

Department of
Engineering and Mathematics

Annual Report 2015



FH Bielefeld
University of
Applied Sciences

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Department of
Engineering and Mathematics

Introduction

Department of Engineering and Mathematics Welcome



Welcome to the Department of Engineering and Mathematics,

Since the University of Applied Sciences moved to the new main Bielefeld campus, there is no longer any separation between the different departments. The additional new proximity to the University of Bielefeld also provides an attractive environment for studies, R&D, and entrepreneurial partnerships.

The University of Bielefeld, the University of Applied Sciences, and the CITEC comprise the new Bielefeld campus. The Department of Engineering and Mathematics now has a cooperative master's degree program in partnership with the University of Bielefeld. In addition, the branch site of the University of Applied Sciences in Gütersloh is rapidly developing, the first research projects have started and more new master degree programs are being planned.

The changes in 2015 bring not only new challenges but also new possibilities for University of Applied Sciences students and staff to take part in university life. The election of the new presidium for a six year term will set the course for the future. Furthermore, the quality of learning and teaching has been strengthened by the successful completion of the system accreditation, thereby transferring the responsibility of quality management to the University of Applied Sciences. The following pages outline what else happened in the Department of Engineering and Mathematics in 2015.

We hope you enjoy reading our annual report and finding out more about the Department of Engineering and Mathematics.

Prof. Dr.-Ing. Prof. h.c. Lothar Budde
Dean Department of Engineering
and Mathematics

Prof. Dr. rer. nat. Sonja Schöning
Vice Dean Department of Engineering
and Mathematics

Department of Engineering and Mathematics Moving to the new Bielefeld campus

The new Bielefeld campus – a decisive occasion in 2015

The eagerly awaited move to the new Bielefeld campus took place during the recess period in the summer of 2015. The Department of Engineering and Mathematics, which had been located at different branch sites before, is now consolidated at one campus location (except for the branch site in Gütersloh). The location of Biotechnology and Instrumentation Engineering is also accessible on foot. Subsequently, the central administration, the university library, two other departments and all central facilities have a new common address: Interaktion 1, 33619 Bielefeld, Germany.

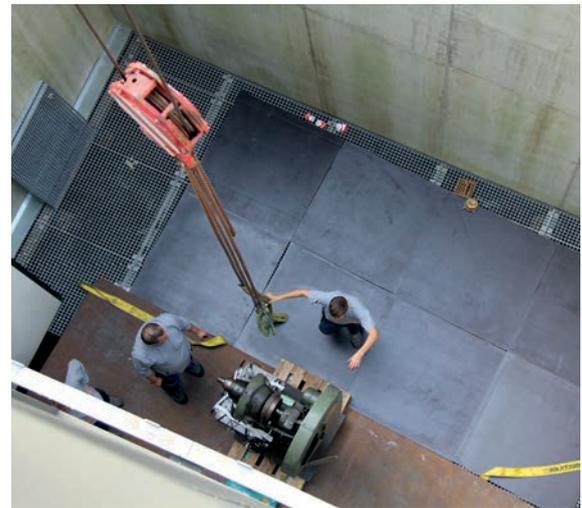
The building provides 2000 rooms and offers new possibilities for learning and teaching. Students and

members of the Department of Engineering are happy to use the new lecture halls, seminar rooms, laboratories and office space. The fact that everyone is now under a single roof has brought a new enthusiasm to the University of Applied Sciences. A real “campus atmosphere” was created and this is reinforced by the close proximity to the University Bielefeld and to the CITEC. Whereas some colleagues had previously been housed at different locations beforehand, we are now able to cross paths more often, thanks to the short distances. In addition, the main auditorium and the large experimental hall also emphasize this unifying campus atmosphere.

Many thanks to all who contributed to the success of our move!



Department of Engineering and Mathematics Moving to the new Bielefeld campus



The Department of Engineering and Mathematics

Modern studies are an essential contribution to innovation and the sites of Bielefeld and Gütersloh need a firm base to rely on. Here is an overview of the structures which characterize the Department of Engineering and Mathematics. These include facts about students, teachers, sites, facilities and people who put ideas into practice. This is what constitutes our solid base which supports our students at the Department of Engineering and Mathematics.



The new address of the University of Applied Sciences is: **Fachbereich Ingenieurwissenschaften und Mathematik
Fachhochschule Bielefeld
Interaktion 1
33619 Bielefeld, Germany**



Gütersloh

**In Gütersloh we can be found at:
Schulstr. 10
33330 Gütersloh, Germany**

The Bachelor study programs of Industrial Engineering and Mechatronics/ Automation are offered in Gütersloh.



Biotechnology and Instrumentation Engineering

**The location of Biotechnology and Instrumentation Engineering:
Universitätsstraße 27
33615 Bielefeld, Germany**

The study program of Biotechnology and Instrumentation Engineering are located in a technically well-equipped and modern building on the new main campus of Bielefeld.

Facts and Figures

- Founded in 1958
 (originally as a public school of engineering)
- 3215 students
- 70 professors and specialist teachers
- 94 employees in research, teaching and administration



Number of students at the Department of Engineering and Mathematics, winter term 2015/16

Study program	M	W	Degree
Applied Mathematics	94	124	Bachelor
Biotechnology and Instrumentation Engineering	71	55	Bachelor
Electrical Engineering	288	9	Bachelor
Information Technology (program closing)	56	1	Bachelor
Computer Engineering	137	9	Bachelor
Mechanical Engineering	784	55	Bachelor
Mechanical Engineering (part time)	188	23	Bachelor
Mechatronics	138	6	Bachelor
Mechatronics/Automation (integrated practice studies)	132	8	Bachelor
Production and Plastics Engineering (program closing)	39	2	Bachelor
Renewable Energies	249	41	Bachelor
Industrial Engineering	327	66	Bachelor
Industrial Engineering (integrated practice studies)	79	24	Bachelor
Biomechanics*	8	0	Master
Electrical Engineering	64	5	Master
Mechanical Engineering	67	0	Master
Optimization and Simulation	42	15	Master
In total: 3215 students	2775	440	

* enrollment in winter term at the University of Bielefeld and in summer term at the University of Applied Sciences

Department of
Engineering and Mathematics

Teaching & Learning



FH Bielefeld
University of
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Programs of study at the Department of Engineering and Mathematics

Bachelor Studies

Applied Mathematics *Bachelor of Engineering*

In Applied Mathematics, students acquire special skills in mathematics as well as basic knowledge in Business Administration, Engineering and Computer Science. Following the basic lectures, students choose additional coursework according to their interests. They can select from two different programs: the mathematical elective modules (catalogue A) and the mathematical applications (catalogue B). They learn how to use computer algebra systems and other applications and programs in the fields of engineering, computer science, and economics. Moreover, they are able to solve real-life problems using appropriate mathematical methods.

Career Options

After training at the Bielefeld University of Applied Sciences, mathematicians will find a variety of possible careers. The framework of our interdisciplinary and innovative environment of computer science, economics, R&D and technology in a company allows mathematicians to take on the role of "bridge builders" and mediators between these various disciplines. The key competences of graduates include their analytical skills and their ability to solve a company's problems by transferring these into suitable mathematical models and implementing them.

Biotechnology and Instrumentation Engineering *Bachelor of Engineering*

In the course of this program students are exposed to very practical components. Learning content and scientific skills are applied in the modern biotechnology laboratories, and students gain important experience for their entry into professional life. The Department of Engineering and Mathematics offers a variety of different learning environments such as lectures,

seminars, practice sessions, team work and presentations. Moreover, students participate in different projects and internships and can elect to spend a practical term in a company.

Career Options

Our graduates have expertise in both the fields of biotechnology and engineering, which means their application possibilities are as varied as the many sectors in which where this expertise is in demand:

- General: Diagnostics, development of new analytical equipment, establishment of innovative, diagnostic procedures, product management
- Pharmaceutical industry: Pharmaceutical development of therapeutic molecules, pharmaceutical production of active substances, quality assurance
- Medical industry: Development of technical devices, working in the field of "tissue engineering" or gene therapies
- Chemical industry: Production of bulk chemicals and solvents, synthesis of specialty fine chemicals
- Environmental technology: Production of alternative fuels or biogas, treatment of organic waste and sewage
- Food industry: Production of baker's yeast, cheese, yogurt, vinegar and soy sauce, brewery and winery products, production of aroma flavorings and dyes
- Agriculture: Breeding resistant plants, plant modification to improve nutritional content and manufacturing processes.

Computer Engineering *Bachelor of Engineering*

The Computer Engineering program provides a solid basis for a successful career start in many industries. The University of Applied Sciences supports students acquiring important professional skills. The most important markets for Bachelor of Engineering are the information and communication technology sector, as well as the electrical engineering or automation industries.

