



UNIVERSITÄT
DUISBURG
ESSEN


Open-Minded

Faculty of Engineering



*Coming together is the beginning,
keeping together is progress,
working together is success.*

(Henry Ford)



1489 nm
(Channel 5)

The image shows a close-up of an optical setup. A black metal component, likely a fiber optic coupler or filter, is the central focus. It has several ports at the top, including a prominent orange fiber optic cable. A white paper label is attached to the front of this component with the handwritten text '1489 nm (Channel 5)'. To the right of the component, two circular mirrors are mounted on a metal base. The mirrors are highly reflective, showing a bright yellowish-gold color. The background is blurred, showing other parts of the laboratory equipment.



Content



- 1 Greetings from the Dean [6]
- 2 Faculty of Engineering [8]
- 3 The faculty in figures [10]
- 4 Fields of expertise [12]
- 5 Institutes [18]
- 6 Teaching [26]
- 7 General study information [28]
- 8 Degree courses [30]
- 9 Research [32]
- 10 Tailored Materials [34]
- 11 Human-Centered Cyber-Physical Systems [36]
- 12 Smart Engineering [38]
- 13 Energy and Resource Engineering [40]
- 14 Interdisciplinary Research Centres [42]
- 15 International [46]
- 16 Student teams [48]
- 17 Sponsoring association [50]
- 18 Transfer to the public and industry [52]

Dear reader,

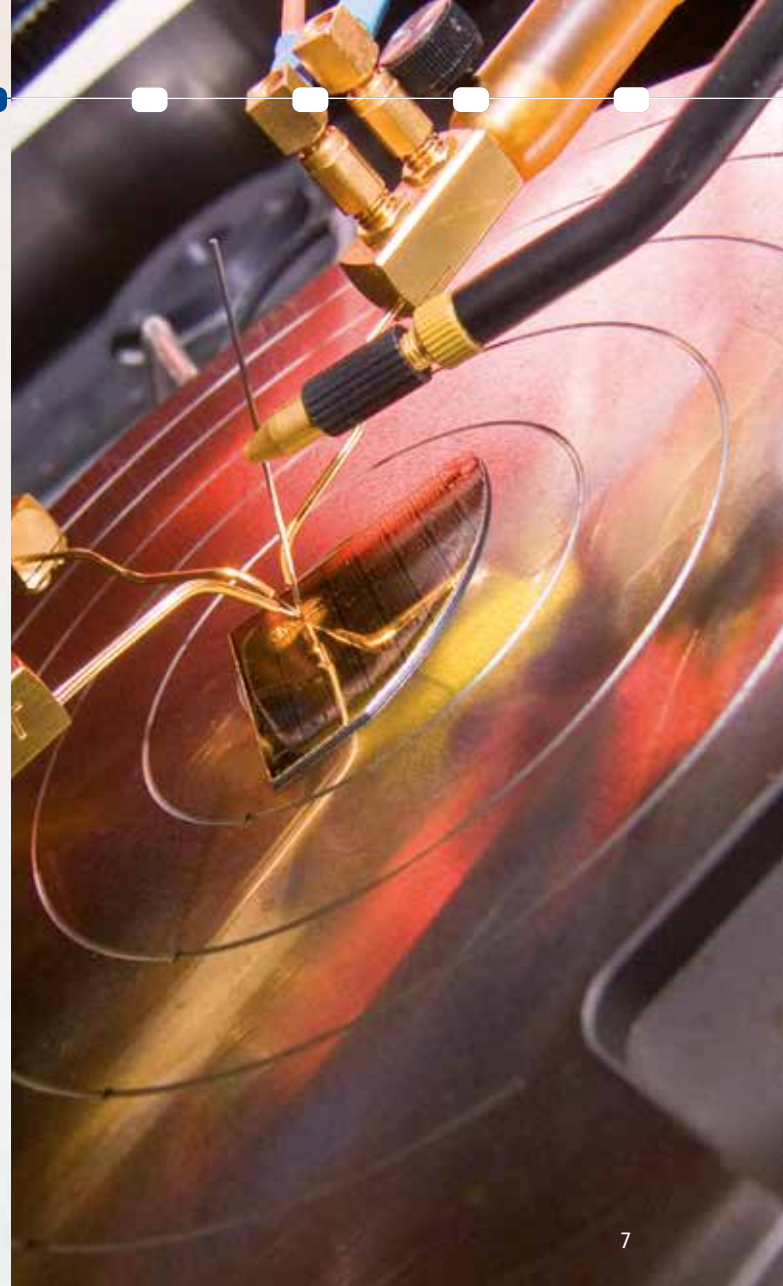
the progressive globalisation of the planet makes our blue earth seem smaller and smaller. At the same time, the problems of the world seem to become even bigger. How will eight billion people be fed soon? With dwindling resources, how can we satisfy the hunger for energy around the globe? How do we improve and change mobility? How can we protect and regenerate the environment? How do we manage, pre-

serve and transport the world's knowledge and create participation in education and communication? The solution to these problems is a task for politicians. Nevertheless, primarily we in science and research develop the tools needed to do so. The natural sciences and engineering are challenged in particular. The complex problems of our time require thinking and work-

ing that transcends borders – geographically and institutionally. Applied scientific work must be international and interdisciplinary. Scientists live from competition, but even more from the exchange of knowledge and cooperation. One of the birthplaces of European industrialisation is the Ruhr area. For 250 years, the economic well-being of the people here has been closely linked with engineering development – initially for a long time in the coal and steel industry, then in the course of the structural change since the 1980s in technologies such as IT, automotive, communication and energy. The University of Duisburg-Essen is located in the heart of this region and it is one of the motors of this change. With more than 42,000 students in eleven faculties, it is one of the ten largest in Germany. Since its foundation in 2003, the University of Duisburg-Essen has developed into a globally recognised research university, which is also reflected in international rankings. The Faculty of Engineering with its departments of Civil Engineering, Electrical Engineering and Information Technology, Computer Science and Applied Cognitive Science, and Mechanical and Process Engineering conducts basic and applied research at a high, internationally renowned level, for example in the automotive, ship or fuel cell technology sectors, but also at the interfaces between business administration and cognitive and media science. The nanoscience is one of the university's

main profile areas. The „Centre for Nano Integration Duisburg-Essen“ (CENIDE) has been networking all relevant research activities on an interdisciplinary basis since 2005. The engineering sciences are strongly involved in this network. The Institute for Energy and Environmental Technology (IUTA), the Nano Energy Technology Centre (NETZ), the Centre for Fuel Cell Technology (ZBT) as well as the interdisciplinary institute „MObility TransformatiON“ (MOTION) and the Centre of Rotating Equipment (CoRE) form important infrastructural pillars. Here and in our main research areas, we make our contribution to solving the problems of our world in a worldwide network. The writer and physicist Georg Christoph Lichtenberg recognised as early as the 18th century: „Where the boundaries of science were then, there is now the middle“. This is still true today. So: let us shape the middle of tomorrow. I wish us all success, endurance and the necessary bit of luck.

D. Sela---




Faculty of Engineering

We are one of the youngest faculties with a nationwide unique structure. From Electrical Engineering and Computer Science through Mechanical Engineering and Materials Technology up to Civil Engineering, everything is under one roof, which belongs to the engineering sciences. The fact that the topics of media and communication, cognitive and social psy-

chology and business administration and logistics are included not only provides further multi-perspective study programmes and research approaches, but also contributes to the rapid development towards multidisciplinary. With around 80 specialist areas and more than 11,000 students, we are one of the largest faculties in Germany. Teaching, research and





learning at our faculty also means living in an exciting region of change with a unique history, industrial culture, green landscape and the concentrated offer of a metropolitan region with more than five million people. We invite you to get to know our faculty. It was founded in its current structure in 2001, when the departments of Electrical Engineering, Computer Science, Mechanical Engineering and Materials Engineering were merged. In the years 2006 to 2008, strategic expansions and the integration of the faculties of Civil Engineering, Cognitive Science and parts of the Business Administration followed. We had recognised early that the cooperation of all engineering disciplines is indispensable, since complex technical systems increasingly require interdisciplinary networking. The consideration that the engineering sciences can only meet the requirements for social and technical developments if topics in the field of human-machine interfaces as well as economic efficiency and marketability are taken into account also played a major role. This interdependence is reflected in the current 17 bachelor and 26 master degree courses, for the success of which several teaching units of the faculty contribute together. The faculty has thus anticipated a development that is today shaping the world, especially for technologically leading and research-strong companies and institutions.

Our faculty is divided into seven teaching units, which are extended over four departments:

Civil Engineering (BW)

- Civil Engineering (BI)
- Teaching Profession Technology (TE)

Electrical Engineering and Information Technology (EIT)

- Electrical Engineering (ET)

Computer Science and Applied Cognitive Science (INKO)

- Computer Science (IN)
- Applied Cognitive and Media Science (KM)

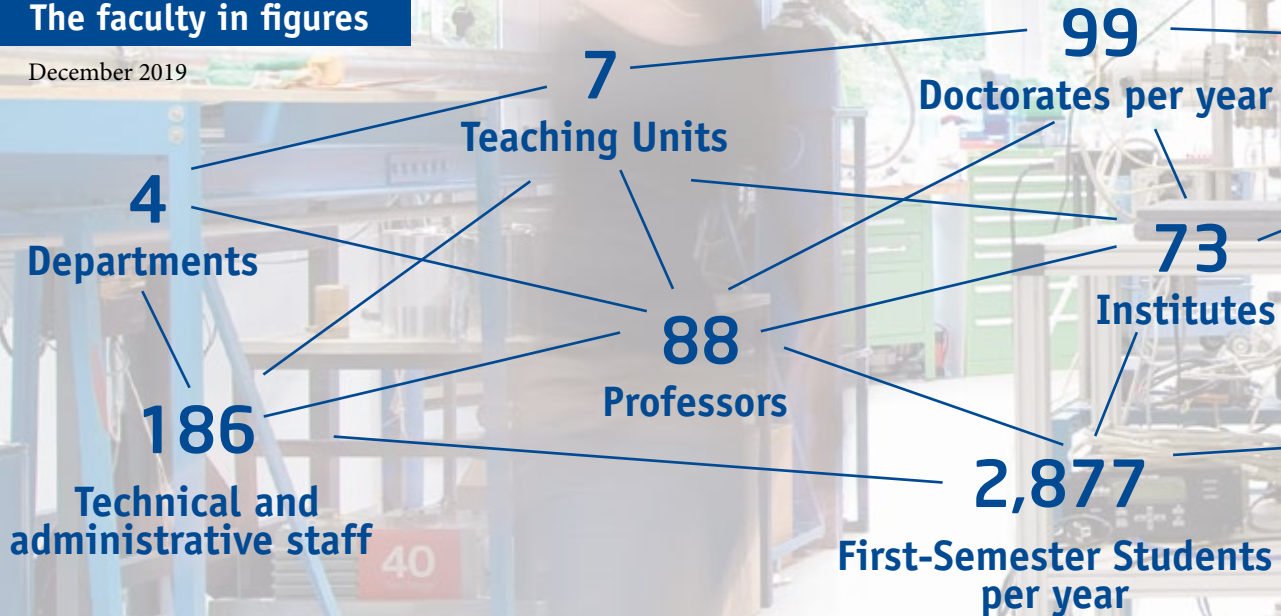
Mechanical and Process Engineering (MBVT)

- Mechanical Engineering (MB)
- Industrial Engineering and Management (WI)

This specific organisational structure aims to promote and facilitate the networking of teaching units in teaching and research. Due to the large unit, there are also organisational advantages through multiple use and standardisation of organisational processes.

