
Prof. Roland Kasper
Prof. Karl-Heinrich Grote
Prof. Bernhard Preim
Prof. Klaus Jenewein
Patron:
Dr. Reiner Haseloff, Saxony-Anhalt Minister of Economics and Labor

November 2-3, 2006, Freiberg

Converting Material into Gases in Energy Process Engineering (Innovation Forum)
Exhibit:
– Solid Electrolyte Probes
Direction:
Dr. Eyck Schotte
Dr. Sascha Thomas
Bert Lemin

November 2-4, 2006, Stralsund

2nd International Baltic-Bioenergy Conference IBBC 2006
Contributor:
Mike Wäsche

November 8-9, 2006, Magdeburg

Innovation in Lignite Mining (Colloquium)
Presentation:
– The Material Internet as a Technically Oriented Thought Model for Maintenance Logistics in Lignite Mining
Contributor:
Dr. Klaus Richter

Guest Lecture Series patron Minister of Economics and Labor Reiner Haseloff.

Saxony-Anhalt Minister of Economics and Labor Reiner Haseloff assumed the patronage of the Fraunhofer Guest Lecture Series "Virtual Reality: Human and Machine in Interactive Dialog" for the first time in 2006. The annual series of lectures at which top speakers from business and research report on the use of VR and AR technologies in their companies and organizations was held for the third time. Dr. Christoph Gümbel, Head of the Virtual Vehicle Division, spoke for example on "How Virtual Reality Brings Digital Prototypes to Life". Dr. Dieter Langer, Project Manager in the Military Air Systems Division at EADS Deutschland GmbH, described how augmented reality is used when servicing aircraft.

All the Guest Lecture Series presentations are collected in a volume of proceedings. The publication (ISBN-10 3-8167-7256-0) is available from the Fraunhofer IFF.

The biannual RPD conference in Leiria, Portugal is an international meeting point for specialists in rapid prototyping and rapid manufacturing. Researchers, developers and well-known vendors and service providers present global advances in and new approaches to rapid product development and discuss them with potential users and interested parties. Researchers from the Fraunhofer IFF presented an intelligent prototype developed by Susan Gronwald and her team. RFID technology is already integrated in this grinder.

6th Aachen Colloquium on Maintenance, Diagnostics and Plant Monitoring AKIDA
Exhibits:
– Statelogger: Determination of Rates of Wear of Technical Assets to Formulate Condition-based Maintenance Strategies
– Competence Finder: Establishing Service Partnerships
– RFID Applications in Maintenance
Presentations:
– Smart Maintenance Objects: Experiences Piloting RFID in Maintenance Logistics for Complex Equipment
– Statelogger:Method and Tool for Planning Condition-based Maintenance
Contributors:
Cathrin Plate
Frank Ryll
Tobias Kutzler

November 15-16, 2006, Zwickau

1st Innovative and Interdisziplinary Production Engineering Symposium
Panel Discussion:
– Opportunities and Possibilities to Export Industrial Services for SME
Direction:
Holger Seidel
Contributor:
Jörg von Garrel

November 15-18, 2006, Düsseldorf

MEDICA 2006 World Forum for Medicine
Exhibit:
– Virtual Interactive 3-D Module for Neuromedical Technology Know-how Transfer
Joint stand with FIT-Bildungs-GmbH
Contributor:
Wolfram Schoor

Seventy-two first rate presentations at Eurogress Aachen informed experts from industry and research about the latest developments and new trends in the production of raw materials, rolling mill engineering, vehicle diagnostics, maintenance, plant monitoring, wind energy converters, RFID and life cycle costing. The Fraunhofer IFF was represented at this year's AKIDA with two papers and presented its services and products at a stand in the exhibition accompanying the colloquium.

Medical technical training module in the virtual lab: Left, applying a primary antibody to a tissue section and, right, analyzing the detected structures under a microscope.

Once they have completed their basic training, medical technical lab assistants (MTLA) must first familiarize themselves with their sphere of activity. Ultimately, every specialized field of medicine has its own individual methods. Together with FIT-Bildungs-GmbH, the Fraunhofer IFF presented a new training model at MEDICA 2006. Virtual models from the Virtual Development and Training Centre VDTC familiarize MTLA with their specific field.