System developers are not only necessary in the technical areas; hardware and software development are important aspects in many other industries as well.

Career Options

Computer engineers work in between the fields of >>

informatics, electronics, software and hardware development. They develop electronic components and circuits, working as software architects and developers. They simulate and develop automatic controls and are involved in the organization of plants and systems, such as safe computer networks. Furthermore, graduates can work as a consultant to companies offering customized solutions.

Electrical Engineering *Bachelor of Engineering*

Students of Electrical Engineering focus on fundamental, practical aspects, however, the program includes options to specialize in certain subjects. The program helps satisfy the regional and national high demand for electrical engineers. Subsequently, the bachelor's degree also enables students to enroll in a master degree program.

Career Options

The living standard of modern society is essentially based on the achievements and on the evolution of the use of electricity. Therefore, the working areas for engineers and electrical engineers are diverse:

- Electrical Power: power production and distribution of electricity (grid expansion, wind turbines, photovoltaic systems, etc.)
- Electrical drive technology: development of electric motors (driving units in electric cars, trains and trams, servomotors, etc.)
- Electronics: development of analogous and digital components, circuits and systems for applications from small to large currents and from low to high frequencies.
- Automation technology: controlling, measuring, regulating, and communicating the automatic flow of processes in machines, equipment, and buildings.

Industrial Engineering *Bachelor of Science*

The bachelor's degree program of Industrial Engineering gives students integrative problem-solving skills needed by companies looking for managers who can

act as an interface between the and technology. This interdisciplinary approach allows students to gain knowledge of technical and business disciplines. It uses a practical and project-oriented training approach to optimally prepare graduates. The final thesis students submit is realized in cooperation with an industrial company, where they apply their methodological skills and knowledge acquired in their studies to come to a result that can be implemented. Two specifications can be chosen within the course: "Production Management" and "Technical Sales". Moreover, individuals can set appropriate priorities in the fields of production/logistics/materials management or in the field of marketing/sales, giving all graduates a slightly different specification profile in addition to a general education.

Career Options

Following their training at the University of Applied Sciences, economy engineers and industrial engineers have a broad, general study profile with a specialization either in "Production Management" or "Technical Sales". This profiling is not industry-related, but rather is functional-related, allowing graduates to work in all industries, such as in mechanical engineering, electrical engineering, or in the information technology industry. With regard to their functional tasks, graduates are particularly capable of working in the areas of Production, Material Management, Logistics, Quality Management or Sales/Marketing.

Industrial Engineering (Integrated practice studies) *Bachelor of Engineering*

According to the study program of Industrial Engineering, economic and technical aspects are a core part of the education. The practical integration trains industrial engineers in interdisciplinary activities to build an interface between technology and business management. Due to the balanced engineering and business education aspects of the program, they are capable of assessing, organizing and optimizing business processes.

Career Options

The universal character of studies offers various fields of work in many industries. Small and medium-sized companies also appreciate economic engineers because of their multiple competences. Main working areas are purchasing, production planning, quality and project management, as well as technical distribution. Economic >>

engineers also often occupy positions in marketing, finance and controlling, because often it is in these domains where technical interdisciplinary and business skills are required.

Mechanical Engineering *Bachelor of Engineering*

Machines enable us to conquer space and to explore the earth. They secure food and energy and make us move. Engineers of mechanical engineering develop solutions for a variety of needs and requirements. From the first customer contact to development, manufacturing, commissioning, sales and maintenance, engineers are required to find creative solutions. In research projects they develop innovative strategies for new products. In a world with decreasing resources they develop environmentally friendly and competitive products, thereby contribute to sustainability in our society. Regardless of their chosen specialization, graduates of the Mechanical Engineering program know all components, assemblies, machines and equipment and they can develop processes that implement theory into practice. A focus is also on cost-effectiveness and efficiency in the use of energy and raw materials. There are four specializations possible:

1. Construction and development
2. Energy technology, including the construction and optimization of energy installations and equipment
3. Production and logistics, covering planning, implementation and operation of production and logistics systems
4. Plastic and material technology, taking technological, manufacturing, processing, quality and cost aspects into account.

Mechanical Engineering (cooperative engineer training) *Bachelor of Engineering*

This program involves training the specialists of tomorrow. The Department of Engineering and Mathematics at the University of Applied Sciences has a cooperative engineering program for the study of Mechanical Engineering. The close links between theory and practice prepares graduates to enter easily

into professional life after graduation. They gain insight into operational processes and build up a professional network. The cooperative Engineering training provides the opportunity to graduate within four years and students have to pass two tests. The first is the skilled workers' examination administered by the Industrial Chamber of Commerce (IHK) or the final examination at the Chamber of Crafts (HWK) and the university degree (Bachelor of Engineering). Students' training is organized in close cooperation between a company, the university, and the Chamber of Commerce or the HWK.

Career Options

The increasing internationalization of companies, the rapid development of technology, and the use of media pose new challenges for engineers. They have to be versatile, educated professionals and managers. They address issues in an interdisciplinary environment and communicate with employees from all functional areas in order to work out solutions. Therefore, engineers have numerous working areas: development, design, manufacturing, sales, installation, service, recycling, quality management, planning, and testing.

Graduates of the cooperative engineering program have broad professional options: business engineering and plant engineering, construction and basic industry, the chemical and pharmaceutical industries, consulting companies, consumer goods industries, design offices, electrical companies, and transportation.

Mechanical Engineering (part time) *Bachelor of Engineering*

This composite course allows students to work part time while studying mechanical engineering, offering a practical engineering education. The degree course has a focus on manufacturing technology and thus makes it possible to apply engineering methods, analyze technical applications, and work out practical solutions. Additional topics include particular aspects of cost reduction, the increase in production, and the increase in quality. Because the entire process of planning is in focus, the program promotes multidisciplinary thinking, so graduates are capable of goal-oriented cooperation with other functional areas of a company. In their 8th term students choose a special orientation: metal, plastic, construction or operational organization. The course at the University of Applied Sciences is offered in partnership with the University of South-Westphalia. »

Career Options

The fields of engineering range from development, design and manufacturing, sales, installation, service and quality management to recycling, planning and testing. Graduates often work in companies of mechanical and plant engineering, construction and basic industries, such as the chemical and pharmaceutical industry, in consulting companies, in consumer goods companies, in designing offices and in companies of electrical engineering, the electrical industry and transportation companies.

Mechatronics *Bachelor of Science*

With a bachelor's degree in Mechatronics, the aim is to educate developers and product designers for the areas of machinery, vehicles, plant and training equipment manufacturing. The key skills of teamwork and communication are promoted through strong emphasis on project work. These projects are introduced by the teacher and implemented by including the students' ideas. Project work is carried out in small groups which work independently, but get support and advice from student tutors. In teams, students learn to solve specific problems of mechatronic development processes under practical conditions. Graduates with such qualifications are well prepared to work in vehicle, machinery, plant or equipment companies.

Career Options

Mechatronics engineers can be found in all classical engineering fields. They mainly work in R&D, production, services, sales or marketing, but they can also be professors or university teachers. However, mechatronics engineers are also often a part of company management. This is partly because they are technical experts and can help in developing strategies as well. Secondly, they are excellent project managers because they are structured, can observe analytically and do solution-oriented work. These skills may be the reason for the high demand for mechatronics engineers. An analysis of the professional life of former graduates in mechatronics shows that a significant percentage of students take part in the development, planning and controlling of projects. They accompany the development of products from conception to shipping. They coordinate company departments and use their project management skills acquired at the University of Applied Sciences.

Mechanical Engineering (Integrated practice studies) *Bachelor of Engineering*

The graduates of the Mechatronics / Automation program differ from others by linking elements of mechanical engineering, electrical engineering and computer science in the development and manufacturing of technical systems. The engineers take complex technical systems and secure their maintenance and work on their improvement. Finally, the training of the students has a focus on project management and successful teamwork.

Career Options

Because of their interdisciplinary training, graduates may work in many industries. Mechatronic graduates are needed, for example, in mechanical engineering, in the vehicle industry, in plants, in automation technology, in the aerospace engineering industry, in information and entertainment technology and even in the medical technology sector. A high demand for engineers of Mechatronics / Automation can be found in mechanical engineering companies and in the electrical industry. The main working areas are: R&D, design, manufacturing, quality management, service and sales.

Renewable Energies *Bachelor of Engineering*

In this course students acquire the knowledge and practical skills they will need to work as an engineer in the renewable energy industry. The main emphasis is on:

1. Production, distribution and effective use of electrical energy on the basis of renewable energy and
2. Production, distribution of bioenergy from renewable raw materials and biological waste.