The faculty in figures

December 2019



Dates and facts

1972

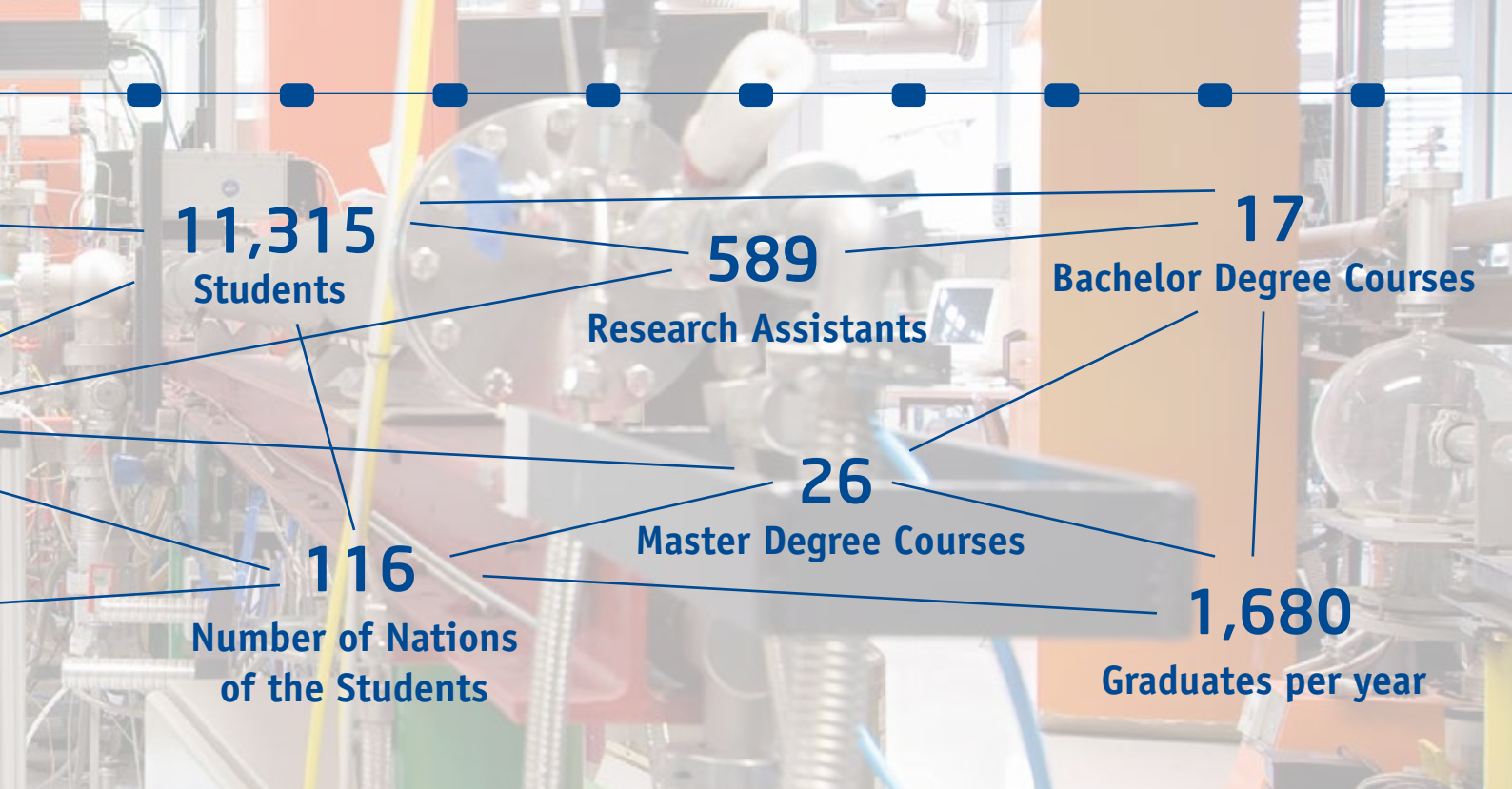
Foundation of Gerhard-Mercator-Universität Duisburg and Universität-Gesamthochschule Essen

2001

Merging the departments Electrical Engineering, Computer Science, Mechanical Engineering and Material Technology to form the new Faculty of Engineering

2003

Merging of the “Gerhard-Mercator-Universität Duisburg” and the “Universität-Gesamthochschule Essen” to the new University of Duisburg-Essen



2006

Integration of the
department Civil Engineering
into the Faculty of Engineering

2007

Integration of the unit
Cognitive Science into the
Faculty of Engineering

2008

Integration of parts of the unit
Business Administration into
the Faculty of Engineering

Departments and Teaching Units

Civil Engineering

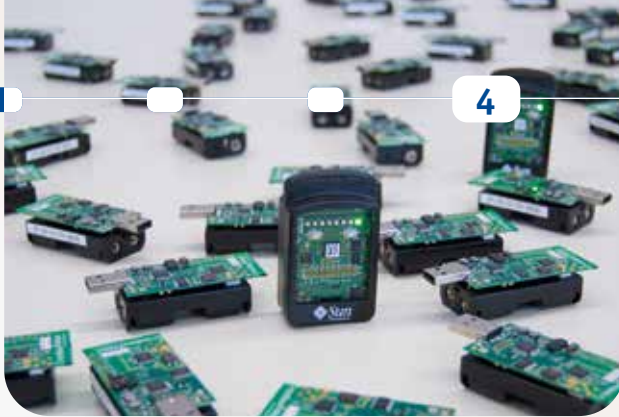
- **Construction Operations and Construction Industry**
Prof. Alexander Malkwitz
- **Structural Analysis and Construction**
Prof. Jochen Menkenhagen
- **Geotechnical Engineering**
Prof. Eugen Perau
Prof. Bettina Detmann
- **Engineering Mathematics**
Prof. Wilhelm Heinrichs
- **Concrete Structures Engineering**
Prof. Martina Schnellenbach-Held
- **Material Science**
Prof. Doru C. Lupascu
- **Mechanics**
Prof. Jörg Schröder
Prof. Joachim Bluhm
- **Metal and Lightweight Structures**
Prof. Natalie Stranghöner
- **Mobility and Urban Development**
Prof. Dirk Wittowsky
- **Urban Water- and Waste-Management**
Prof. Renuat Widmann
Prof. Martin Denecke
- **Structural Analysis of Plates and Shells**
Prof. Carolin Birk
- **Hydraulic Engineering and Water Management**
Prof. André Niemann
- **Technology and Didactics of Technics**
Prof. Martin Lang
Prof. Stefan Fletcher





Electrical Engineering and Information Technology

- **General and Theoretical Electrical Engineering**
Prof. Daniel Erni
- **Automatic Control and Complex Systems**
Prof. Steven X. Ding
- **High Frequency Electronic Devices**
Prof. Nils Weimann
- **Digital Signal Processing**
Prof. Thomas Kaiser
Prof. Klaus Solbach
- **Electrical Energy Systems**
Prof. Hendrik Vennegeerts
- **Electronic Components and Circuits**
Prof. Anton Grabmaier
Prof. Rainer Kokozinski
Prof. Karsten Peter Seidl
Prof. Holger Vogt
- **Power Transmission and Storage**
Prof. Holger Hirsch
- **Communication Technologies**
Prof. Peter Jung
- **Communication Systems**
Prof. Andreas Czylik
Prof. Jan-Christof Balzer
Prof. Stefan van Waasen
- **Technology for Nanostructures**
Prof. Roland Schmechel
Prof. Niels Benson
Prof. Thomas Kirchartz
Prof. Einar Kruis
- **Optoelectronics**
Prof. Andreas Stöhr
- **Medical Technology Systems**
Prof. Elsa Kirchner
- **Computer Engineering**
Prof. Axel Hunger
- **Electronic Materials and Nanostructures**
Prof. Gerd Bacher



Computer Science and Applied Cognitive Science

- **General Psychology: Cognition**
Prof. Matthias Brand
- **Embedded Systems**
Prof. Gregor Schiele
- **Formal Methods in Computer Science**
Prof. Janis Voigtländer
- **High-Performance Computing**
Prof. Jens Krüger
- **Information Systems**
Prof. Norbert Fuhr
- **Intelligent Systems**
Prof. Josef Pauli
- **Interactive Systems**
Prof. Jürgen Ziegler
- **Collaborative Learning in Intelligent Distributed Environments (COLLIDE)**
Prof. Heinz Ulrich Hoppe
- **Multimedia Engineering – Entertainment Computing**
Prof. Maic Masuch
- **Digital Communication and Transformation**
Prof. Stefan Stieglitz
- **Psychological Research Methods: Media-based Knowledge Construction**
Prof. Daniel Bodemer
- **Social Computing**
Prof. Mohamed Amine Chatti
- **Software Engineering**
Prof. Maritta Heisel
- **Social Psychology: Media and Communication**
Prof. Nicole Krämer
- **Computational Linguistics**
Prof. Torsten Zesch
- **Theoretical Computer Science**
Prof. Barbara König
- **Distributed Systems**
Prof. Torben Weis
- **Economic and Consumer Psychology**
Prof. Oliver Büttner