Deutschland
Land der Ideen

Ausgewählter Ort 2006

More than four hundred high ranking guest from politics, research, academia and business celebrated the opening of the Virtual Development and Training Centre. Saxony-Anhalt's Minister President Wolfgang Böhmer and Fraunhofer-Gesellschaft Senior Vice President Research Planning Ulrich Buller handed over a symbolic key to Director Michael Schenk. FC Deutschland GmbH CEO Mike de Vries presented Schenk the award as "Landmark in the Land of Ideas" for the institute. In addition, Mayor Lutz Trümper bestowed the Regional Award on the director for his achievements making Magdeburg a center of research.

November 27, 2006, Stuttgart
DL 06 – Services Going International –
Focus Group Meeting
Exhibit:
– Project "One-stop services for
  Worldwide Industrial Manufacturing"
Contributor:
Jörg von Garrel

November 29-30, 2006, Göttingen
System Verkehr, Steuern, Regeln,
Entwickeln (Conference)
Host:
German Institute of Navigation DGON
Presentation:
– Telematic Technologies and Services
  for Integrated Logistics in Forests and
  Meadows: Off-road Navigation, LBS,
  RFID
Contributor:
Dr. Ina Ehrhardt

November 30, 2006, Fellbach
3rd Intuition Workshop
Contributors:
Dr. Eberhard Blümel
Marco Schumann
Heike Kissner

December 3-6, 2006, Monterey (USA)
Winter Simulation Conference
Exhibits:
– VDTC Products and Services
– Presentations and chairing of the
  session "Simulation Interoperability"
Contributor:
Dr. Steffen Strassburger
Steffen Masik

December 6, 2006
SME Day "Virtual Engineering"
Contributor:
Dr. Ulrich Schmucker
Arnim Wagner

The laser-based large projection system was presented to the public for the first time. Six Jenoptik laser projectors projected virtual models of complex machinery and plants on a 360 degree projection surface. Three-dimensional renderings have remarkable color brilliance, contrast and brightness. Specialists from Jenoptik and the Magdeburg Fraunhofer Institute jointly designed the laser-based large projection system. The experts intend to collaborate on upgrading it and developing new fields of application. At its VDTC, the Fraunhofer Institute for Factory Operation and Automation IFF undertakes applied research in the field of virtual engineering to plan, test and operate technical systems. Contractual partners and clients include large international concerns, regional small and medium-sized enterprises and the state. It sustains close collaboration with nonacademic research organizations in Magdeburg, particularly Otto von Guericke University, the Max Planck Institute for Dynamics of Complex Technical Systems, the Leibniz Institute of Neurobiology and the Leibniz Institute of Plant Genetics and Crop Plant Research in Gatersleben. Interdisciplinarily collaborating specialists develop customized solutions based on virtual and augmented reality such as virtual-interactive training for technical staff.

Committee Work in 2006 (Selection)

ALFA Growth Core
Susan Gronwald – Growth Core Advisory Board

Simulation Working Group
Marco Schumann – Member of the Distributed Modeling and Simulation Expert Group
Dr. Steffen Strassburger – Member of the Distributed Modeling and Simulation Expert Group

Competence Management Working Group
Stefan Voigt – Co-cordinator with Wilhelm Termath

Asian Society for Environmental Protection (ASEP)
Ralf Opierzynski – Member

ATV-DVWK Research Group ES-8.12
Repair of Sewer Lines and Systems with Robotic Systems
Dr. Norbert Elkmann – Member

German Logistics Association (BVL)
Prof. Michael Schenk – Member of the Executive Board and the Präsidiums
Holger Seidel – Saxony-Anhalt Regional Chapter Spokesman

CEN TC 319 Maintenance
Cathrin Plate – Member

German-Russian Forum
Prof. Michael Schenk – Member

DGfZP, Magdeburg Working Group
Dirk Berndt – Member

European Technology Platform ETPIS, Industrial Safety
Dr. Eberhard Blümel – Member

EU Commission's 6th Framework Program
Dr. Eberhard Blümel – Expert

European Intermodal Research Avisory Council (EIRAC)
Dr. Eberhard Blümel – Member