Career Options

These two specifications, electric energy and bioenergy, provide the structure for the course of studies and are thus the two main branches graduates usually gravitate towards after graduation. It is possible to work in the field of the generation and distribution of energy, but also in the field of the efficient use of energy. Especially the efficient use is becoming a new challenge in a wide range of working sectors. However, there are also new working areas with innovative ideas to be developed, >>

such as in data centers, communication technologies, industrial drives, production lines, municipalities, and private households. As far as bioenergy is concerned, it is primarily the relatively undiscovered fields of plant automation and plant control systems which offer new career options.

Master Courses

Electrical Engineering *Master of Engineering*

Specification:

Networked Electronic Systems

Electronic systems dominate all areas of our lives. In addition to an increase in the complexity of the individual systems, modern electronic systems are characterized by a high degree of crosslinking and new technology. In this master program students gain the basis for understanding networks and linked electronic systems and they are able to use their acquired knowledge when solving specific problems.

Career Options

The widespread use of electronic systems has created a large demand for specialists in this area; including in the R&D departments of companies in the engineering, electrical engineering and automotive industries. By emphasizing a systematic approach and the provision of management skills, graduates can also work in development or as a product manager for electronic systems. This master program trains graduates to act independently and to guide others in projects in the field of electronics. Thus, graduates may work in many areas and also fulfill the conditions for obtaining management positions.

Specification:

Intelligent Energy Systems (IES)

Efficient and effective power generation, transport and energy use are the key to a sustainable future. In particular, the expansion and conversion of the infrastructure (smart grid), the integration of energy storage and the intelligent use of energy characterize the future challenges for engineers. Therefore, classical fields of power engineering are mixed with methods of process automation, communications technology and

intelligent control and operating methods.

Career Options

Graduates of the specialization fields IES can work in all professional fields in which electrical energy plays a significant role, including a wide range of manufacturing companies of automation components, classic power companies, automotive supply and automobile manufacturers as well as planning and consulting companies or municipalities in public administration. Furthermore, the master's degree enables students to enter a doctorate program.

Mechanical Engineering *Master of Science*

Modern machine technology ranges from microsystems, miniature robots, washing machines and cars to the production of machine tools and plants. Development of new products requires the optimization of existing products with modern methods of "digital prototyping". Computer-aided design, analysis, simulation and visualization techniques offer enormous potential in the development and optimization of products in terms of quality, durability, reliability, energy efficiency and resource conservation. The master course of Mechanical Engineering builds a consecutive program following the bachelor program in the department of Engineering and Mathematics. The aim of the master program is to educate graduates for activity in the field of computer-assisted development and construction. They learn how to use scientific methods independently and are then qualified for further independent scientific work, such as a doctorate.

Career Options

Machine exporters in Germany need highly trained experts to continue steady innovation and to maintain global competition. The master's program qualifies its graduates to work in independent engineering activities in many fields of mechanical engineering, in particular in the field of computer-aided design and engineering. Positions in this area are excellent, as there is a high demand for experts and professionals. Mechanical engineers are required in a variety of industries, some examples are as follows:

- Plant engineering
- Automotive industry

>>

- Aerospace industry
- Chemical industry
- Electrical industry
- Consultants.

The scarcity of fossil fuels requires exploration and development of new technologies for the use of renewable energy. There are huge challenges for graduates, e.g. in the context of:

- Wind turbines
- Tidal power plants
- Fuel cells

Optimization and Simulation *Master of Science*

Mathematical models and methods, in particular from the field of optimization and simulation, have immense importance for numerous key areas of science and the economy. It is now standard, for example, in industries such as automotive, aircraft or aerospace industry, in the electrical industry or the chemical industry, to calculate processes and numerical computer simulations before actual production can start. Experiments using valuable raw materials are no longer acceptable due to the costs and environmental aspects. In the resource, sales and financial planning, computerized simulations are the basis for optimization approaches.

However, performing complex simulations in a professional way requires sound theoretical training. For this serves the new Master program Optimization and Simulation. Students are enabled to do scientific independent contributions in modeling, optimization and simulation. In addition to qualifying the students for many demanding activities in companies, it also enables them to work in the higher civil service.

Career Options

The demand for experts, professionals and executives in the field of computer optimization and simulation is large, so that there are many excellent career options for graduates of the master program. There are numerous specific positions in different industries where graduates can work. The following areas of work are some examples:

- Technical calculations: strength calculations, vibration analysis, image data analysis, weather calculations, default calculations, statistical analysis, news channels or encryptions

- Technical simulations: traffic simulations, network simulations, aerodynamic simulations or reactor simulations
- Technical system analysis, such as the modeling procedural processes for data processing or for computer product analysis
- Modeling and optimization of production processes, for example, solving machine scheduling problems or the organization of queues
- Sales and resource planning, for example, inventory optimization, improvement of delivery systems, material requirements planning, and determining optimal sales prices
- Financial and risk management, for example, reliability calculations, development of enterprise simulation based risk control systems, and optimization of the individual company finance structure.

New Master Courses in 2015

Biomechatronics *Master of Science*

This course comprises four terms and 120 credit points and leads students to a Master of Science (M.Sc.) degree in Biomechatronics. Students can start the program in either the winter or the summer term. In the first two terms the studies contain an introduction into biomechatronics from the perspectives of biology and engineering (three compulsory courses), a basic course about system design (three compulsory courses), two Biomechatronics internships, a project and elective courses for an individual differentiation. The final course is reserved for the master thesis and a colloquium, which can be done in cooperation with a company.

Career Options

The master program imparts theoretical basics, scientific skills and methodological competence in the field of system engineering as well as general professional qualification such as the use of modern software and hardware. Moreover, the program also addresses secondary skills such as social, scientific and ethical subjects which result from applications and decision-making. Students are trained to work independently according to the scientific principles of engineering as well as to work in teams for social and leadership skills. >>

The interdisciplinary study programs are of particular importance at the University of Applied Sciences. There is a high demand for well-trained engineers in industry, in services, and in research in the field of mechatronic systems. Possible career fields can be e.g. in the R&D departments of the machine and plant construction, in production, in the automotive industry, in medical technology, in the development of autonomous systems (robots, intelligent assistance systems), as well as in scientific research.

Molecular Biotechnology* *Master of Science*

* in cooperation with the University of Bielefeld

The aim of the master program is to deepen skills acquired in the bachelor's degree in order to apply this knowledge to the practical environment while taking

modern techniques and methods of biotechnology into account. In addition, students are increasingly trained to work independently and according to the common scientific principles of biotechnology.

Career Options

The profile of the program is structured in a way that broad training and a choice of all domains of biotechnology can be realized. This ensures that all graduates have a relatively uniform educational profile in biotechnology, but still have individual specialization profiles. This helps students in competition for jobs, as they can work in a wide range of fields. The master program is characterized by a high level of practical work to ensure that graduates are able to apply current techniques and methods of biotechnology. This is also important for those graduates who will go on to obtain a doctorate. Students who have extensive training both in current molecular genetic / biochemical processes and thorough knowledge in material production, especially in conjunction with cell culture technology and processing methods, will be increasingly in demand by the industry in the future.



The zdi school pupil laboratory experiMINT

About the laboratory

The zdi-laboratory for school pupils has been in existence at the University of Applied Sciences, more precisely at the Department of Engineering and Mathematics, since 2011. This is a multifunctional experiment and work laboratory for children, teenagers and young adults. Renewable energies, product development, and construction are some of the interesting topics the Department of Engineering and Mathematics have addressed in this lab. Professors and students of different study programs collect ideas and develop workshops for school pupils within the frame of student projects. University students are the most important workers in the lab, with four student workers belonging to the zdi team.

Even university students ask themselves what they want to do after their studies in their professional lives. And as university students, they are still young and not so distant from school pupils, they remember the difficult question of "What do I want to do in my professional life?" This means they are in an excellent position to advise pupils who are still in school. To help young people find the right profession is one of the objectives of the zdi lab. In this respect, it is important to appeal to pupils' curiosity and technical fascination. Workshops for young visitors help give an orientation in the broad choice of professions and studies. In the ideal case, these workshops will link up pupils who are interested in studying one of the programs of the Department of Engineering and Mathematics, and they can clarify what engineers really do, clearing up misconceptions. The main target group is pupils still in high schools and community colleges, but learners in nursery schools and elementary schools are also welcome. The fascination of the technical domain can be encouraged very early in life.

