Digitalization & Automation

Fluid Power Components

Tribology & Fluids

Simulation Development & Validation

Mobile & Stationary Systems

English Brochure also available online! www.ifas.rwth-aachen.de/brochure_en

Deutsche Broschüre online verfügbar! www.ifas.rwth-aachen.de/brochure_de
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Welcome

Research, Development and Education – these are the pillars upon which our innovative institution is built. We invite all companies, partners, associations, and students to challenge us with current issues to further develop and advance our specialization: the field of Fluid Power Systems.

We believe that only excellent education and continuous training enable the enhancement and development of fluid power systems and technology. This path will also empower a professionally satisfying career. As an academic institution, we encourage and build upon the active participation of interested domestic and international students. Exciting research projects and challenging scientific activities offer many possibilities for personal and academic growth. The resulting synergy of promoting the institute’s goals and offering outstanding qualifications for aspiring high potentials continuously leads to new impulses and innovations.

This brochure gives an insight into the organisational structure of IFAS and its fields of research. Moreover, its aim is to inspire ideas for new cooperations and projects. We are always keen to find new partners to further widen our horizon and to expand the original field of fluid power systems. We offer tailored solutions to short and long term industrial projects and public research opportunities to accommodate cutting edge industrial and academic demands. We are looking forward to discuss any possibilities for national, international and/or interdisciplinary cooperations with you.

Prof. Hubertus Murrenhoff took over the management of IFAS in October 1994. At the 11th IFK in March 2018 the directorship was handed over to his successor, Prof. Katharina Schmitz.

Prof. Katharina Schmitz graduated in mechanical engineering at RWTH Aachen University in 2010. During her studies she gained valuable technical and intercultural competencies while studying at Carnegie Mellon University in Pittsburgh (USA) and subsequently working in Le Havre (France). After graduation, she started working as a scientific staff member at IFAS and, due to her expertise and leadership skills, was appointed to Deputy Chief Engineer of IFAS in 2012. In 2015, Prof. Schmitz graduated as Dr.-Ing. and moved to Southern Germany to begin working in the industrial sector for a family-owned company, which focuses on special purpose hydraulic solutions. There, after gaining an extensive insight and experience in the design and manufacturing of large special purpose hydraulic cylinders and systems as project engineer, she was promoted to Technical Director in 2016. Her role included responsibility for the design, development and manufacturing of special purpose hydraulic components.

Prof. Hubertus Murrenhoff graduated in mechanical engineering at RWTH Aachen University in 1978 and subsequently started working as a scientific staff member at IFAS which was then called IHP. Having obtained his doctorate, he was appointed to a leading position as Chief Engineer of IHP in 1983. During his subsequent employment in the industrial sector, beginning 1986, he gathered a wide range of experience in the field of servo-hydraulics and electromechanical components and systems. A well founded fluid power expertise was achieved in his position as Vice President Engineering and Marketing of an aviation technology company in western NY, USA, during his four year stay, and subsequently in the position of Managing Director Technology of a world leading company for electro-mechanical devices in Bavaria.
Our Aims

... are to initiate continuous advances in the field of fluid power through innovative research and development, scientific progress and excellent (engineering) education. Therefore, the essential scientific expertise is continuously improved through our highly motivated PhD candidates by conducting theoretical, experimental and simulative projects. Thus, their professional qualification is enabled and excellent opportunities to complete their degrees result.
History of the Institute

1968
- Establishment of the Institute for Hydraulic and Pneumatic Drives and Controls (IHP) in the rooms of the Institute for Agricultural Technology in Eilfschornsteistr.
- Appointment of Prof. Backé as Director of IHP

1974
- Establishment of the Aachen Fluid Power Conference (AFK)

1972
- Relocation to Kopernikusstr.