Mechanical and Process Engineering

Institute for Mechatronics and System Dynamics

- **Mechanics and Robotics**
Prof. Andrés Kecskeméthy
Prof. Wojciech Kowalczyk
- **Mechatronics**
Prof. Dieter Schramm
- **Dynamics and Control**
Prof. Dirk Söffker

Institute for Combustion and Gas Dynamics

- **Fluid Dynamics**
Prof. Andreas Kempf
Prof. Khadijeh Mohri

- **Nanoparticle Process Technology**
Prof. Markus Winterer
Prof. Frank Schmidt
- **Reactive Fluids**
Prof. Christof Schulz
Prof. Thomas Dreier
Prof. Sebastian Kaiser
Prof. Doris Segets
Prof. Hartmut Wiggers
- **Thermodynamics**
Prof. Burak Atakan
Prof. Tina Kasper

***Institute for Energy and
Environmental Process Engineering***

- **Energy Technology**
Prof. Angelika Heinzl
- **Mechanical Process Engineering / Water Technology**
Prof. Stefan Panglisch
- **Turbomachinery**
Prof. Dieter Brillert
- **Thermal Process Engineering**
Prof. Dieter Bathen
- **Environmental Process Engineering and Plant Design**
Prof. Klaus Görner

Institute for Product Engineering

- **Manufacturing Technology**
Prof. Gerd Witt
- **Engineering Design and Plastics Machinery**
Prof. Reinhard Schiffers
- **Product Engineering Processes and Data Management**
Prof. Arun Nagarajah
- **Transport Systems and Logistics**
Prof. Bernd Noche
- **Virtual Product Design**
Prof. Frank Lobeck





Institute for Metallurgy

- Mathematics for Engineers
Prof. Johannes Gottschling
- Metallurgy and Steel Production
Prof. Rüdiger Deike
- Metal Forming
N. N.
- Material Technology
N. N.

Institute of Ship Technology, Ocean Engineering and Transport Systems

- Ship Technology, Ocean Engineering and Transport Systems
Prof. Bettar Ould el Moctar
Prof. Milovan Perić

Institute for Industrial Engineering

- Business Administration and Mobility
Prof. Ellen Enkel
- Business Administration and Management Accounting
Prof. Andreas Wömpener
- Business Administration and International Automotive Management
Prof. Heike Proff
- Business Administration and Production Management
Prof. Jutta Geldermann

More information on the individual fields at:
<https://www.uni-due.de/iw/en/institutes.php>

Institutes



Five affiliated institutes and three more university-related institutions are directly linked to the Faculty of Engineering: the Development Centre for Marine Technology and Transport Systems (DST), the Institute for Mobile and Satellite Radio Technology (IMST), the Institute for Energy and Environmental Technology (IUTA), the Institute for Water Research (IWW), the Centre for Fuel Cell Technology (ZBT), the Fraunhofer Institute for Microelectronic Systems and Circuits (IMS), the Gas and Heat Institute (GWI) and the Centre of Rotating Equipment (CoRE). These institutes are important elements of applied research at the faculty and form elementary links to the economy. The aim of the institutes is both the transfer of new scientific findings and methods into industrial processes, procedures and products (Technology Push) and the identification of market requirements or the solution of problems in the industrial sector by recourse to scientific findings and methods (Market Pull). The institutes are organisationally and legally independent research institutions. They are affiliated to the University of Duisburg-Essen, but organised under private law. Due to their close contacts to the industry, they are also important motors for the acquisition of third-party funds for the faculty. DST, IUTA, IWW and ZBT are members of the Johannes-Rau-Forschungsgemeinschaft e. V., founded in 2014.

Affiliated Institutes

DST

The Development Centre for Ship Technology and Transport Systems (DST) is an internationally active research institute in the fields of inland and coastal shipping and transport and logistics. One focus is on the hydrodynamics of ships and the support of the industry in the development and modernisation of vessels, in particular on energy efficiency and greening issues. In addition, it deals with transport logistics issues with the aim of developing new potentials for inland navigation and contributing to an economic and environmentally compatible management of the growing transport demand. In addition, questions related to simulation, automation right up to autonomous driving as well as wave and current power plants are increasingly coming to the fore. The DST has been an affiliated institute of the University of Duisburg-Essen since 1989.



IMST

IMST GmbH (Institute for Mobile and Satellite Radio Technology) is a competence centre and professional development house for high-frequency circuits, antenna technology, radio modules and communication systems. IMST was founded in 1992 and employs today 165 persons in the fields of application-oriented research for radio communication and radar systems as well as microsystems technology and nano-electronics, industrial contract development, production and product testing. A core competence of IMST is the field of electronic steerable antennas for mobile satellite communication with focus on 5G. IMST picks up innovations – based on the generally available university knowledge – and tries to develop marketable and high-quality products and solutions for customers. This application-oriented research and development forms central crystallisation points for participation in EU research alliances. Since its foundation, the IMST has been an affiliated institute of the University of Duisburg-Essen.



IUTA

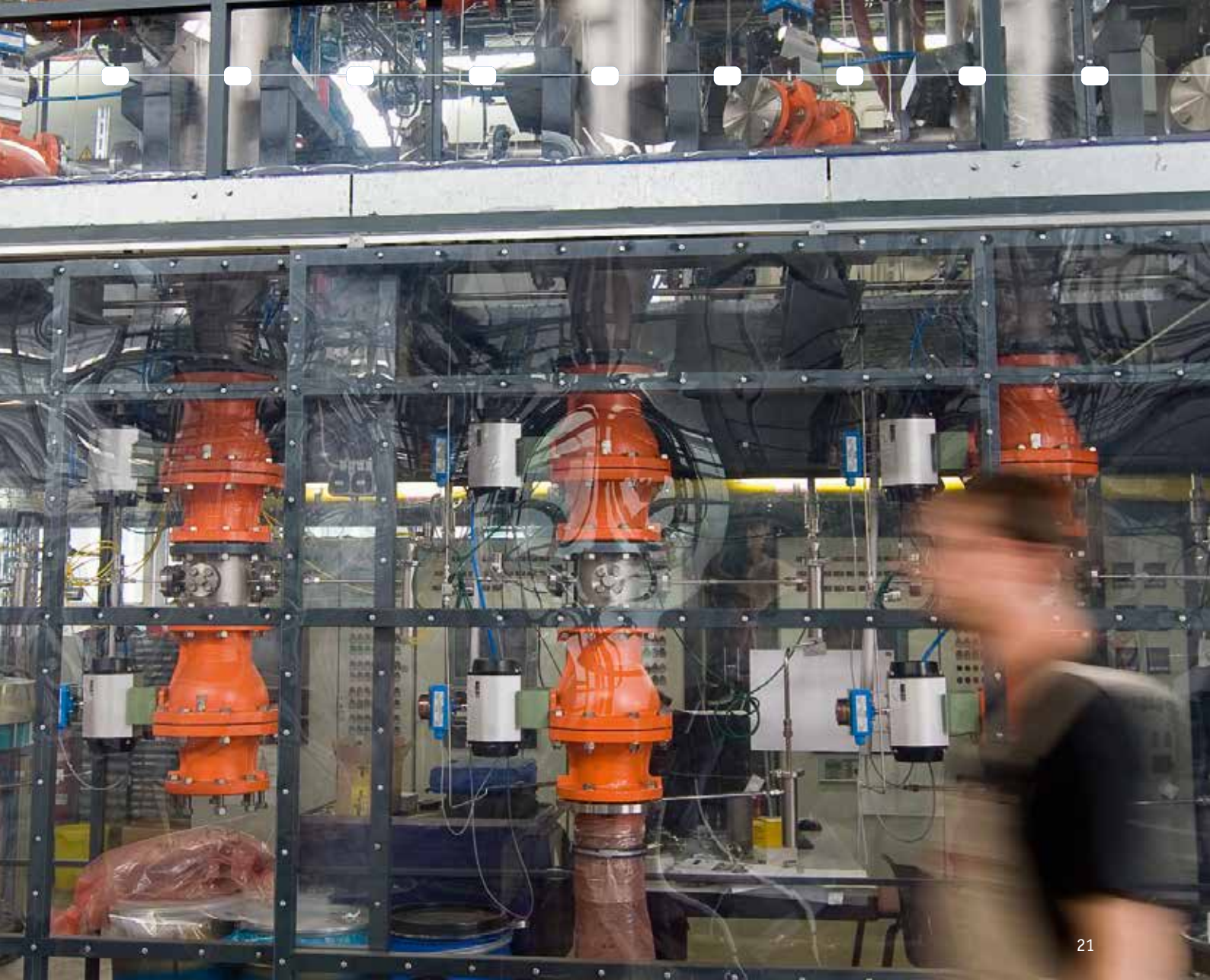
The Institute for Energy and Environmental Technology (IUTA) is one of the largest process engineering institutes in Germany with 140 employees and an annual turnover of about 10 million euros. It forms the bridge between basic research and industrial application, especially for medium-sized companies. IUTA has extensive instrumentation and equipment with pilot plants, some of which are unique in the world. The dimensions of these plants allow for a safe scale-up to an industrial process level. The equipment of the institute is completed by extensive analytics for the characterisation of substances or pollutants. The institute's core areas of activity can be divided into the four main topics of aerosols and particles, air pollution control and gas process technology, resources and energy as well as analytics and measurement technology. In 1991, IUTA became an affiliated institute of the former Universität-Gesamthochschule Duisburg.



IWW

IWW Water Centre is one of the leading institutes in Germany for research, consulting and further education in the field of water supply. The services of the six business areas Water Resources Management, Water Technology, Water Networks, Water Quality, Applied Microbiology and Water Economics & Management are used, for example, by utilities, industry, wastewater associations, public institutions and authorities. In the IWW chemists, engineers, microbiologists, geologists and economists work together in an interdisciplinary way. The IWW became an affiliated institute of the University of Duisburg-Essen in 1987.





ZBT

The Centre for Fuel Cell Technology (ZBT) works together with its partners on technical solutions for our future energy system. In addition to comprehensive basic research, various projects in applied research and experimental development are carried out in cooperation with industry and science. The energy system that is still largely based on fossil fuels must be converted into a sustainable, climate-neutral system with almost 100% renewable energy over the next

decades. Hydrogen plays a key role here as a seasonal energy storage medium, as a fuel for the three sectors electricity, heat and transport, and as a reaction partner in the chemical industry. As an application-oriented institute, the ZBT therefore develops future technologies in the three main areas of hydrogen, fuel cells and batteries.