Facts and Figures 2015

All in all, the zdi lab offered nine regular workshops, addressing automation technique, construction of bridges or robots. During the school holidays there are special programs which can generate new ideas that are then adopted by the regular program. The zdi-lab increased their total number of visitors by about 10% in 2015, with more than 820 workshop participants between the ages of 6 to 65, compared to 745 visitors in the preceding year. The composition of participants is always different: one quarter of participants were in high schoolers (10th grade or higher), and 40% were in secondary schools (grades 7 and higher). Younger

participants, attending nursery/ elementary schools and the early stages of secondary schools (grades 5 and 6) made up 10% of the visitors.

More than half of all participants were at upper-level high schools, which grant the German high school degree (Abitur) which enables graduates to enrol at university studies later on.

Despite the two-month break during the move, during which no workshops could take place, in 2015 the zdi-lab was open in for 68 days, offering 57 workshops and other guided tours. On the university's open-house day roughly 1500 people visited the zdi-lab. In addition, they were also people attending special events, fairs, and participating days, such as guided tours at the Hannover fair. Other special events were the experiMINT day in Herford and the MINT-participating day in Gütersloh, which help promote STEM (in German "MINT") subjects.

Silja Stark

zdi

"Zukunft durch
Innovation" - Future
through innovation



Teaching & Learning

Special characteristics of the department

Leonardo da Vinci - Fascinating, unusual, successful



Prof. Dr. Horst Langer, Jana Mielke, Prof. Dr. Andreas Beaugrand, Prof. Dr. Anne Weber-Krüger, Prof. Dr. Lothar Budde and Prof. Dr. Beate Rennen-Allhoff.

The Leonardo project celebrates 10 years at the Department of Engineering and Mathematics.

Since the winter term 2004/2005, students of the University of Applied Sciences have been dealing with the ideas and works of the famous artist and engineer Leonardo da Vinci under the guidance of Professor Dr. Horst Langer. Some students came up with the idea of constructing models of da Vinci's drawings. From this idea, to not only deal with the drawings in theory but to replicate them in real life, came a successful exhibition which enables people to take part in and to touch da Vinci's models. It has even garnered international attention and become successful.

"I was looking for an idea for our project work, when I came across a book of Leonardo. I thought, that it could be a good topic. The students would deal with its engineering and prepare presentations," said Langer, who teaches students in what was then the product development program (now mechatronics). Fascinated by the works of Leonardo, the students started to elaborate on a first poster which reflected their research results. One day, Dirk Brockbalz, a skilled carpenter, said, "This is far too theoretical for me." Said and done: he built the first model from the drawings, which was a pulley block.

Langer notes that. "The pulley block is still hanging in the University building in honor of that student and it is not lent out to anyone." Soon thereafter, numerous other models were conceived and constructed by students, as they "were allowed to play and also blunder," as Langer recalls. "You have to play in order to be creative."

In 2006 the first press conference was held to show the students' works to the public. Shortly thereafter the first request from the lock and metal fittings museum in Velbert arrived. Horst Langer, his students and the employees had to face completely new demands and requirements concerning these models. All exhibits are manufactured in the laboratories of the University of Applied Sciences and Horst Langer also collaborates with the Department of Design. This is how the first major exhibition objects came into being.

But the exhibition was still missing something – a professional concept. This was also Jana Mielke's opinion. Mielke, a graphical design student, suggested developing such an exhibition concept as her final thesis project. Thus, the model descriptions and accompanying >>

Teaching & Learning

Special characteristics of the department

materials for the exhibits were put together, giving the exhibition its own unmistakable style, with the blue triangles as a symbol of high recognition.

So far about 350 students have worked on the models. Today the collection includes 105 models, a music instrument, a gear box, flying objects, war equipment and more. Thousands of visitors from all over Germany, from London and from Utrecht have visited the exhibition, which was sold out almost from the beginning. In 2015 there were more requests leading through the end of 2016 and exhibitions have already been planned for 2017.

"In the meantime, we have started separating all models strictly into project works on the one hand and exhibits on the other," said Professor Langer. "The exhibits have to be robust and secure, as the visitor frequency is up to 10.000 per month. We want people to be able to touch the models." There is now a specification catalogue for the exhibits, so that the models are prepared for these numbers of visitors. "Someone once told me that we have built the most successful exhibition of Leonardo da Vinci's objects in Europe," noted Langer. The exhibition is a magnet for visitors. Even museum educators have contacted the Leonardo team to learn about how they have created this success. "The essential thing is participation. This is confirmed by our students, who are incredibly motivated and have fun in their studies," says Langer, referring to the low dropout rate of students in the first year of the degree program.

Meanwhile, the exhibition has become a small company. To secure the future, the team has been formed around Horst Langer, Jana Mielke, a laboratory employee and seven student assistants and they are developing specific plans and visions. Leonardo will be cooperating with the Competence Center of Technology Diversity and Equal Opportunities, which coordinates the nationwide Girls' Day. In addition, the establishment of an association is being considered. The team would even cooperate with companies, "for example, to recruit apprentices," said Jana Mielke. Dean Professor Lothar Budde emphasized "that the department wants Leonardo to continue to contribute to society in the future".

Horst Langer's vision is to achieve an even more intensive study of Leonardo in the exhibitions and to come up with topics such as energy, power systems and flight equipment and measuring devices, which could be accompanied by an audio guide.



Prof. Dr. Horst Langer remembers 10 years of Leonardo.



Jana Mielke, a graduate of the Department of Design, created the design of the exhibition and has accompanied the project for several years.

The jubilee celebration was accompanied musically by Professor Anne Weber-Krüger (bassoon) from the Department of Social Affairs, who also created a reference to Leonardo: "A bassoon is not an instrument of the Renaissance, but it is a tinker-instrument and Leonardo had indeed also built these kinds of instruments, such as the famous Horsehead-Lyra".

Finally, Professor Langer thanked his team and the supporters of the project, including the President of the University of Applied Sciences, Professor Dr. Beate Rennen-Allhoff, Vice President Professor Dr. Andreas Beaugrand and the former and current students, who represented the 350 students who have worked in the projects over the last ten years.

The current exhibition dates can be found at www.leonardo-bewegende-erfindungen.de



Department of
Engineering and Mathematics

Research and Development



FH Bielefeld
University of
Applied Sciences

Institut für Systemdynamik und Mechatronik - (ISyM) *Institute for System Dynamics and Mechatronics*

Director

Prof. Dr.-Ing. Rolf Naumann

Deputy Director

Prof. Dr.-Ing. Sebastian Hoffmann

Management

Dr. rer. nat. Tatjana Heckel (through Oct. 2015)

Tobias Lehmann, M.Sc. (as of Nov. 2015)

Other members

Prof. Dr.-Ing. Dirk Weidemann

Prof. Dr.-Ing. Joachim Waßmuth

Prof. Dr.-Ing. habil. Klaus Panreck

Prof. Dr. rer. nat. Axel Schneider

Prof. Dr.-Ing. Heinrich Kühler



In developing the marketing strategy for the ISyM Institute, an image film was conceived and filmed in early 2015. It includes excerpts from numerous research activities and also contains information about the focus and topics. The film can be accessed at www.isym-bielefeld.de.

In April 2015 the ISyM attended the Hannover Messe with a joint display stand with the "Leading-Edge Cluster Intelligent Technical Systems OstWestfalenLippe – it's OWL". The newly designed fair stand, which is similar to a market stand, was presented to the public for the first time. The concept of the exhibition stand is very flexible; both the size and the contents can be customized. The Department of Engineering and Mathematics is now responsible for organizing the stand and coordinating its different dates of use. In the future it can be used for many different purposes and be borrowed by any members of the department. The fair stand demonstrated the priorities of the Institute to the visitors at the Hannover Messe. There was even a delegation from the Economic

Committee of the NRW-Landtag parliament who came to the stand to obtain information about the research work being done at the University of Applied Sciences.

In early May, the professors and the management involved in ISyM work spent two days together in order to discuss the Institute's further steps, research applications and other topics. Over the course of this meeting the professors agreed on a main focus of Human Mechatronics. Additional foci will be Model Based Automation and Low-cost Mechatronics, which are also important for the Institute. Other research proposals of the Institute were also prepared at this meeting.

At the end of October the managing director of ISyM, Dr. Tatjana Heckel, was given a warm send-off and we would like to take this opportunity to thank her once again for all the work she has done for the Institute. Her successor, Tobias Lehmann, took on the position of Director in November 2015. Lehmann had previously worked as a research assistant at the Institute and he is >>



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The Institute's stand at the "FMB Zuliefermesse"

thus also able to provide technical assistance concerning new topics and processes. At the end of 2015, ISyM was involved in the "FMB Zuliefermesse", a fair held in Bad Salzuflen. A special part of the Institute's stand was a small humanoid robot, which is able to mimic hand and arm movements as detected by a camera. The demonstrator's motto is: "Human Mechatronics – Den Menschen mitdenken" ("Human Mechatronics – think as human beings"). The director of the Institute, Professor Rolf Naumann, also gave a presentation on this subject at the fair.