1977
- Relocation of the institute and opening of laboratory 1 in the development area Seffent-Melaten, Steinbachstrasse

1978

1994
- Retirement of Prof. Backé as Director of IHP
- Name change into Institute for Fluid Power Drives and Controls (IFAS)
- Appointment of Prof. Murrenhoff as Director of IFAS

1998
- Establishment of the International Fluid Power Conference (IFK) with the two-year alternating venue Aachen – Dresden

1994
- Retirement of Prof. Backé as Director of IHP
- Name change into Institute for Fluid Power Drives and Controls (IFAS)
- Appointment of Prof. Murrenhoff as Director of IFAS

2005
- Successful completion of the Collaborative Research Center 368 “Autonomous Production Cells” (1994 – 2005)

2009
- Colloquium to honor the 80th birthday of Prof. Backé
- Successful completion of the Collaborative Research Center 442: “Environmentally Friendly Tribosystems” (1997 – 2009)
2011
Establishment of 1 MW wind energy transmission test rig

2013
Raising of DFG-Koselleck grant on instationary friction and leakage behavior of translatory hydraulic seals together with the Peter Grünberg Institute (PGI), FZ Jülich

2014
Establishment of 1.2 MW (peak power) wave energy test rig

2015
Successful completion of STEAM system implementation and validation on 18 t excavator

2016
· Damage of lab 1 due to fire at neighboring institute – lab 1 remains unusable until major maintenance work is completed
· Prof. Wolfgang Backé passes away at age 86

2018
· 50 years of fluid power at RWTH Aachen University
· Retirement of Prof. Murrenhoff as Director of IFAS
· Name change into Institute for Fluid Power Drives and Systems (IFAS) and implementation of new corporate design
· Appointment of Prof. Schmitz as Director of IFAS

2010
Start of operation of the new central pressure supply for laboratory 1 (450 kW installed power)
About Us

The Institute for Fluid Power Drives and Systems (IFAS) of RWTH Aachen University is one of the world’s largest and best known scientific institutions conducting research in all aspects of fluid power. This includes hydraulics and pneumatics, as well as all of its fields of application. To be equipped for the future, current research includes areas such as information technology, servo-control engineering, electrical engineering, tribology and chemistry on top of mechanical engineering.

Environmental, safety and health regulations as well as increasing industrial consumer requirements necessitate a continuous development of sustainable and efficient fluid power technology. Greater environmental awareness and new technologies, e.g., mechatronic systems, preventative maintenance, additive manufacturing, biomedical applications, surface coating techniques and modern information technologies, offer new perspectives and fields of application for fluid power systems.

The highly motivated team of aspiring young scientists takes on the challenges presented by this extensive and diversified field of study. The institute’s multiple and profound national and international connections with manufacturers and users of fluid power components and systems, as well as other research facilities, ensure that its activities are leading the way into the future of research, development and education of fluid power systems.

IFK

The International Fluid Power Conference (IFK) addresses users, manufacturers and scientists in the field of fluid power engineering. The IFK is one of the largest conferences of its kind and is organised by the Society of Advancement for Fluid Power Technology Inc. in cooperation with the Fluid Power Association of the German Engineering Federation (VDMA) and IFAS.

Industrial Colloquium

The industrial colloquium takes place several times throughout the year and provides companies in the field of fluid power with an opportunity to report on interesting new developments and trends inside the market. It is open to the public and offers fluid power manufacturers as well as users a platform for networking and technical discussions.

Knowledge Transfer

IFAS academic staff members publish in technical journals and attend conferences all over the world, thereby presenting current research activities and findings in fluid power and related subjects. They also introduce the latest developments into practical industrial applications by means of cooperative projects.
Research Facilities