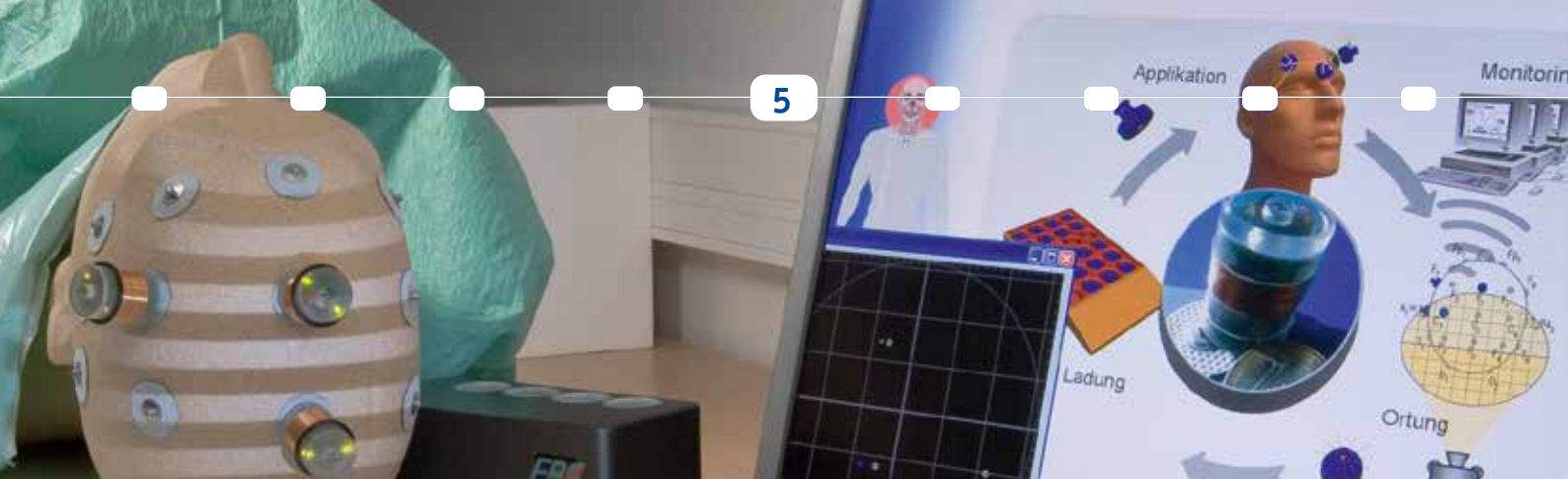
In-Institute

MOTION

The institute **MO**bility **T**ransformat**ION** (**MOTION**) bundles the mobility research activities of the faculty across the boundaries of the departments and fields of expertise. The Institute's fields of activity are not limited to automotive engineering and economics, but also include other areas of mobility. These include ship technology and transport logistics. In this way, the Institute takes into account the fact that new

technologies today can no longer be easily assigned to specific industries. Methods that are developed and used for the autonomous driving of cars can also be applied to inland navigation for example. In addition, transport logistics is responding to the networked world and demands energy-efficient and automated systems.





Cooperating Institutes

CoRE

The Centre of Rotating Equipment (CoRE) is a cooperation with Siemens AG for research, education and training purposes for efficient turbomachinery. In addition to the joint use of rotating components from the Turbomachinery Group for research and practical applications, it also enables product-specific training of university graduates, students, service staff and users of turbomachinery (hydro, steam, gas, wind turbines, pumps and compressors). The transfer of knowledge with regard to education, training and research purposes is a central component of the joint strategy for an international target group as well as a part-time master's degree course in energy conversion.



Fraunhofer IMS

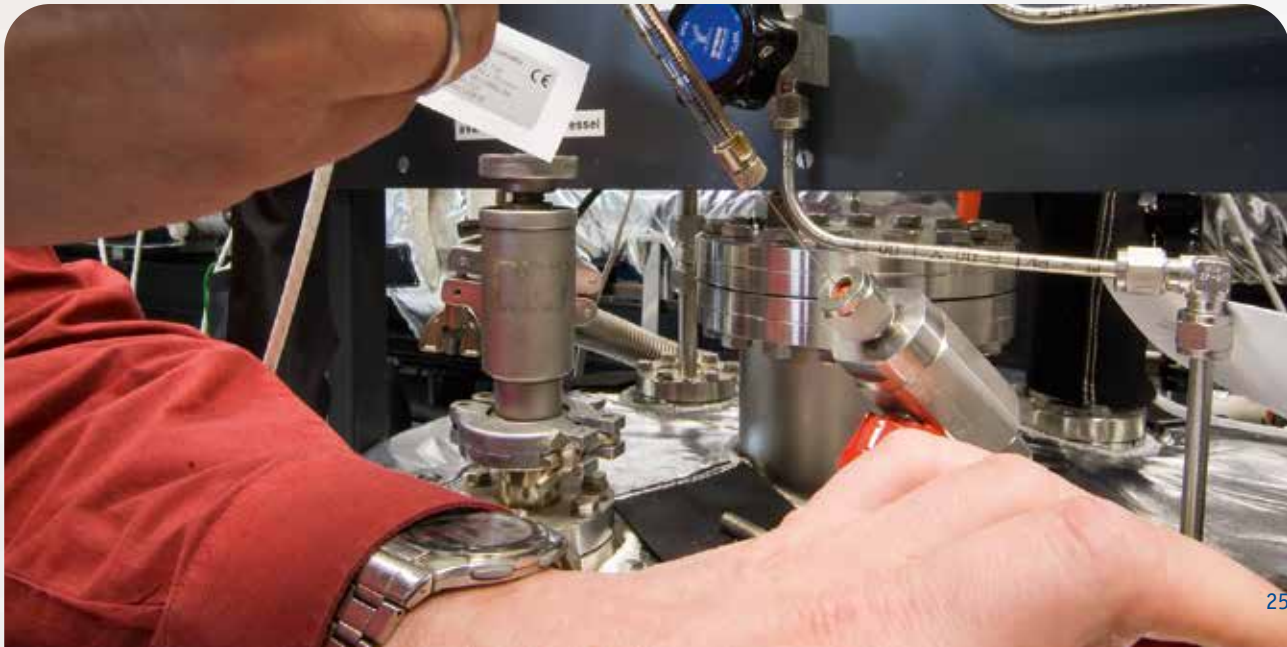
The Fraunhofer IMS has been conducting research, development and pilot production of microelectronic solutions for users from industry and society since 1984. The second main pillar are customers from the semiconductor industry. Stable, efficient and marketable developments are in the focus. Therefore, the IMS has grouped its activities into different business areas: Devices and Technologies, ASICs, High Temperature Electronics, IR Imagers, CMOS Image Sensors, Pressure Sensor Systems, Biohybrid Systems, Wireless and Transponder Systems and Electronic Assistance Systems. The Fraunhofer IMS employs about 250 employees; most of them have a scientific or engineering background.



GWI

The **Gas and Heat Institute Essen e.V. (GWI)** was founded in 1937 with the mission to identify and bundle R&D activities in the gas industry and to process them on a scientific basis. This mission is more relevant than ever under the constraints of the energy turnaround. In addition to the topics of gas composition and gas application technology, the institute is now increasingly working on questions and developments in connection with Power-to-X (P2G, P2F, P2C and P2H) technologies and sector coupling. In this context GWI also coordinates the two Virtual Institutes “KWK.NRW” and

“Electricity to Gas and Heat”. As part of the development of a Living Lab, a radio-based ICT infrastructure was also set up, which allows digitisation approaches to be rolled out quickly and efficiently for future accommodation solutions. These topics are dealt with in the central areas “Research and Development”, “Test Laboratory”, “Market Room Conversion” as well as “Consulting and further education”. The GWI is neutral and non-profit and can therefore independently deal with the energy issues of the future.



Teaching

Our students should always enjoy learning and researching. They are supposed to be able to understand and develop complex technical systems comprehensively. Our engineers should also feel responsible for the environment and society and therefore seek exchange with corresponding experts from neighbouring disciplines. At the end of their studies, our graduates are capable of analysing, improving and redesigning technical systems, taking into account current and future insights in engineering and natural sciences. They are proficient in the experimental and theoretical methods of engineering sciences as well as in the structured explanation of their practice and problem-solving approaches in German and English. The spectrum of the programme comprises traditional as well as interdisciplinary courses in numerous attractive and innovative fields. It consists of German taught degree courses as well as international courses with lectures and exams in English and an obligatory stay abroad. In addition, the faculty offers dual degree courses of study, degree courses of study accompanying vocational training as well as further education degree courses, a distance learning degree course and several teaching and vocational degree courses. For each Bachelor degree course there is at least one Master degree course that leads to a consecutive Master degree without additional requirements. The engineering sciences are strongly shaped

by mathematics and natural sciences. A high degree of logical thinking, technical understanding and an affinity for mathematics and physics are important prerequisites for a successful study. In addition, a good ability to imagine, to think abstractly, and to enjoy scientific and technical questions are important skills. Due to their comprehensive and solid professional training, the undergraduate Bachelor degree courses prepare students both for entering into professional life as well as for an advanced Master degree. The Master degree courses are profile forming and research-oriented. The students come into close contact with the broadly diversified research activities of the faculty. The Master degree is often followed by a doctorate or a professional activity with a strong scientific reference. The faculty develops its study programmes according to strategic aspects. The broadly based and established courses of study in Mechanical Engineering, Electrical Engineering, Civil Engineering and Computer Science form the basis, which meets the demand of most students. The faculty is oriented on the one hand towards a continuation of the international study programmes and on the other hand towards the further development of specialised, but also interdisciplinary Master programmes. The Faculty of Engineering attaches great importance to the extensive support of its students. The size of the faculty, with its diverse range of courses and a high-

ly heterogeneous student body, requires special attention to the counseling and support of students. Therefore, the Faculty conducts the Support Centre for (International) Engineering Students (SCIES), a service and consulting office that is available all year round for both prospective and already enrolled students. SCIES advises on questions about studying, provides assistance in administrative matters, answers questions specific to the study programme, give tips on campus life and is the first point of contact for students for all problems.