Fachverband für Sensorik AMA
Dr. Ulrich Schmucker – Member

Society for the Promotion of Renewable Energies (FEE)
Dr. Matthias Gohla – Member of the Biogas Fuel Cells Working Group
Dr. Helmar Tepper – Member of the Biomass Gasification Working Group

Association for the Promotion of Materials Cycle Management
Dr. Lutz Hoyer – Member of the Board

Forum Vision Maintenance
Cathrin Plate – Member, Fraunhofer IFF Representative in the Consortium

Fraunhofer Vision Alliance
Dirk Berndt – Fraunhofer IFF Spokesman

Fraunhofer-Gesellschaft (FhG) Scientific-Technical Board (WTR)
Prof. Michael Schenk – Member of the Main Commission
Dr. Gerhard Müller – Fraunhofer IFF Representative

Fraunhofer Group for Energy EST
Dr. Lutz Hoyer – Coordinator of Fraunhofer IFF Activities

Fraunhofer-Gesellschaft (FhG)
Fraunhofer Group for Production
Prof. Michael Schenk – Member

Fraunhofer Traffic and Transportation
Alliance FVV
Daniel Reh – Member

German Construction Technology
Platform, Cultural Heritage Working
Group
Dr. Rüdiger Mecke, Andreas Hoepfner –
Contributors

Society for Computer Science (GI)
Ralf Opierzynski – Member of the
Industrial Environmental Information
Systems FG

Society for Operations Research
Holger Seidel – Member

Society for Project Management
Katrin Reschwamm – Member of the
Magdeburg Regional Chapter

Comprehensive Center for Transportation
Braunschweig (GZVB)
Eyk Flechtner – Member

Society for Knowledge Management e.V.
Mark Staiger – Member

IGZ Innovations- und Gründerzentrum
Magdeburg GmbH
Prof. Michael Schenk – Member of the
Advisory Board

International Green Productivity
Association (IGPA)
Ralf Opierzynski – Member

Jenoptik AG, Scientific Advisory Board
Prof. Michael Schenk – Member

Karl Heinz Beckurts Foundation
Prof. Michael Schenk – Member

Kompetenznetzwerk Mitteldeutsche
Entsorgungswirtschaft
Dr. Eyck Schotte – Member of the
Renewable Energies Working Group
Dr. Lutz Hoyer – Member of the
Substitute Fuels Working Group

MLFU Coordination Office for Renewable
Raw Materials KoNaRo (LSA),
Biogenic Fuels Working Group
Dr. Lutz Hoyer – Member

LICON Logistics e.V.
Dr. Klaus Richter – Member of the board

Leonardo Power Quality Initiative
Vocational Education System LPQIVES
Certification Board
Przemyslaw Komarnicki – Member

Pipeline and Plant Engineering Network
Andrea Urbansky – Member of the
Coordinating Board

Open GIS Consortium (OGC)
Frank Mewes

Practical Forum for Competence
Management
Mark Staiger – Coordinator

Federal Association for Industrial
Engineering, Business Organization and
Corporate Development REFA,
Saxony-Anhalt State Chapter
Holger Seidel – Member of the
Extended Board

German Business Rationalization and
Innovation Center RKW´in Saxony-Anhalt
Dr. Gerhard Müller – Member of the
Board

Saxony-Anhalt Satellite Navigation
(SANASA)
Dr. Klaus Richter – Member of the Board

Simulation Interoperability Standards
Organization
Dr. Steffen Strassburger – Vice Chair of
the COTS Simulation Package Interoper-
ability Product Development Group

Society for Modeling and Simulation
International
Dr. Steffen Strassburger – Member

Virtual Engineering Strategy Group
Dr. Eberhard Blümel – Member

The International Emergency
Management Society
Dr. Martin Endig – Member

Fraunhofer Energy Alliance
Dr. Lutz Hoyer – Coordinator of IFF
Activities (on behalf of Management)

TKB Technologiekontor Bremerhaven F&E
Gesellschaft für die Nutzung regenerati-
ver Energien m.b.H.
Prof. Michael Schenk – Member of the
Board of Directors

Transfer Center for Automation in
Mechanical Engineering (TAM)
Dr. Ulrich Schmucker – Member of the
Board