After a little more than two years' work, the research project "Low-cost Mechatronic Systems (LoCoMS)" was successfully completed at the end of March 2015. Over the course of this project software was developed which can perform sound and vibration analyses to find cost-effective solutions for problems such as too much vibration or noise. Two demonstrators were developed during the course of this project. The dynamic behavior of vibration and damping was examined with the aid of a wheelchair, produced by INVACARE in Porta Westfalica. Also an ANC-system for active noise compensation (ANC) was implemented in order to create an acoustically pleasant workplace for the driver of a forage harvester cab in conjunction with the company CLAAS in

Harsewinkel. Another research project called "it's owl-InoTeK" was also successfully completed in November 2015. The overall objective was to develop an intelligent dough mixer that could optimize the kneading process with regard to the dough quality, time reduction, cost reduction and energy efficiency. By combining the kneading tool with an intelligent control system of the kneading process, promising potentials for optimization were developed. The partial goals of the University of Applied Sciences were the identification of measured variables as well as measuring the kneading during the process and improving the dough hooks. Project partners were also conducted with the Neuenkirchener Maschinenfabrik Emil Kemper GmbH in Rietberg and the Heinz Nixdorf Institute – RtM as well as the Department of Control Engineering and Mechatronics at the University of Paderborn.

After intensive discussions and networking the ISyM became integrated in a special concept of the region "OstWestfalen Lippe" – EastWestphalia called "OWL 4.0 – industry, labor, society". A competition helped formulate the competencies of the Institute and the subject of "Human Mechatronics" in connection with transport aids and assistance systems in the health industry.

The two sub-projects, "Project workshop health 4.0" and "4.0 Industry for the middle class" are expected to create >>

Research and Development

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two part-time jobs for scientific employees for three years. The essential goal of these projects is connectivity in the region and the transfer of knowledge in the field of industry 4.0. This concerns the transfer from universities

to industry and society, and the formulation of future project subjects and applications.

Bielefelder Institut für Angewandte Materialforschung (BifAM)

Bielefeld Institute for Applied Materials Research

Director

Prof. Dr. rer. nat. Christian Schröder

Deputy Director

Prof. Dr.-Ing. Bruno Hüsgen

Management

Dr. rer. nat. Tatjana Heckel (through Oct. 2015)

Katharina König, Dipl. Biochemist (as of Feb. 2016)

Other members

Prof. Dr.-Ing. Wolf-Berend Busch

Prof. Dr. rer. nat. Frank Hamelmann

Prof. Dr.-Ing. Thomas Kordisch

Prof. Dr. rer. nat. Martin Petry

Prof. Dr. rer. nat. Sonja Schöning

Prof. Dr.-Ing. Dirk Zielke



The BifAM can look back on a positive development over the course of 2015, both in terms of external funds and with regard to its number of publications. It meets not only the internal performance criteria for institutes of the University of Applied Sciences Bielefeld, but also the performance criteria of the German University Directors' Conference, which has recognized it as part of a national research focus. To further establish the "brand" BifAM, its members have been engaged in various public events and national and international conferences. Furthermore, an image film for the external representation of BifAM was created, which is available on the Institute's website (www.BifAM.de).

The Bielefeld Materials Day ("Bielefelder Werkstofftag") was one of the most important events in 2015. It was the first time that the event dealt with the subject of

"virtual product development – materials in modeling and simulation" and it was widely accepted by the participants. Six lectures were held by speakers from the industry and sciences. Issues such as numerical flow simulation, reverse engineering as a method for determining material parameters or the modeling of carbon were discussed during the program.

In 2015, the BifAM presented two projects at the Hannover Messe at a joint stand with the North Rhine-Westphalian Ministry of Science. First, the thermography drone was presented by Professor Frank Hamelmann. It was developed at the Technical Department at the University of Applied Sciences in Minden and is equipped with a thermal imaging camera. It can fly over photovoltaic systems and automatically check on the connected modules. Up to 1300 modules can be >>

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observed in just one hour of flight time.

Professor Dirk Zielke showed the prototype of an energy self-sufficient shock sensor called Pisens, which can be installed in transport boxes and accurately determine the time at which a possible transport damage occurs. This is particularly useful for goods with a higher value. What makes Pisens unique when compared to previous solutions is that it is both reusable and energy-self-sufficient. The mutual internal cooperation of the members of BIfAM increased in 2015. There were several joint applications for research projects filed by two or more members of the Institute.

Another decisive joint activity was the strategy session in January 2015, which decided on important measures that were implemented during the year, as was also confirmed in the review in December 2015.



Prof. Dr.-Ing. Dirk Zielke, Dr. Tatjana Heckel, Timo Göstenkors, Irina Stockem, Prof. Dr. Christian Schröder and Rico Schindler presenting the thermography drone and shock sensor Pisens.

Forschungsschwerpunkt Intelligente Technische EnergieSysteme – *Intelligent Technical Energy Systems (FSP ITES)*

Spokesperson

Prof. Dr.-Ing. Eva Schwenzfeier-Hellkamp

Deputy Speaker

Prof. Dr.-Ing. Jens Haubrock

Management

Dipl.-Ing. (FH) Daniel Werner

Other members

Prof. Dr. rer. nat. Jörn Loviscach

Prof. Dr. rer. pol. Hildegard Manz-Schumacher

Prof. Dr.-Ing. Frank Sander



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Based on the success already achieved in 2015, it was decided to develop the research focus of ITES even further. Essential components of this development include increasing staff in the existing research team. Basic parts of the research extension are the integration of light and/or energy "recovery" in textile materials, lightweight construction and fiber-reinforced plastics in electric mobility, the thematic extension of information, elucidation and training in the cross-cutting issue, smart interfaces and – last but not least – the implementation of a concept for cooperative doctorate programs with the University of Bielefeld. >>



The goal is to solve inter- and trans-disciplinary questions of systems engineering and to obtain an integration of economic, environmental optimization and social integration of decentralized energy systems - a safe, inexpensive, environmentally sound and efficient delivery/use of energy. The proven organizational structure of ITES in different sub-topics is to be maintained as a basic structure.

The main topic **Smart Light** will set its focus in the future on LED, particularly on applications, on energy "production" and on textile materials through semiconductor materials. The integration of light and/or the production of energy in materials of the textile industry is just one example. The product development of market and environmentally oriented LED street lights is important in order to satisfy customer requests. Furthermore, there is a need for LED lights in the field of health and safety, which comprises safety at large events as well as light in different contexts such as light & age and light & dementia. Other areas for specific applications of LED are the coexistence of human beings and animals, the combination of dairy cattle & human beings, pigs & human beings, as well as bats & human beings.

The main focus of **Smart Mobility** in the future will be on research, which will take place in the field of charging infrastructures and centralized charging systems of vehicles, examining its effects on grids. It is necessary to find solutions for the integration of such systems into the overall electrical system.

It is also planned that lightweight structures for electric vehicles will be manufactured. Their production should be cost and energy efficient, using an innovative mold

system. With these structures, extremely lightweight structures can be produced in medium quantities at a relatively low cost. This could result in the development of an e-mobile platform for innovative lightweight materials with competitive prices.

In the frame of **Smart Energy**, R&D is dealing with the intelligent interconnection of future infrastructures for the energy distribution grid. Another research approach is the integration of the new DC technology in energy distribution. Furthermore, TSP Smart Energy deals with the interconnection of energy grids, in particular with district heating grids, which are used in metropolitan areas and consolidated within virtual power plants in order to construct a hybrid energy grid.

The focus of the cross-sectional theme **Smart Interfaces** is still on man-machine interaction, which comprises three main research fields. Information and education is important to show people how the interaction between human beings and technology can work. An example is Virtual Reality and Augmented Reality, which demonstrates how to utilize an on-shore wind energy plant in your own garden within a district and how this would play out. Furthermore, the intelligent use of technology deals with the development of information systems and incentive systems for the development of intelligent devices that start depending on active feeding and grid loads. They are supposed to shift the network load and to give feedback in electric cars to counteract concerns of having an empty battery. In the area of guidance and training, interactive manual books, electronic trainings and web-based co-operations are in planning. The objective is to support different professionals from different fields of the energy technology sector and to amend technical innovations.