General Study Information



Each semester lasts six months. The lecture period in the winter semester begins in October and ends in February, for the summer semester it runs from the beginning or middle of April to the end of July. The exam period begins directly after the end of the lecture period and lasts about six weeks. After that, there is a remaining time for vacation or internships. The duration of study depends on the chosen course of study. A Bachelor programme lasts six or seven semesters, a Master programme three respectively four semesters. There is no tuition fee in North Rhine-Westphalia, only a social contribution of about 320 euros per semester. The particularity is that the semester ticket for public transport in NRW is there included – a good thing! Another part of the money is for the General Students' Committee (AStA) and for the University's student union, among other things for discounts on meals in the canteens. Admission requirements vary depending on the degree course and subject of study. Some are admission-free; others have a numerus clausus. For Master degree courses, a Bachelor degree in a related subject with a correspondingly good grade is a prerequisite. It is recommended to attend the faculty's free preliminary courses before beginning the Bachelor programme in order to ensure a smooth transition to the university and to compensate possible deficits from the school. This primarily concerns mathematical, scientific and techni-



cal skills, but also language skills. The faculty offers a comprehensive range of support with personal counseling, tutorials and mentoring for new students.

Bachelor Degree Courses



Traditional Study Programmes

- B.Sc. Applied Computer Science
- B.Sc. Civil Engineering
- B.Sc. Electrical Engineering and Information Technology
- B.Sc. Mechanical Engineering (Maschinenbau)

Interdisciplinary Study Programmes

- B.Sc. Applied Cognitive and Media Science
- B.Sc. Industrial Engineering
- B.Sc. Medical Engineering
- B.Sc. NanoEngineering

International Study Programmes

- B.Sc. Computer Engineering
- B.Sc. Electrical and Electronic Engineering
- B.Sc. Mechanical Engineering
- B.Sc. Metallurgy and Metal Forming
- B.Sc. Structural Engineering

Dual Study Programs

- B.Sc. Steel Technology and Metal Forming

Teaching Profession Study Programmes

- B.Sc. Construction Technique

Master Degree Courses

Traditional Study Programmes

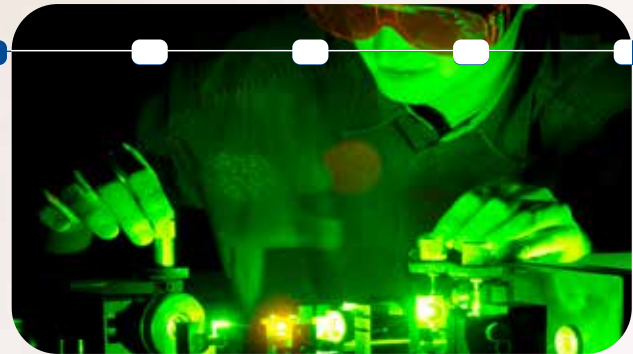
- M.Sc. Applied Computer Science
- M.Sc. Civil Engineering
- M.Sc. Electrical Engineering and Information Technology
- M.Sc. Mechanical Engineering (Maschinenbau)

Interdisciplinary Study Programmes

- M.Sc. Applied Cognitive and Media Science
- M.Sc. Automotive Engineering & Management
- M.Sc. Industrial Engineering
- M.Sc. Logistics Engineering
- M.Sc. Medical Engineering
- M.Sc. NanoEngineering
- M.Sc. Cyber Physical Systems

International Study Programmes

- M.Sc. Automation and Safety
- M.Sc. Communications Engineering
- M.Sc. Computational Mechanics
- M.Sc. Computer Engineering
- M.Sc. Embedded Systems Engineering
- M.Sc. Management and Technology of Water and Waste Water
- M.Sc. Mechanical Engineering



- M.Sc. Metallurgy and Metal Forming
- M.Sc. Power Engineering

Distance Study Programmes

- M.Sc. Electrical Engineering and Information Technology Online Master

Teaching Profession Study Programs

- Master of Education Construction Technique

Continuing Education Programme

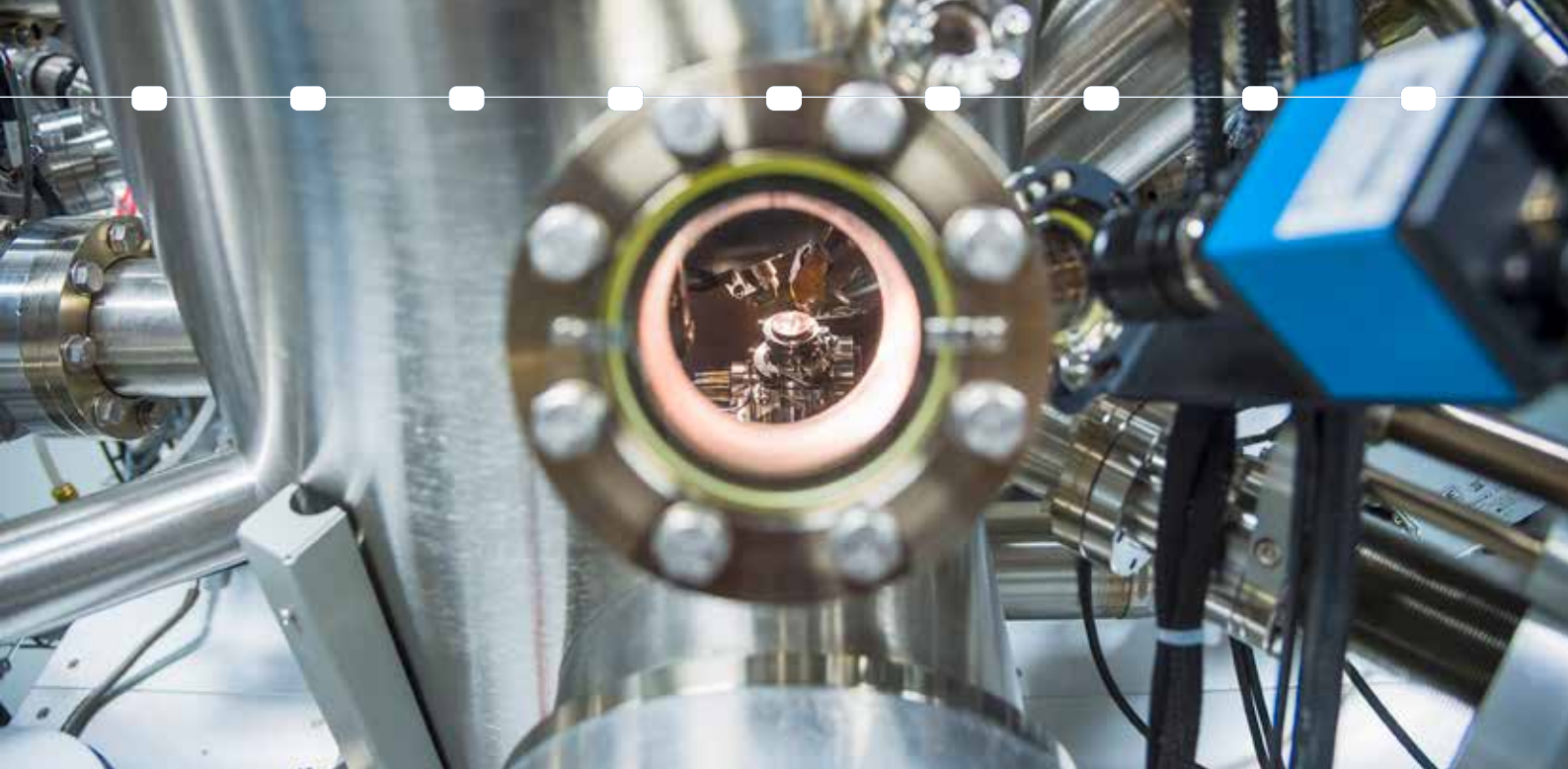
- M.Sc. Automotive Engineering and Management Executive

More information about the individual study courses:
<https://www.uni-due.de/iw/en/study/degreeoffer.php>

Research

With its closely networked departments, the engineering sciences at the University of Duisburg-Essen achieve a unique range of research. The Faculty of Engineering is closely linked to teaching at the highest level, which is oriented towards the focus of the faculty. Supported by the five affiliated institutes and further cooperating institutions, the faculty efficiently and quickly implements its research results, achieved together with partners from other national and international research institutions as well as economy and industry, into practical projects ready for application. This is not the only reason why the faculty is internationally highly respected and interconnected in many areas: In nanotechnology, for example, the faculty also occupies a leading position in research of combustion processes. The international reputation is also high in the fields of automotive engineering, energy, environmental technology and semiconductor research. The same applies to the optimisation of communication, radio and radar systems, energy networks as well as optoelectronics and interactive media systems. In addition, research is characterised by the topics of materials, climate culture, digital construction and new constructive approaches. The entire research chain from basic knowledge to technical application between the natural and engineering sciences has achieved nationwide recognition. This is also a major reason for the successful acquisition of

several Collaborative Research Centres. The faculty's special features also include the laboratories for fire detection and high voltage engineering. In these facilities, not only the sensor technology in fire detection systems is continuously optimised, but new types of high-performance cables are also being developed, for example for offshore wind farms. In the field of microelectronics and medical technology, the faculty has been conducting research in various areas for years, such as highly developed electronics for diagnosis and therapy or the development of new materials for better implants and prostheses. The combination of technological, informatics and psychological competence is a further success factor of the faculty. The focus is on Human-Computer interfaces and their better shaping, but also the influence of new media on human behaviour. The world's largest inland harbour is located in Duisburg. This makes the city inevitably a European centre for logistics. The faculty takes account to this fact with an active research group that focuses on supply chain management and the logistics of transport systems. The faculty also owns one of the few German university institutes for ship technology and ocean engineering. As for Industrial Engineering, especially with a view to the automotive industry, lateral thinkers qualified in a versatile manner are trained for the interfaces between the engineering sciences and business



administration. In 2015, the faculty has restructured its research activities in distinctly interdisciplinary areas of focus, bundling research activities across departmental boundaries. The structure is based on an analysis of the faculty's competencies and scientific activities that have already been developed over many years. Definition criteria were in particular already ongoing significant third party funding activities, experience and potential for forward-looking research groups and collaborative research centres of the German Research Foundation DFG, external visibility of the named topics and

anchoring in teaching and the integration of the existing central scientific institutions and associated institutes, where the engineering sciences are decisively involved.