Experimental Laboratories

- Over 1250 m² of laboratory space for testing
  - 6 machine beds with isolated foundations
  - 5 isolated test chambers with machine beds and hydraulic power supplies
  - 3x 1 MW electrical power supply
  - Compressed air systems at 6 and 16 bar up to 2800 Nm³/h
  - Over 50 tailored scientific, component, prototype and system test rigs
  - Friction force test stands for rotational and translatory motion
  - Valve test rig (up to NS25 / 840 l/min)
  - Accelerated ageing test rig for hydraulic valves
  - 1 MW wind energy transmission test rig
  - 1.2 MW wave energy test rig
  - Anechoic room on isolated foundation, 6.5 × 8 m
    - Sound pressure, power and intensity
    - Dynamic pressure pulsation
    - Vibration
  - Pass-through climatic test chamber, 4 × 4.8 × 3 m, -70 °C to +70 °C, 15% to 95% rel. humidity
  - Oil laboratory for fluid property measurements
  - Surface measurement laboratory, including
    - 3D-confocal microscope
    - 3D-contact stylus instrument
    - Cylindricity and Microhardness measuring instruments
  - Mechanical and electronic workshop

Lectures & Courses

- Fundamentals of fluid power (D & E)
- Servo-hydraulics (D)
- Simulation of fluid power systems (D)
- Lubricants and pressure media (D)
- Design of fluid power components (D)
- Fluid power for mobile applications (D)

Office Wing

- Modern office space for up to 30 researchers
- 5 rooms for meetings, seminars and students
- High-performance servers for simulation
- Academic library containing fluid power journals, reports, conference proceedings and reference books (approx. 5000 references)

Experimental laboratory 1
The application areas for hydraulic systems are extensive and range from industrial, stationary use to the implementation in mobile machinery. Within this broad spectrum, the research group “Mobile & Stationary Systems” focuses on the systematic, tailored redesign or new development of hydraulic systems and architectures in an increasingly mechatronic environment.

The extension of these fluid-mechatronic drive structures by modern information technology as part of the IIoT is continuously increasing the scope for research and development projects. In this context the research for stationary systems concentrates on enhancing the systems’ durability, efficiency and service intervals as well as enabling preventative maintenance. In order for condition monitoring and preventative maintenance to be usefully implemented, new system requirements in terms of digital modeling, simplification and standardized structures arise, presenting new challenges to the group.

Innovative drives have to be developed in order to meet the ever-increasing demands in terms of availability, productivity and energy efficiency. The holistic view of the system from the primary energy source to the output creates fundamentally new drive concepts. However, the need for research is not limited to the novel interconnection of hydraulic and electrical components but also includes the development of higher-level system controls.

The wider use of real-time control hardware results in hydraulic-mechanical controllers being progressively replaced by electronic controls. The availability of smart components results in new alternative, robust and energy-efficient system concepts, which are already apparent today through the increased use of electro-hydraulic direct drives.
Hybridization of Mobile Machinery
The aim of this research approach is to optimize the load on the diesel engine, which will remain a central component of construction machinery today and in the near future. By recovering energy from the machine’s drives, the power requirement on the diesel engine can be optimized. All in all, fuel consumption and emissions (noise and particles) can be reduced in this way.

Carbon Footprint of Actuators for Industrial Automation Systems
The reduction of greenhouse gas (GHG) emissions necessitates the knowledge of the significant influence factors in automation systems. In cooperation with FIR of RWTH Aachen University, an online based user tool for the estimation of GHG-emissions throughout the life cycle of pneumatic, hydraulic and electromechanical drives in accordance to technical guidelines is developed.

Drivetrains for Renewable Energy
Drive train are being developed for various forms of renewable energies, including solutions for wind, wave and flying wind turbines. The design goals for drivetrains are high degrees of energy generation ranging from partial to full load, compact design, low life cycle costs and successful competition against electro-mechanical drive solutions.

Machine and Process Controls
Due to the increasing digitalization and the high availability of cross-machine and cross-process data, new system concepts are developed in close cooperation with the group Digitalization & Automation. These in turn lead to great potential for shortening production and cycle times, improving human-machine interaction and process stability.
These distributed systems create new functionalities, enabling the development of new business areas that are tailored to the customers’ individual needs. This requirement presupposes that basic functional patterns and design guidelines are reconsidered. Fluid power systems must not only be adaptable but also self-describing and functionally reliable using the concepts of feature definitions and asset administration shells. Finally, by utilizing dynamic and theoretically infinite amounts of computing power, e.g., cloud or high performance computing, advanced control algorithms and data analysis techniques can lead to unforeseen functionalities.