Forschungsschwerpunkt Angewandte Mathematische Modellierung und Optimierung (FSP AMMO) – *Applied Mathematical Modelling and Optimization*



Speaker

Prof. Dr. sc. techn. Dr. rer. nat. Rainer Ueckerdt (through August 2015), Prof. Dr. rer. nat. Svetozara Petrova (as of September 2015)

Deputy Speaker

Prof. Dr. rer. nat. Svetozara Petrova (through August 2015), Dr. rer. nat. Sabrina Proß (as of September 2015)

Other members

Prof. Dr. phil. Bernhard Bachmann
Prof. Dr. math. Friedrich Biegler-König
Prof. Dr. rer. nat. Claudia Cottin
Prof. Dr. rer. pol. Hermann-Josef Kruse
and 5 academic staff



The research focus AMMO was founded in 2008 and grew to 12 members by 2015, all of whom bring together specific knowledge from different research orientations of mathematics and in-depth knowledge of various practice environments. AMMO bundles these skills in the common intersectional area of mathematical modeling and optimization in order to find common R&D projects. Since the establishment of AMMO, many different projects have been initiated and put into practice.

By the end of 2015, AMMO was looking back on an eventful year. A new director headed AMMO since the winter term of 2015. Because Professor Rainer Ueckerdt was preparing to retire, the position of spokesperson was given to the newly elected leadership of Professor Svetozara Petrova as spokesperson and Dr. Sabrina Proß as her representative.

The R&D focus has been in existence for seven years now. The idea to present its content in a book came about in 2015. In this book the field of applied mathematical modeling and optimization is presented through typical problems and corresponding solutions. The aim of

this book is to describe a systematic approach to the solution of a practical problem, starting with the problem description, going on to the mathematical modeling and development, including the selection of appropriate solution methods and their adaptation, then ending with the solution interpretation. All of this is based on a few case studies. The book will be published in early 2016 as part of a publication series in the Department of Engineering and Mathematics.

In 2015 five lectures were held as part of the established event series "Treffpunkt AMMO" to which scientists from other universities and representatives of companies belong. They reported on recent R&D results and discussed specific practical problems in relation to the subject.

The report series "AMMO – reports about research and technology transfer" grew by one magazine thanks to the CPN group (Coloured Petri Net). Another magazine on the subject "Colored Petri Nets" is currently in preparation and will be published in early 2016.

In October 2015, the new research project "Flexible and >>

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intelligent planning nurses (Filip)" was launched at the University of Applied Sciences. Within the next three years the scientists want to develop a new software tool that will support clinics in effective and resource efficient nursing staff planning. What is special about this project is the unique collaboration of nursing science and mathematics, represented by the AMMO members Professor Hermann-Josef Kruse, Professor Bernhard Bachmann, and Timo Lask (M. Sc.).

The project TimeWiki has now been taken over by Jens Schönbohm after the retirement of Professor Rainer Ueckerdt in 2015. TimeWiki is a multimedia database project whose objective is to explain the historical context in the development of mathematics and to visualize and create a comprehensive documentation of the historical context and the important people who were involved in this.

Professor Bernhard Bachmann, the academic staff and AMMO members Dipl.-Math. (FH) Willi Braun, Lennart

Ochel, M. Sc. and Vitalij Ruge, M. Sc. participated in the OpenModelica Annual Workshop at the University of Linköping (Linköping, Sweden) and at the 11th International Modelica Conference in Paris (France) and gave several speeches. Within the framework of the MODPROD workshops and the Modelica Conference, two tutorials on "Graphical based dynamic optimization with OpenModelica" were held.

The collaboration was continued with other scientific national and international institutions, such as the Center for Biotechnology (CeBiTec), the Technical Department of the University of Bielefeld, the Institute of Mathematics of the University of Paderborn, the Swedish University in Linköping, the Center of Excellence on Supercomputing Applications at the Bulgarian Academy of Sciences and the City University of Hong Kong.

Other research projects have been successfully carried out by the members of AMMO and new projects were started in 2015.

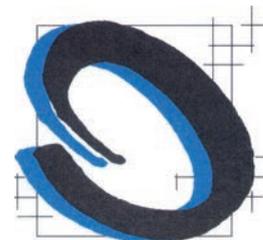
Forschungsschwerpunkt Industrielle Bewegungstechnologie – Industrial Motion Technology (FSP IBT)

Spokesman

Prof. Dr.-Ing. Ralf Hörstmeier

Deputy Spokesman

Prof. Dr.-Ing. Jürgen Sauser



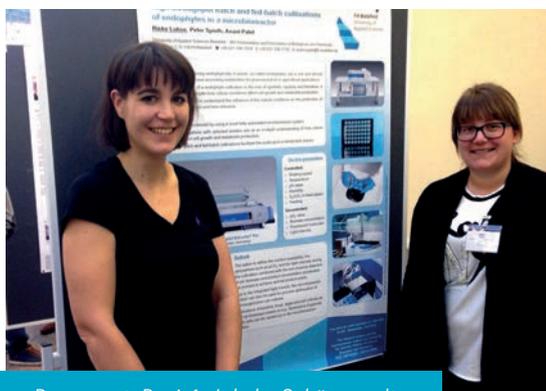
Since 01 May 2015 Professor Ralf Hörstmeier, spokesman for the R&D focus on industrial motion technology (IBT), and Professor Jürgen Sauser, as deputy spokesman, have held the joint leadership concerning the research contents. Professor Rainer Albrecht had worked as deputy speaker in the past decade, but due to his pending retirement in early 2016 it was very important for him to transfer his tasks to Professor Sauser early on. Sauser has been a professor for process and information management since 2012 and is responsible for the specialization "Production & Logistics".

In 1994, the research of IBT started with a funding of the Land North-Rhine-Westphalia. Numerous transfer and funded projects as well as the development of external funding sources demonstrate the success and dynamism of the research focus which was founded by Professor Hörstmeier. All activities center is on "design/

development", "testing", "planning and organization" and concerning or deal with the "motion processes", it is always taking the aspects of "people" and "technology" into account.



AG Fermentation und Formulierung von Zellen und Wirkstoffen – *Working group Fermentation and Formulation of Biologicals and Chemicals*



*Dr. rer. nat. Desirée Jakobs-Schönwandt
and Dr. sc. agr. Rieke Lohse*

Head of working group

Prof. Dr. rer. nat. Anant Patel

Other members

14 scientific workersstaff / doctorate students

The calendar of the working group "Fermentation and Formulation of Biologicals and Chemicals" was quite full in 2015, thanks to the many contributions at national and international conferences. In February the doctoral candidate Vivien Krell and Dr. Desirée Jakobs-Schönwandt presented their research results on "Entomopathogenic Fungi as Endophytes" at the PPPHE Symposium in Berlin. In June, Professor Patel and his team traveled to Riga to attend a conference of the IOBC on "New Challenges for Biological Control". A special highlight in 2015 was the group's stand at theACHEMA in Frankfurt. During this fair, Vivien Krell was given an award by the Society for Chemical Engineering and Biotechnology (Gesellschaft für Chemische Technik und Biotechnologie e.V. DECHEMA). She was honored for her particularly efficient study with excellent achievements in the field of biotechnology. Over a period of five days, both the Department of Engineering and Mathematics as well as the current research subjects of the working group were presented at the fair.

The largest conference in 2015 was the International Plant Protection Conference in Berlin with 1.200 participants from 95 countries. The Fermentation and Formulation of Biologicals and Chemicals working group was represented not only by two lectures and a poster, but was also invited to conduct a workshop on "Fungal Endophytes and Plant Health" and was invited to present their results in an article for the journal "Phytomedicine". In September, Professor Patel, Dr. Desirée Jakobs-Schönwandt and Dr. Miriam Hanitzsch traveled to Swansea, Wales. There was a conference on "Biopesticides – Innovative technologies & strategies

for pest control" and the working group had the opportunity to actively learn about the Welsh culture and Céilí dances. Another meeting in September 2015 was the International Conference for Bioencapsulation in Delft, Netherlands. In addition to a successful lecture given by Pascal Humbert, Michael Przyklenk received an award for a scientific poster. Other events held in September were the federal algae regulars' table, the mycologist's conference (Madeira, Portugal), and the ECAP (Nice, France). The latter was attended by Vanessa Homburg and Dr. Rieke Lohse. Furthermore, Dr. Marina Vemmer represented the working group at the well-visited industry meeting ABIM in Basel in October and presented two posters concerning the development of organic products.

At the end of the year, Dr. Lohse and Dr. Jakobs-Schönwandt presented their research results at the miCROPe conference in Vienna, where 253 scientists from 43 countries came together. They discussed "Microbe-assisted crop production" and new trends in biological plant protection. Finally, the EU project INBIOSOIL was successfully completed in 2015, as the last official meeting of all 15 EU partners took place in Göttingen, Germany.