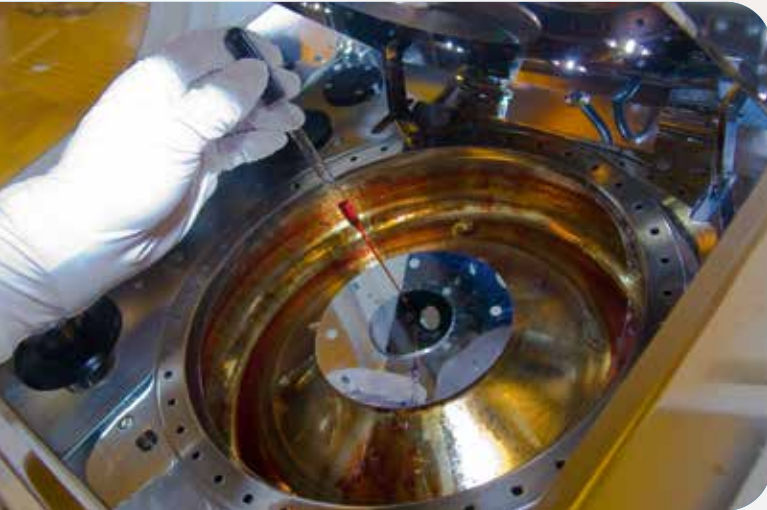
As a result, the four main faculty areas

- *Tailored Materials*
- *Human-Centred Cyber-Physical Systems*
- *Smart Engineering*
- *Energy and Resource Engineering*

were identified and defined.

Tailored Materials

Materials research covers a broad spectrum of functional and structural materials. It includes the investigation and further development of processes for their production, forming and modification, the analysis of the corresponding tai-



lor-made properties on a macroscopic and microscopic level as well as the integration of materials into components and systems. The range of materials varies from metallic materials to high-performance concrete as well as oxidic materials such as ceramics, polymers and composites made of these materi-

als. A high degree of structural control is achieved by bottom-up structuring with nanoscale or atomistic precision. Processing procedures based on thermodynamic and kinetic properties enable deterministic self-structuring. The research approaches in Tailored Materials range from basic research to application orientation and thus offer complementary approaches to current problems in research and development. Within this arc of tension, different aspects of materials research with high national and international visibility have already been established in the faculty before. It is the declared goal of the faculty's research profile to combine these thematic areas, to bring together the previous strengths and thus to create the basis for a holistic understanding of materials science from nanostructure and the importance of interfaces to production technology and system application. The research profile on Tailored Materials is closely associated with the research profile on "Nanosciences" at the University of Duisburg-Essen and makes significant contributions to the overarching research profile on "Materials Chain" of the University Alliance Ruhr. However, questions of sustainability, recycling and economic efficiency also play an important role in this research profile. Through research into energy applications of new materials, there is a close thematic link to the faculty focus "Energy and Resource Engineering".





Human-Centered Cyber-Physical Systems

The term “Cyber-Physical Systems” (CPS) stands for the fusion of information technology with the real world and thus lies at the intersection of the disciplines of Mechanical Engineering, Electrical Engineering, Civil Engineering and Computer Science as well as Medicine. CPS form the basis for many modern technical systems, because machines must be given an understanding of the real world in order to be able to exert a targeted influence on it by means of actuators. This results in a control loop that will decisively determine how our digitised environment will behave in the future. “Human-Centred Cyber-Physical Systems” (HCPS) involve humans in this control loop. This means that the system acts on the human being and vice versa, the human being acts on the system. In addition to the engineering perspective, psychological methods are also used to investigate how humans behave in such an environment. Based on empirical findings and models based on them, statements are to be made about how complex HCPS behave. Research on HCPS creates the basis for innovative applications. For example, new approaches in sensor technology are being investigated. In the field of radio technologies with highest transmission rates for the fifth generation mobile phone network or for networking the “Internet of Things”, cooperative projects with international visibility already exist in the faculty. In the faculty research profile HCPS, image analy-

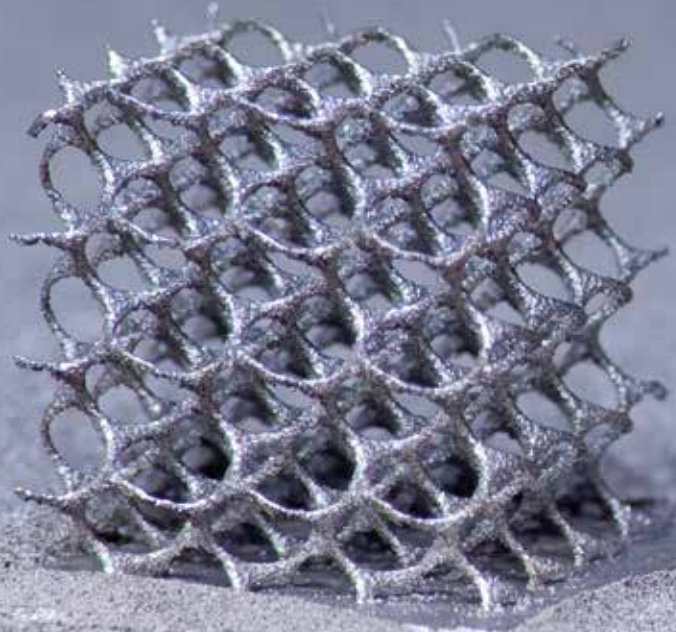
sis and vehicle sensor technology are being researched as well as technologies for intelligent buildings. The information about the real world obtained in this way is processed by information technology. It is investigated how this data can be processed in consideration of security, privacy, quality and availability. In the field of actuators, research is being conducted into how this knowledge of the real world can be used to intervene in the real world in a controlling manner. This includes topics such as autonomous driving and robotics, but also psychological and sensory issues related to the human-machine interface. Due to its interdisciplinary composition, the faculty is ideally suited to work on the topic of HCPS. This is because issues of control engineering, communication, adaptronics, sensor technology, actuators, environmental technology, psychology and computer science all play a role here.

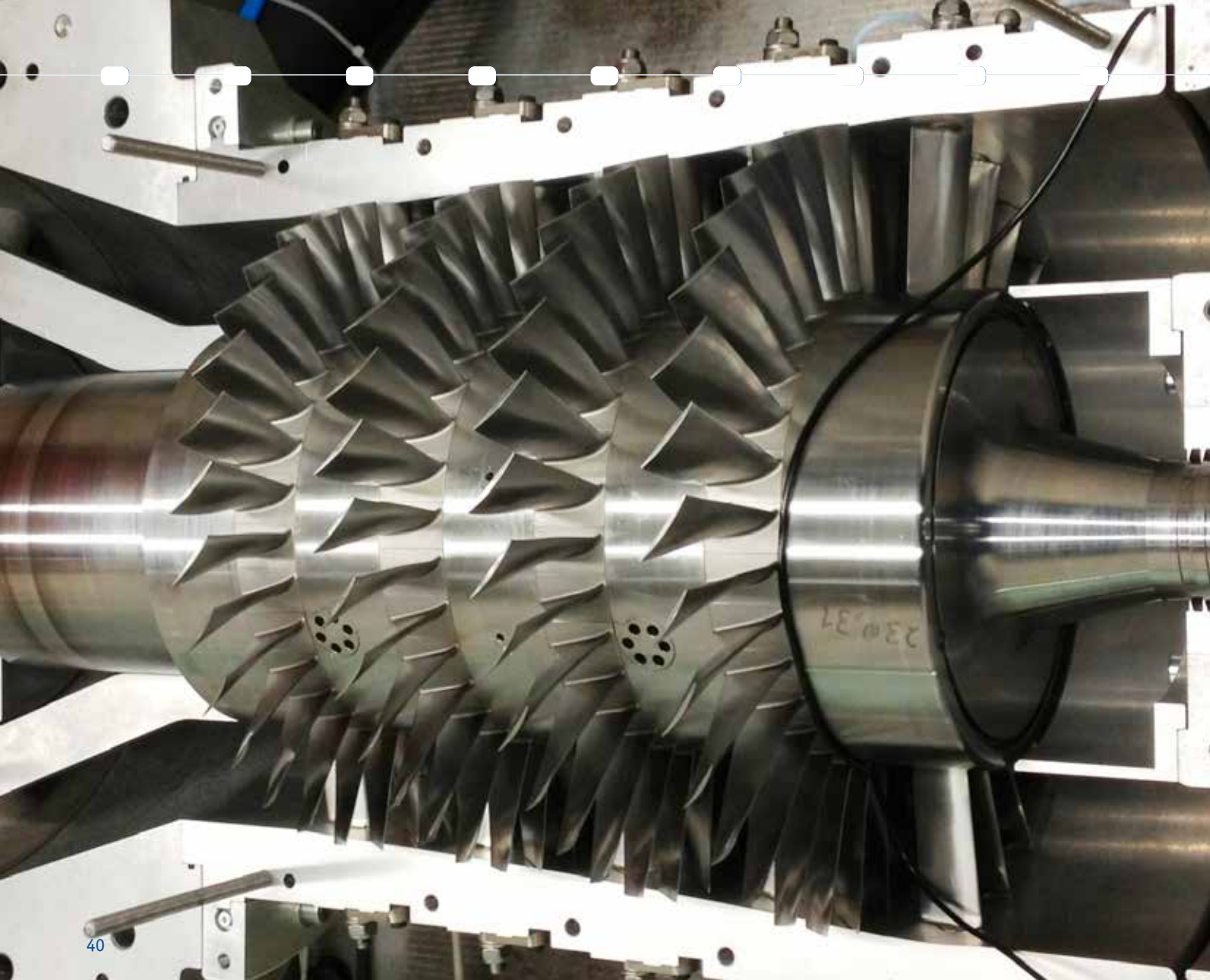


Smart Engineering

Smart Engineering describes methods, processes and IT tools for the interdisciplinary, system-oriented development of innovative, intelligent and networked products, production plants and infrastructures. These aspects are commonly known under the term “Industry 4.0”. The comprehensive exchange of information between all components involved in the production process plays a major and decisive role. In addition, it also involves the exchange of information between the individual sub-processes of both product development and manufacturing, with the aim of improving performance, quality, customer acceptance and cost reduction of products. An equally important segment is an interdisciplinary “Life Cycle Management” in order to improve the knowledge domains and interactions that have so far largely been insufficiently linked, and thus to counteract a continuous loss of information and experience. Thus, especially when it comes to networking of all development and production steps from interdisciplinary concepts to the production process, product use as well as final disposal, there are fields of action to be developed in the area of product data and process models. The applications in the faculty’s research profile on Smart Engineering already start in the planning processes of product development. The reason for this is that structuring and the associated information models are already being started, taking

into account possible boundary conditions. This digital development process finally leads to the qualification and networking of production and modelling processes as well as automation technology. The basis for this is to ensure clear communication between sub-processes and production plants. The main challenge in this context is probably a secure communication to mobile production components. Finally, smart engineering comprises the integration of product development, production planning and production control for the rapid market-ready implementation of innovative product ideas and thus the creation of value through a digitally influenced development process. Important here is the development of a PLM concept (PLM: Product Lifecycle Management) to capture the entire product life cycle and thus improve productivity, quality and reliability across all process boundaries.