Association of German Foundry Experts
(VDG)
Prof. Michael Schenk – Member of the
Research Advisory Board
Sonja Hintze – Member of the
Committee of Foundry Experts

Association of German Engineers (VDI)
VDI Society of Metrology and
Automation (GMA)
Dirk Berndt – Member of the Technical
Committee 3.32: Optical 3-D Metrology

Association of German Engineers (VDI)
VDI Society for Industrial Engineering
(ADB)
Dr. Gerhard Müller – Member of the
Board and Head of the Plant Manage-
ment Competence Field
VDI-ADB Factory Planning Expert
Committee,
Claudia Falke – Member of the Digital
Factory Working Group
Daniel Reh
Rico Schady – Member of the Extended
Economic Feasibility Studies Committee
Thomas Dengler – Member of theVDI
Factory Planning Guidelines Working
Group
VDI-ADB Maintenance Expert Committee
Cathrin Plate – Member of the Guidelines
Formulation Working Group

Association of German Engineers (VDI)
VDI Environmental Engineering Coordina-
tion Office (VDI-KUT), Industrial Environ-
mental Management Performance Indi-
cators Working Group
Ralf Opierzynski – Member

Association of German Engineers (VDI)
VDI Saxony-Anhalt State Chapter
Prof.Michael Schenk – State Represent-
ative
VDI Magdeburger District Association
Dr. Klaus Richter – Ombudsman for the
Development, Engineering and Sales
Working Group
Dr. Mirko Peglow – Ombudsman for the
Students and Young Engineers' Working
Group

Association for the Promotion of Power
and Environmental Engineering (VEU)
Dr. Lutz Hoyer – Member

Magdeburg CCI Transportation
Committee
Holger Seidel – Member

Windenergie-Agentur Bremerhaven/
Bremen e.V. (WAB)
Dr. Klaus Richter, Frank Ryll – Technical
Collaboration

Center for Neuroscientific Innovation and
Technology ZENIT GmbH
Prof. Michael Schenk – Member of the
Scientific Advisory Board

Saxony-Anhalt Center for Renewable
Energies (ZERE)
Dr. Gerhard Müller – Member of the
Board
Dr. Lutz Hoyer – Fraunhofer IFF Contact
Person

Association for the Promotion of
Mechanical and Plant Engineering in
Saxony and Saxony-Anhalt (FASA)
Prof. Michael Schenk – Chairman of the
Board
Andrea Urbansky – Managing Director

International Research and Cooperation Partners in 2006 (Selection)

Aeronautical Institute Kharkov, Kharkov, Ukraine

ALMA, Lyon, France

ARIES, Bucharest, Romania

Asia Pacific Roundtable for Cleaner Production (APRCP), Manila, Philippines

Asian Society for Environmental Protection (ASEP), Bangkok, Thailand

Atos Origin, Madrid, Spain

Baltic Container Terminal Ltd., Riga, Latvia

Beacontech Ltd., Tel Aviv, Israel

Beijing Hope Software Co., Beijing, China

Biomag, Ing. Cerny, Uníčov, Czech Republic

Brno University of Technology, Brno, Czech Republic

Budapest University of Technology and Economics, Budapest, Hungary

Federal Institute for Materials Research and Testing, Berlin

Centrale Recherche SA, Paris, France

Centre for Renewable Energy CRES, Pikermi Attiki, Greece

Centre for Research and Technology Hellas CERTH, Ptolemais, Greece

Centre for Research and Technology Hellas, Thermi, Thessaloniki, Greece

CENTRIM University of Brighton, Brighton, Great Britain

Centrul De Afaceri Transilvania (CAT), Cluj-Napoca, Romania

CEPE – Centre for Energy Policy and Economics, Swiss Federal Institute of Technology Zurich, Zurich, Switzerland