In total, the 14 members of the working group attended 13 national and international conferences and one exhibition. They held more than 20 lectures and produced 25 poster presentations. In addition, numerous research applications were submitted, of which the first have already been approved. Next year, the numerous doctoral candidates will be present in prestigious publications appearing in peer-reviewed journals.

Forschungskolleg MoRitS (Modellbasierte Realisierung intelligenter Systeme in der Nano- und Bio-Technologie)

Research Group Model-based implementation of intelligent systems in nano- and biotechnology (MoRitS)



Duration

01 December 2013 - 31 December 2016

Members

Prof. Dr. rer. nat. Christian Schröder
Prof. Dr. rer. nat. Axel Schneider
Prof. Dr. phil. Bernhard Bachmann
Prof. Dr. rer. nat. Anant Patel
Prof. Dr. rer. nat. Marc-Oliver Schierenberg

Management

Bettina Krammer



MoRitS is an initiative of the Department of Engineering and Mathematics at the University of Applied Sciences and the Department of Physics, the Department of Biology and the Technical Department of the University of Bielefeld. The research collaboration offers opportunities for cooperative doctorate programs in the promising field of research on nanotechnologies and biotechnologies, which is one of the strategic priorities in Bielefeld. MoRitS was funded by the Ministry of Innovation, Science and Research of the Land North Rhine-Westphalia and was funded with a total of 1.8 million Euros for four years as part of the program "NRW.Forschungskooperationen Universität & Fachhochschule".

Currently, there are eleven doctoral students in MoRitS, five at the University of Applied Sciences of which four are also graduates of the University of Applied Sciences. In addition to demonstrating the equality of university degrees in Germany, female junior researchers are also supported. The special focus on women in the STEM disciplines is particularly successful, as nearly two thirds of the doctoral students are female.

The scientific focus of this cooperation is the trendsetting topic "Energy and Resource Efficiency", especially in the context of nano- and biotechnological systems. At least one partner from the University of Applied Sciences and one from the University accompany the following five

interdisciplinary research projects together:

Magneto-resistive sensors based on nanoparticles in silicone gel

The aim is to examine the GMR (giant magnetoresistance) effect for its possible use in sensors. As a basis, magnetic cobalt nanoparticles are dispersed in new silicone gels and positioned by external magnetic fields to selectively adjust GMR characteristics. This experimental research is supported by modeling and computer simulations.

With the successful completion of Lisa Teich's doctorate in December 2015, a simulation package was developed that realistically shows the GMR effect in nanoparticulate systems in which magnetic nanoparticles are embedded in conductive matrices. The algorithms developed by Teich can predict the next neighboring configurations of magnetic nanoparticles. They can be modelled as a function of their size, distance and torque distribution and show the viscosity of the matrices. Subsequently the GMR characteristics can be calculated.

By combining a molecular dynamics approach with a spin dynamics approach, the molecular motion of the nanoparticles has been considered as a function of their simultaneously-changing spin dynamics. As the simulation package is generally formulated for 3D, it also allows calculation of results by experimental methods >>

and comparison of the calculation of the GMR effect of cobalt nanoparticles dispersed in agarose with the experimental data.

Bioinspired electrical receptors for measurement, classification, and navigation tasks in fluids

Electric fish have special organs to produce electrical signals. Electrical receptors in their bodies allow them to detect objects in the vicinity and to "perceive" an "electric image" on the basis of their self-generated electric field. Such orientation and navigation via electric sensors with a low range, such as those used by the fish are also interesting for biomechatronic research. Therefore, a simulation environment for examining electrical field properties in fluids with the different conductivities in COMSOL, MATLAB and MAPLE are implemented in the sub-project at the University of Applied Sciences.

In addition to the simulation of the electric field and its representation, EEV (Ensemble of Electrosensory Viewpoints) are generated. These simulations help to find out how transmitting and receiving electrodes must be built in order to "see" objects in liquids by means of electric fields. Meanwhile, a test for measuring electrical field sizes in liquids of different conductivity is being created, which might confirm the simulated results.



Lisa Teich received her doctorate degree at the University of Applied Sciences, flanked here together by her tutors Prof. Dr. Christian Schröder, University of Applied Sciences and Prof. Dr. Andreas Hütten, Bielefeld University

Real-time image processing of high-resolution optical microscopy data of living cells

"High-resolution" microscopy is used to make visible those objects which actually lie below the resolution limit of optical microscopes. In this project, high-resolution images are reconstructed in real-time from single, lower-resolution light microscopy images. This is done to observe the interaction of new kinds of materials, such as nanoparticle preparations with living cells in unprecedented spatial and temporal detail. Therefore, a software package has been developed at the University of Applied Sciences which allows the computer to interact with the microscope. This allows us to view, edit, and reconstruct certain images.

Modeling and optimization of biological processes

The modeling of biological processes is usually based on data obtained in a laboratory in combination with a hypothesis that is refined and verified by additional experiments and simulations. Eventually, all relevant parameters are recorded and the model for regulation and control of the system can be used.

In this project, the processing, integration, and analysis of biological data as well as the mathematical modeling and analysis for subsequent simulations and optimization of the underlying biological processes are combined in one software package. Thus, the entire modeling process is covered: starting with the biological phenomenon and ending up with the verified model.

Immobilization of algae in novel silicone gel for biological hydrogen production

In addition to several other microorganisms, the unicellular green alga *Chlamydomonas reinhardtii* is capable of using solar light energy to produce molecular hydrogen under anaerobic conditions. To continuously produce hydrogen using immobilized microalgae, strains are identified and genetically optimized at the University of Applied Science. These are suitable for immobilization. At the University of Applied Sciences novel immobilization materials and methods are being developed to gently immobilize algae in transparent silicone gel.

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Spitzencluster Intelligente Technische Systeme – (it's OWL) Leading-Edge Cluster Intelligent Technical Systems OstWestfalenLippe

Within the network of "Intelligent Technical Systems OstWestfalenLippe" (nicknamed "it's OWL") there are 174 companies, universities, research institutions and organizations that come together to work on innovations in mechatronics and intelligent technical systems. Companies work in cooperation with research institutes to develop new products, technologies and applications for the market, all within 33 innovation projects. The regional universities provide a basis for this with interdisciplinary projects and their research results. The individual skills are brought together in the projects.

The Department of Engineering and Mathematics is involved in four innovative projects, in which three cooperative doctorate degrees will be completed. The first of these projects, "Intelligent kneading process" under the direction of the company WP Kemper GmbH, was successfully completed in 2015. The result is an intelligent dough hook, which determines the dough status with the help of an innovative sensor and can show e.g. whether the dough must be kneaded more intensively or for a longer period of time. The system then adjusts its operation automatically.



Intelligent dough hook

Fachhochschule Bielefeld steht für Zukunft.

Im Technologie-Netzwerk:
Intelligente Technische Systeme OstWestfalenLippe

it's owl

GEFÖRDERT VOM



Bundesministerium
für Bildung
und Forschung

In 2016 two projects, "Intelligent processing of large components with large tolerances" with the leadership of Goldbeck Bauelemente Bielefeld GmbH and "Intelligent work preparation based on virtual machine tools" with the company DMG Mori Seiki AG (formerly Gildemeister), will present their final results. The project "eXtreme Fast Control – increasing the efficiency of standard machines" will run even longer, in conjunction with the company Beckhoff Automation at their branch site in Gütersloh.

A visible effect of the "Leading-Edge Cluster" influence in the Department of Engineering and Mathematics is the consolidated and enhanced connectivity in the region. Important industrial cooperation projects and joint research activities with other institutions could be expanded or deepened.

Currently, the department is working with partners in the technology network in order to plan subsequent projects. The first major success is the approval of the action concept "OWL 4.0 - industry, labor, society" in the frame of the competition Regio.NRW. The department is involved in the implementation of projects such as "Industry 4.0 for the middle class", "Project Workshop Health 4.0" and "Climate, Energy and Building in the Industry 4.0 environment". The projects are financed by the European Regional Development Fund (ERDF) and the Land North-Rhine-Westphalia.

The institutes of the Department of Engineering and Mathematics of the University of Applied Sciences present their projects at the Hannover Messe, one of the world's largest industrial trade fairs



A delegation of the Economic Committee of the NRW Landtag visited the booth of ISyMs in Hall 16

The main topics presented at the fair were control damage during transports and ways of examining solar systems.