Energy and Resource Engineering

The transition to a sustainable and resource-saving energy supply is one of the major challenges society is facing today. The Faculty of Engineering addresses the need for research in the most diverse fields in a variety of ways. Based on the understanding of existing technologies of energy conversion and resource use as well as the analysis of current and foreseeable problems, new scientific approaches and technologies are to be developed to contribute to solutions. The use of fossil fuels for power generation will continue to play a major role worldwide. However, it will lose importance in favour of other primary energy sources, especially in Germany, as part of the energy system transformation. Due to the temporal mismatch between energy supply and energy demand, this will lead to many new questions that will probably not be answered by a single technology, but will have to be tackled with a bundle of technologies. Energy storage in the form of chemicals, in batteries, pressure or heat storage systems can be just as much a solution as use in the form of energy-intensively processed resources. Because of the distance between the places of production and use, questions of energy transport, regulation and grid stability are also of great importance. Future mobility also requires new concepts, from electro-mobility to autonomous driving and new logistical concepts at all levels. All these concepts have a strong energy and resource-related component.

For example, the entire system can be optimised in terms of material and energy by means of a significantly higher sector coupling in the future. Finally, in the generation of electricity and heat or the conversion of resources, it must be assessed whether new or modified processes and technologies make sense and are accepted by society. The assessment concerns several levels, starting with the thermodynamic-exergetic analysis, the life cycle assessment, the economic analysis and the ethical-sociological assessment. The inclusion of systemic aspects such as stability considerations of complex networks or the conformity of the technologies required in the context of the reorganisation of energy supply structures with the requirements of society is a further focal point. There are many challenges for engineers – let us tackle them!

Interdisciplinary research centres

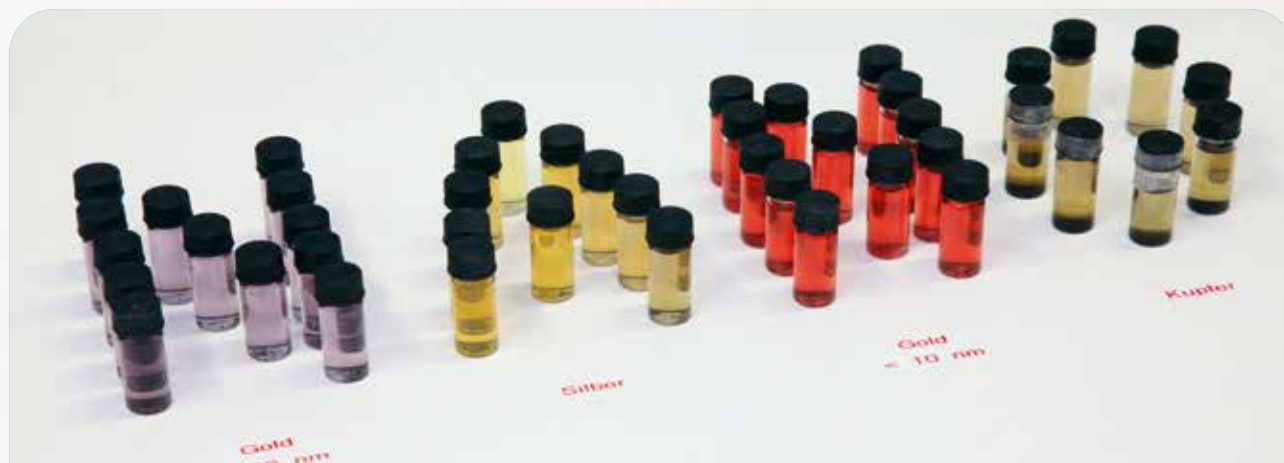
To use the synergies within the Faculty of Engineering and with other faculties, research activities were bundled in multidisciplinary centres.

Center for Nano Integration Duisburg-Essen (CENIDE)

As a central scientific institution, CENIDE represents a research profile of the University of Duisburg-Essen. It forms an interdisciplinary network of creative minds that promotes interdisciplinary cooperation and helps bridge the gap between basic academic research and industrial implementation. CENIDE coordinates and promotes scientific pro-



gress in chemistry, physics, engineering, biology and medicine with a focus on catalysis, dynamic processes in solids, gas phase synthesis of nanomaterials, magnetic materials, nanomaterials for health and nanotechnology in energy applications. CENIDE offers access to state-of-the-art infrastructure, such as the unique research building NanoEnergieTechnik-Centre (NETZ), in which new materials for energy technology applications and scalable methods of making and processing them are developed. The NETWORK Interdisciplinary Centre for Analytics on the Nanoscale (ICAN) combines equipment, methods and technical competence for analysis on the nanometre scale. Scientific basic research has influence here in the application-oriented development of new materials.





Center for Computational Sciences and Simulation (CCSS)

Complex numerical calculations are performed in numerous working groups, institutes and research groups at the University of Duisburg-Essen. The CCSS provides the basis for multidisciplinary cooperation, which has been established at the interface between the basic disciplines. “Computational Science and Engineering” and “Scientific Computing” are seen in the CCSS in close interaction with both theoretical-analytical and experimental-technological oriented research. The scientific work is based on interdisciplinary cooperation in modelling, simulation and experimental verification. The CCSS connects the activities of the participating research groups and helps to open up new fields of application with highly topical issues.



Erwin L. Hahn Institute for Magnetic Resonance Imaging (ELH)

The ELH Institute is dedicated to the research, development and application of ultrahigh field magnetic resonance imaging (UHF-MRI), especially in the cognitive neurosciences and in clinical diagnostic imaging. The heart of the ELH Institute is a whole-body magnetic resonance tomograph from Siemens Healthcare, which operates with a magnetic field strength of 7 Tesla, making it the strongest magnet in the entire Ruhr area. One of the main goals of the ELH-Institute with its technical and methodological developments is to apply the advantages of UHF-MRI from neuro-imaging to the entire human body and to promote the dissemination and application of this technology. For this purpose, the institute provides an excellent research infrastructure for different research groups and cooperates very closely with different academic as well as industrial partners.



Centre for Logistics and Traffic (ZLV)

As a university competence centre, the ZLV is dedicated to the interdisciplinary conception, management and transfer of scientific work in connection with logistics, mobility and transport from various disciplines. The design of future supply and value-added chains, energy-efficient transport systems or infrastructures and the recycling of valuable materials play just as much a role as methods of business mathematics inside and between companies, logistic systems in humanitarian aid or the control of the mobility behaviour of young people. The ZLV focuses on long-term sustainable, economically beneficial, socially acceptable and ecologically safe innovations (sustainability research).



Centre for Water and Environmental Research (Zwu)

The Zwu is an interdisciplinary and multidisciplinary research centre. It coordinates the UDE profile focus on water research and pools the experience, expertise and resources in water and environmental research. Zwu stands for innovative environmental research that links global societal changes and challenges – such as urbanisation and megacities, climate change, water availability and quality – together with the environment and focuses on the impact on people. Zwu's activities focus on water research with a broad range of expertise in the fields of water ecology, drinking water treatment and distribution, environmental toxicology and chemistry, water and urban water management, hydrology, hydraulic engineering and water governance with economic and legal competencies.



International

The field of international affairs plays a particularly important role in the Faculty of Engineering with numerous partnerships and study programmes. In total, the Faculty maintains 31 non-European cooperations. In addition, there are 57 cooperations within the European Higher Education Area within the framework of Erasmus with approximately 300 exchange students annually. Further activities serve to expand international research cooperation. Top-class universi-

ties in the USA and Europe have been attained as partners. Furthermore, the faculty is pursuing cooperation with partners in Asia with great vigour, as markets of the future with globally oriented jobs and new sales opportunities for products and services are emerging in this region. This includes established partnerships with Malaysia, Indonesia, India and China, for cooperation in the area of joint courses and joint research.





In terms of teaching, the faculty offers the study programme “International Studies in Engineering” (ISE) with five Bachelor and nine Master degree courses. About half of the courses are taught in German, the other half in English. The students work in an international environment and come from over 100 nations. A stay abroad is obligatory for German students in this study programme. On this basis, double-degree courses are also offered with universities in China, Indonesia and Malaysia. So far, more than 340 students have come to the Faculty of Engineering. German students mostly go to

these countries for an exchange; so far, more than 400 have come to the Faculty of Engineering. They appreciate the international experience and the bilingualism of the programme in view of the increasing globalisation of the economy and good career prospects. The proficiency in the English language is taken for granted in most companies today. Numerous high-ranking international scientists and scholars regularly visit the faculty in their role as Mercator Fellows (DFG) or Research Award Winners (A. v. Humboldt Foundation).

Student Teams

Within the Faculty of Engineering, several teams of students have been established to work together on a project, implement it independently and successfully present it at com-



petitions and championships. Besides the practical application of academic knowledge, the focus is on sportsmanship and teamwork. The E-Team – Formula Student Electric Racing

successfully takes part in the worldwide Formula Student Electric Events. The Formula Student is an international design competition for students, which is organised in Germany as Formula Student Germany since 2006. Annually teams from all over the world meet at international venues to compete against each other. At the events, the combination of design, vehicle performance, financial planning and sales argumentation is crucial. The pedal boat team consists of a group of students of marine and offshore technology who want to put into practice what they have learned during their studies. Once a year the students compete with teams from other universities in the “International Waterbike Regatta”, which takes place at changing locations throughout Europe. The form and endurance of the athletes as well as the technical finesse of the boats they construct by themselves are important. Since 2009, the concrete canoe team consists of a group of students of civil engineering. At first, they built canoes of high-strength, fibre-reinforced lightweight construction concrete on their own. Today, they use so-called aerogel concrete, a new type of lightweight concrete that enables the construction of a concrete canoe with a shell only 8 mm thick. In addition to independent planning and construction, the students regularly take part in concrete canoe regattas with the canoes and achieve respectable results.