Chalmers University of Technology, Göteburg, Sweden

Chengdu Lead Science & Technology Co., Ltd. (SCLEAD), Chengdu, China

China Harvest Development Ltd., China

Chulalongkorn University, Bangkok, Thailand

CTO – Ship Design and Research Centre, Gdansk, Poland

Czech Technical University Prague, Prague, Czech Republic

DaimlerChrysler Research Center, Ulm

DaimlerChrysler, Gaggenau

Deere & Co. World Headquarters, Moline, Illinois, USA

Delft University of Technology, Delft, Netherlands

Digipro Computer Consultants Ltd., Pafos, Cyprus

e.sigma Systems GmbH, Munich

EADS Deutschland GmbH, Ulm

Ecole Centrale Paris, Paris, France

Ecole Polytechnique Universitaire de Marseille, Marseille, France

Enigma Information Retrieval, Inc., Burlington, Massachusetts, USA

Escola Superior Agraria de Beja, Beja, Portugal

European Process Safety Centre, Warwickshire, Great Britain

EURESEARCH, Bern, Switzerland

Federation of Thai Industries (FTI), Bangkok, Thailand

Forestry and Game Management Research Institute, Jíloviste-Strnady, Czech Republic

Hanoi University of Technology, Hanoi, Vietnam

Hellenic Institute of Transport, Thessaloniki, Greece

Higher Council for Science and Technology, Amman, Jordan

IDC Information Technologies, Riga, Latvia

Indian Institute of Science, Bangalore, India

Indo German Chamber of Commerce, Bangalore, India

Indonesian Society of Environmental Professionals (ISEP), Jakarta, Indonesia

Industrial Technology Research Institute, Taipei, Taiwan

Inesc Porto, Porto, Portugal

Institut für Diagnostik und Konservierung an Denkmalen in Sachsen und Sachsen-Anhalt e.V., Halle

Institute of Cybernetics, Tallin, Estonia

Instituto de Engenharia de Sistemas e Computadores do Porto (INESC), Porto, Portugal

Instituto de Technología Cerámica-AICE (ITC), Castellón, Spain

InterBalt Maritime Agency, Tallin, Estonia

Intro Solutions Ltd., Ankara, Turkey

Iowa State University, Virtual Reality Applications Center, Ames, Iowa, USA

Italian Ship Research Center (CETENA SpA), Genua, Italy

ITI Aristotle University Thessaloniki, Thessaloniki, Greece

Jenoptik AG/Jenoptik Laser Display Technology LDT GmbH, Jena

Joint Research Company, Ispra, Italy

Sonex Computers Joint Stock Company (SONEX Group), Klaipeda, Lithuania

Jordan University of Science and Technology, Amman, Jordan

Karl Franzens University, Graz, Austria

Kaunas University of Technology, Kaunas, Latvia

Klaipeda State Seaport Authority, Klaipeda, Lithuania

Laboratory of Design, Production and Management, University of Twente, Twente, Netherlands

State Forestry Enterprise of the Slovak Republic, Banská Bystrica, Slovak Republic

State Forestry Enterprise of the Czech Republic, Hradec Králové, Czech Republic

Latvian Intelligent Systems, Riga, Latvia

Chair ofl Technical Computer Science, Otto von Guericke University, Magdeburg

Lesy Ceské republiky, statní podnik, Hradec Králové, Czech Republic

Liophant Simulation Club, University of Genoa, Genoa, Italy

Lithuanian Innovation Centre (LIC), Vilnius, Lithuania

Liverpool John Moores University Higher Education Corporation, Liverpool, Great Britain

Logitrans Consult Ltd., Tallin, Estonia

Lund University, Lund, Sweden

Maritime & Supply Chain Solutions (Europe) Ltd., Ballycarry, Great Britain

Massachusetts Institute of Technology, Cambridge, Massachusetts, USA

Melon Technologies, Sofia, Bulgaria

Nemetschek, Sofia, Bulgaria

Netherlands Organization for Applied Scientific Research, Delft, Netherlands

Niki Information Technologies, Katsika, Greece

Oskar Von Miller – Conception, Research and Design Institute for Thermal Power Equipment (OVM – ICCPET), Bucharest, Romania

Philippine Pollution Prevention Roundtable (P3R), Manila, Philippines

PIAP – Industrial Research Institute for Automation and Measurement, Warsaw, Poland