The Hannover Messe opened on 13 April 2015 and included a stand of the Bielefeld Institute for Applied Materials Research (BifAM) and the Institute for System Dynamics and Mechatronics (ISyM). "Both institutes are still emergent. Therefore, it is particularly important for us to present the research work being done at the University of Applied Sciences to the public," says Professor Christian Schröder, Vice President for Research, Development and Transfer. Two projects of the BifAM institute were presented in hall 2 at the stand of the North Rhine-Westphalian Ministry of Science. Many visitors stopped by to see Professor Frank Hamelmann's thermography drone, which was developed at the Technical Department of the University of Applied Sciences in Minden and is equipped with a thermographic camera. This allows the drone to fly over photovoltaic power plants and automatically check for possible error sources on the basis of thermal images. It can detect e.g. defective cells, internal connection errors and disconnected solar modules. Up to 1300 solar modules can be observed in just one hour of flight time. In addition to the drone, there was also a tiny white cube which repeatedly fell to the floor. Hidden inside this cube is a prototype of an energy-self-sufficient

shock sensor called Pisens. The device can be installed in transport boxes and can record the specific time at which a box or package has been damaged in transport. This is particularly useful for goods with a higher value. Compared to previous solutions, Pisens offers special advantages: It is reusable, can determine the exact point of time of damage, and is energy-self-sufficient. "It produces electric energy for storing information when falling to the floor. Then, the energy is consumed and the sensor falls asleep again," said Professor Dirk Zielke. He developed Pisens together with the students Timo Göstenkors and Rico Schindler, who had worked on the project as part of their master project work at the Department of Engineering and Mathematics. In hall 16 the letters "it's OWL" were already visible from afar. This was the joint stand of the excellence group "it's OWL Leading-Edge Cluster" and the Institute for System Dynamics and Mechatronics (ISyM) which presented its research project at the fair. "Networking is important," says the institute director Professor Rolf Naumann. Even a delegation of the Economic Committee of the North Rhine-Westphalian parliament stopped by the stand to learn about the research being conducted at the University of Applied Sciences. The ISyM members were especially proud of their new stand, which resembles a market stall and was presented to the public at the Hannover Messe for the first time.



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Indian-Summer-School



The partnership between the Department of Engineering and Mathematics and the prestigious Parul Institute, officially Parul University in India has been in place since 2012. Regular student exchanges are also organized jointly with the Department of Business and Health. Every year, Indian exchange students spend an exciting time and gather additional experience in Germany.

In the beginning of winter term 2015/2016 a group of 30 Indian students came to visit the city of Bielefeld for four weeks. During this time there were numerous possibilities for them to not only experience German culture but also to learn more about the technical know-how at the department of Engineering and Mathematics. Professor Jürgen Sauser accompanied ten future engineers during their stay in Germany. He thinks that the cultural exchange of this Summer School is very important. "From industrial experience I can say, that problems often occur when Germans and Asians cooperate due to a lack of knowledge about differences in culture. This Summer School is a unique opportunity to recognize the cultural particularities and to learn a lot about the differences," said Professor Sauser.

This year special lectures and seminars for students from India were again offered in English. The professors held lectures, for example, in Production Management, Thermodynamics or Plastics Technology. Professor Frank Sander, Professor Michael Fahrig and Johannes Brikmann designed the lectures for the guest students and country-specific issues and site visits to companies were integrated during the stay. At the headquarters of the company Claas the international guests had the opportunity to see processes in production. Beforehand, important principles in Production Management had been discussed in the lectures and were then experienced in practice at Claas. In addition, the group visited the

company Miele, also headquartered in the region of East-Westphalia, and the VW production site in Wolfsburg. On the way to the noted city of VW vehicle production, Jürgen Sauser took time to explain the historical context and background of Wolfsburg and VW. The students enjoyed the spontaneous action of the professor and asked him many detailed questions. "We are able to offer this interesting program to the Indian exchange students especially thanks to the excellent cooperation with the Department of Business and Health. The close cooperation between the two departments forms a successful basis for future exchanges and is an expansion of the Indo-German relations," says Professor Sauser.

The highlight of the four week visit in Germany was a trip to Berlin. Because the originally scheduled tour guide was absent, Professor Sauser and Inge Bergmann-Tyacke of the Department of Business and Health organized the tour of Berlin. Students learned about historically and culturally relevant places, such as Alexanderplatz, Rotes Rathaus or Checkpoint Charlie and on the second day the group took a city bus tour to see the many sights of this wide-spread city.

One advantage was that the closing ceremony of the Indian Summer School 2015 was held on the new campus of the University of Applied Sciences. The official farewell evening took place in the Department of Engineering and Mathematics. As requested by the guests, Professor Sander and Professor Sauser accompanied the students to the old town centre of Bielefeld in the evening. Full of impressions and full of new ideas, the students headed to the airport for their return flight back to India. "At all times again. It was an amazing experience. I am very grateful," said a student from the Parul University of Vadodara, summarizing his stay in Germany.

The Indian Summer School provides a unique opportunity for students from Germany to experience Indian culture. The application period for participating is always in February and applications are open to all students who are at least in their third term at the Department of Mathematics and Engineering or Economics and Health. Jürgen Sauser said, "I encourage everyone to apply, even if only 10 students can be chosen. Those who do not get the opportunity to travel to India themselves will be involved in numerous ways when the Indians come to Germany." The team of the Indian Summer School organization is available to answer any questions about the program.

Tanja Hage

„A family from Europe with a Ph.D.“



Economic and political evening. Nils Merkel (v.l.), Christoph Harras-Wolff, Frank Sieren, Dr. Christian Potthoff-Sewing, Hans Lippert, Dr. Christian Mestwerdt and Prof. Dr. Lothar Budde.

Each year, the Ostwestfalen regional Chamber of Commerce and Industry (Industrie- und Handelskammer IHK) presents an industrial country within the frame of the "IHK Encounter Week". In 2015 the chosen country was China. The Chamber of Commerce and Industry organized events from 15-19 June with the theme "Ostwestfalen meets China" which was put into practice in partnership with companies based in the region of Ostwestfalen.

The Department of Engineering and Mathematics of Bielefeld University of Applied Sciences, the Dr. Wolff Institute, and the Chamber of Commerce and Industry issued an invitation to participate in an economic and political evening on Thursday, 19 June.

Frank Sieren, a correspondent in China, gave the opening statement in the Dr. Wolff Institute. This was followed by a panel discussion including Sieren, Professor Lothar Budde, Dean of the Department of Engineering and Mathematics, Christoph Harras-Wolff, managing associate of the Dr. Wolff Group, Nils Merkel, General Manager for the country market Asia of the Dr. Wolff Group, Dr. Christian Potthoff-Sewing, managing associate of the Poppe and Potthoff Group, Hans Lippert, Head of Strategy and Planning in Asia at Audi, and Dr. Christian Mestwerdt, heads of the three A (Asia, Africa, Australia)

at Dr. Oetker. The meeting was moderated by Andreas Liebold, an announcer at Radio Bielefeld. The evening ended with a networking snack in the canteen at the Dr. Wolff Institute.

Frank Sieren has lived in Beijing for about 20 years now. In his introductory remarks, Sieren emphasized the need for European countries to deal with China as industrial country. "Ever since the age of Columbus, Western countries have determined the rules for the world's affairs," said Sieren. This is about to change in the coming years, according to Sieren, who spoke of "an epochal change". China is by far the strongest power among the emerging markets and thus will become a new world power. Hence, China will have a determining influence on the global distribution systems in the future. But as Chinese people have different concepts and ideas compared with Europeans or Americans, one must deal with one another and bring the countries closer to each other. "At the end of the day the Chinese want to live just as we do. That's why we need to shape the future together," Sieren said. Within the frame of the panel discussion, the participants shared their experiences in China. One >>

International Affairs IHK Encounter Week

basic understanding is that anyone who wants to enter the Chinese market must make adjustments. The German company name "Dr. Oetker", for example, was translated into Chinese. "It needed to sound similar phonetically. We are now called 'A family from Europe with a Ph.D.'" said Dr. Christian Mestwerdt.

Frank Sieren emphasized that there is a high degree of trust in the quality of German products sold in China, "a trust which is actually given to no other country in the world to this degree." Therefore, many manufacturers in China place country flags on the product packaging. Professor Lothar Budde stated that collaborations with Chinese universities already exist. However, there are no partnerships with universities in combination with Chinese companies. Such partnerships could be an interesting opportunity, according to Professor Lothar Budde. According to Hans Lippert from Audi, a constant major topic in European media is the copying of techniques. But these days are over. "Especially in the



Dean Prof. Lothar Budde

field of e-commerce, China is far ahead of Europe. As an entrepreneur or company founder, one can get really good ideas for innovations in China," said Lippert.

Impressions



Panel discussion



China correspondent Frank Sieren





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