Förderverein
Ingenieurwissenschaften
Universität Duisburg-Essen e.V.

Den Anfang machen

Miteinander reden

Ins Netz gehen

In Kontakt kommen

Interessenten ansprechen

Wissen vertiefen

Sich gut verkaufen

Innovationen fördern

Ganz klein anfangen

Überall dabei sein

Unabhängigkeit stärken

Freunde gewinnen

UNIVERSITÄT
DUISBURG
ESSEN

Offen im Denken



Sponsoring association

The sponsoring association of the Faculty of Engineering has been existing for more than a quarter of a century, creating a network between students, lecturers, alumni and industry. The primary aim for graduates is to facilitate the transition to professional life. For the same reason, the association promotes presentations, trade fairs, performance and contact exchanges in the Faculty of Engineering. All members have access to the association's information network and regularly receive information about special offers. Students receive current information from the faculty and are introduced to the alumni network during their studies. They can participate in special events of the engineering institutes. Companies gain detailed information about the faculty's areas of expertise – also by finding competent contact persons. They can actively participate in the information network, for example by indicating vacant jobs, internships or research profiles. On graduate days, they have the opportunity to make direct contact with potential employees in discussions. The association has a well-functioning infrastructure. Within the faculty, there is a permanent contact point and the web platform (www.foerderverein-iw.de) provides information about all activities. The attractiveness of the association is promoted among students by means of competitions. In order to promote contacts with companies, the association has organised numerous business

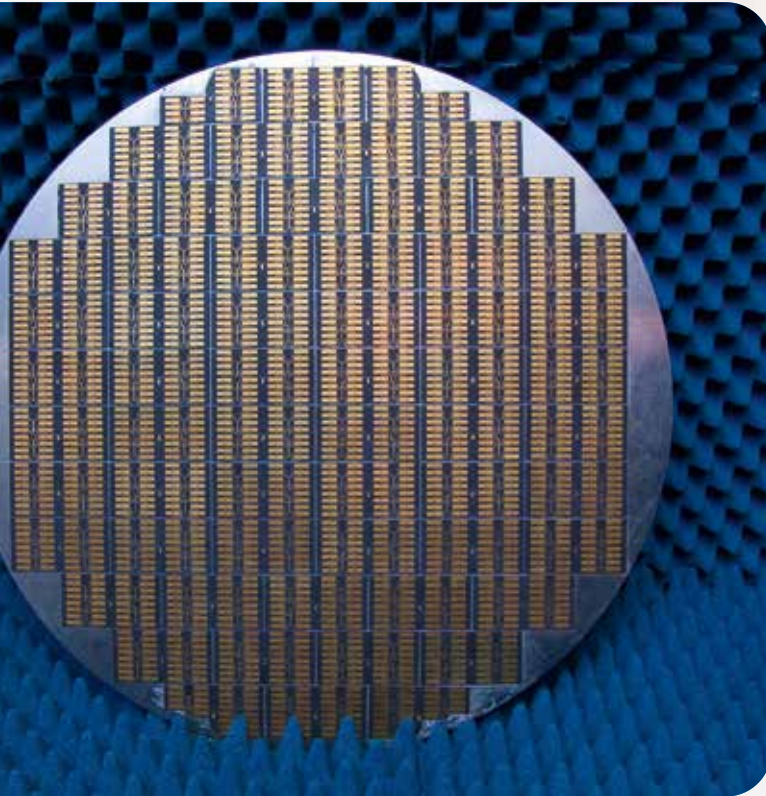


talks on various topics. With the junior and student academies, which are now offered in several cities and are supervised by the UDE, the association aims to interest young people in the natural sciences and technology in the engineering profession even during their school years. Together with the ABZ, career service centre, the association organises the vocational contact fair “Career prospects for engineers”. The active participation in events such as the annual graduation ceremony, the Engineer’s Night and various workshops and conferences is and remains a central concern. For six years now, the

association has been actively organising its own practice colloquium in engineering sciences with series of events in cooperation with lecturers and industry representatives to expand the range of information available to students. By organizing the engineers’ ball “Dance.ing”, the association has created a social platform for encounters between students, lecturers, alumni, friends and sponsors of the faculty. The ball takes place regularly in January. Together with the savings bank “Sparkasse am Niederrhein”, the association awards the annual innovation awards.

Transfer to the public and industry

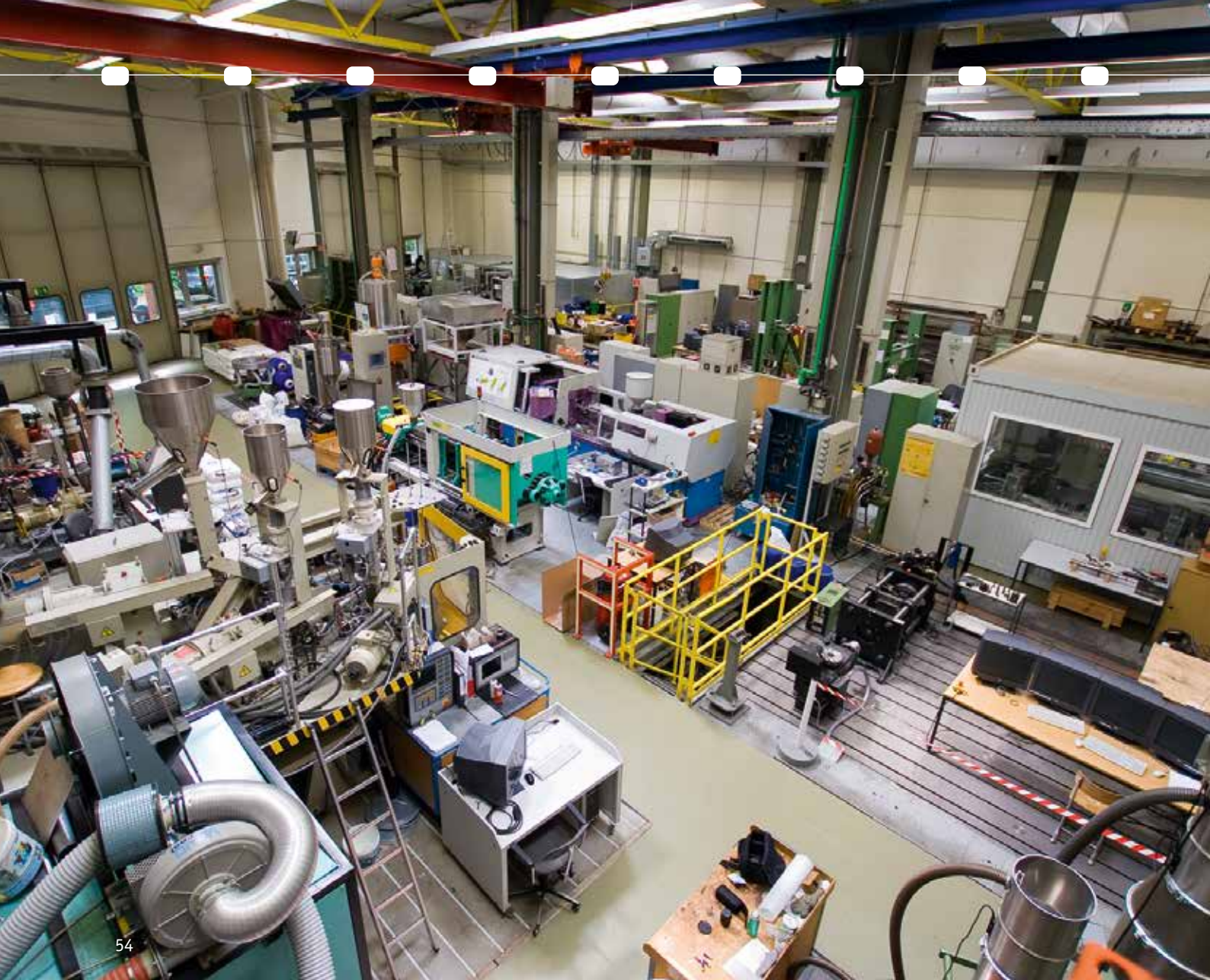
Members of the Faculty of Engineering are involved in basic research at several research-training groups, research



groups and collaborative research centres of the German Research Foundation. In addition, the transfer of knowledge to the public and industry plays a major role. These include spin-offs, start-ups, patents, as well as meetings and conferences. The faculty's activities in this regard are manifold. Exemplary are among them:

- the annual open day and the Engineer's Night, both of which are aimed at a wide audience,
- the professional contact fair with exhibitors from the industry,
- the Science Forum Mobility,
- the Ruhrsymposium,
- the ship technology colloquium,
- the moulding material days,
- the conference on combined heat and power generation,
- the AUBE conference on automatic fire detection,
- the scientific coordination of the university weeks of the savings bank "Sparkasse am Niederrhein",
- the Ruhr-Geo-Day, together with the neighbouring Universities of Bochum, Dortmund and Wuppertal,
- International Symposium on Gas-Phase Synthesis of functional nanoparticles
- the biannual graduate and Alumni Celebration,
- the annual ball of engineers in January "Dance.ing".







Publishing information

Publisher

Universität Duisburg-Essen
Fakultät für Ingenieurwissenschaften
Lotharstraße 1
47057 Duisburg
www.uni-due.de/iw

Conception and text

ARTEFAKT Justus Klasen

Layout and production

rasch.multimedia Ralf Schneider

August 2021

Photographs

Depositphotos (8, 15, 26, 27, 47)
DST Duisburg (19)
Fakultät für Ingenieurwissenschaften (48, 49, 50, 53)
Justus Klasen, ARTEFAKT (12, 36, 52)
Lehrstuhl für Strömungsmaschinen (16)
Institut MObility TransformatION – MOTION (23)
Pressestelle Universität Duisburg-Essen (Titel, 28, 29, 30, 31, 33, 46)
Ralf Schneider, rasch.multimedia (3, 4, 7, 10, 13, 14, 17, 20, 21, 24, 25, 34, 39, 51, 54)
ZBT Duisburg (18, 22, 35)