Plato, Dundalk, Ireland

Politecnico di Milano, Milan, Italy

Port of Kokkola, Kokkola, Finland

Pymera, Valencia, Spain

Regionalne Poradenske A Infomacne Centrum Presov (RPIC), Presov, Slovak Republic

Réseau CCSO, Fribourg, Switzerland

Riga Technical University, Riga, Latvia

Semantic Systems, Derio, Spain

SenterNovem, Den Haag, Netherlands

SFERA – Societa per la Formazione e le Risorse Aziendali per Azioni, Italy

Sheffield Hallam University, Sheffield, Great Britain

Southwest Jiaotong University – Opto-Electronic Engineering Institute, Chengdu, China

SP Swedish Nat. Testing and Research Institute, Boras, Sweden

Staatliches Forschungsinstitut für Flugsysteme (GosNIIAS), Moscow, Russia

Stanford University, Stanford, California,, USA

Swedish University of Agricultural Science SLU, Uppsala, Sweden

T-Systems, Frankfurt am Main

Technical University Crete, Crete, Greece

Technical University of Lisbon, Lisbon, Portugal

Technical University of Sofia, Sofia, Bulgaria

Technische Universität, Forstwissenschaftliche Fakultät Zvolen, Slovak Republic

TESEO Sprl, Brussels, Belgium

Testaluna S.r.l., Milan, Italy

Thai-German Institute (TGI), Chonburi, Thailand

Thailand Environment Institute, Bangkok, Thailand

The Open University, Milton Keynes, Great Britain

Thessaloniki Port Authority, Thessaloniki, Greece

Thule Institute, Oulu, Finland

TP Technoplus Industrial and Trading Ltd, Budapest, Hungary

Trans-European Consultants for Transport, Development and IT (TREDIT), Thessaloniki, Greece

TRIMOS-SYLVA S.A. (PTY) Ltd., Waterkloof, South Africa

Trinity College Dublin, Dublin, Ireland

Tsinghua University, Peking, China

Universidad Politicnica de Valencia, Valencia, Spain

Universita Cattolica del Sacro Cuore di Milano, Milan, Italy

Universita degli Studi di Genova, Genoa, Italy

University of Naples, Naples, Italy

University of Modena, Modena, Italy

Universiy of Zurich, Zurich, Switzerland

Universite Libre de Bruxelles, Brussels, Belgium

Université de Haute Alsace, Muhlhouse, France

Université de Valenciennes, France

University College of Borås, Borås, Sweden

University of Athens, Athens, Greece

University of Birmingham, Birmingham, Great Britain

University of Glasgow, Glasgow, Scottland

University of Helsinki, Helsinki, Finland

Virtual Reality Laboratory, University of Michigan, Ann Arbor, Michigan, USA

University of Southern Queensland, Toowoomba, Australia

University of Tampere, Tampere, Finland

University of Trondheim, Trondheim, Norway

University of Ulster, Ulster, Northern Ireland

University of Zilina, Zilina, Slovak Republic

VDH USA Inc., Millersville, Maryland, USA

Vietnam Productivity Centre (VPC), Hanoi, Vietnam

Vocational Education Development Center (VEDC), Malang, Indonesia

VR Centre - University of Teesside, Middlesbrough, Great Britain

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■ Headquaters and
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■ Location of institutes
● Location of other
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The Fraunhofer-Gesellschaft's primary task is applied research. Founded in 1949, the research organization performs applied research for business and industry and to the benefit of society. Contractual partners and clients are industrial and service companies and the state. Research projects with relevance for the future, which contribute to innovations in the sector of public demand and the economy are carried out on behalf of federal and state ministries and agencies.

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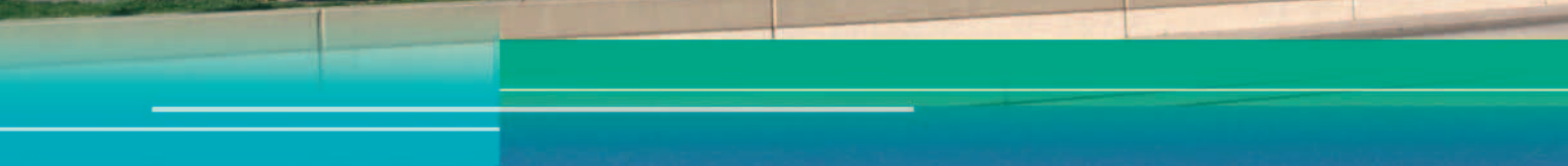
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