The fourth industrial revolution is actually a continuing evolution, whose main feature is the global connection of intelligent components and systems. This endeavor holds tremendous potential and provides new research questions that need to be answered in order to be consistently implemented. The development is not only to be seen in individual sectors, but spreads across the entire industry and crosslinks various components, systems and technologies.

While in the past the focus was set on solutions for condition monitoring and predictive maintenance, the principle of holistic digitalization in fluid power technology and research needs to be expanded. This includes the development of cyber-physical systems that are linked in a global network. These distributed systems create new functionalities, enabling the development of new business areas that are tailored to the customers’ individual needs. This requirement presupposes that basic functional patterns and design guidelines are reconsidered. Fluid power systems must not only be adaptable but also self-describing and functionally reliable using the concepts of feature definitions and asset administration shells. Finally, by utilizing dynamic and theoretically infinite amounts of computing power, e.g., cloud or high performance computing, advanced control algorithms and data analysis techniques can lead to unforeseen functionalities.

The research group “Digitalization & Automation” attempts to close the gap between existing high-tech fluid power components as well as systems and modern information technology. The greatest challenge lies in the implementation of digital concepts that increase the added value and efficiency of the overall system whilst maintaining the well-established fluid power robustness.

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Digitalization & Automation

Group Presentation
Investigation of the Digitalization Potential towards Fluid Power Systems

The digitalization potential is examined in a study by analyzing the use case of a system's initial operation. Here, the process is routed along the examples of a hydraulic compact drive and a pneumatic automation system in order to outline research and development guidelines for the fluid power industry. The study is funded by a consortium of industrial companies at a pre-competitive stage under administration of the VDMA.

Self-Learning Algorithms for Model Identification

Parameter identification is a state of the art process in case of an existent system model. Unfortunately, a sufficiently precise model is not available for most fluid power applications. Therefore, in order to derive a system model autonomously advanced algorithms are used to map existent sensor and actor signals. The algorithms are tested on a pneumatic automation test bench within this research project.

Comparison of Edge- and Cloud-based Systems for Control Designs of Fluid Power Actuators

Digitalization offers the opportunity to shift the processing power towards decentralized computing servers, such as cloud services. When referring to fluid power devices, it is still a vague assumption that cloud computing increases the functional scope or efficiency. Current research approaches try to clarify the benefit of cloud services in comparison to the edge-computation with special focus on functional enhancements, latency and data security.

Lifetime Estimation by Holistic Data Evaluation

Even though hydraulics are formally known as robust technology, complex machine architectures tend to have severe failures during their life time. Since there are huge machineries whose malfunctions have intense economic impact, the early estimation of such events is mandatory. Thus, within this research project the remaining lifetime of a construction vehicle is analyzed by statistical evaluation of several sensors.
Fluid Power Components

Group Presentation

The research and development of diverse fluid power components is focus of the research group “Fluid Power Components”. From concept to prototype and functional testing, customized holistic approaches are offered to successfully conduct or accompany different kinds of component related studies.

In addition to the further development of existing conventional components, the implementation of smart units with embedded sensors is driven forward. The range of research projects reaches from specialized components for aerospace and automotive applications, through construction, agricultural and forestry machinery, to stationary equipment, such as manufacturing machinery or renewable energy plants. Investigations are undertaken in the framework of basic research, pre-competitive research, joint research and industrial projects.

The group considers upcoming challenges in component research and development from all relevant perspectives. This includes the analysis of customary components and the adaptation or optimization for specific use cases, as well as the development of corrective measures in case of damage. The methodology includes the application of analytical, experimental and numerical methods. By the use of these approaches, optimized and novel components can be developed.

Besides cost-effectiveness, modern fluid power drives are required to offer high efficiency and functionality, low noise, long service life and high robustness. Furthermore, environmental issues such as biodegradable supplies and the use of recyclable and non-toxic materials are increasingly gaining importance. Basing on these requirements, further development of components is advanced, constituting an important step in future-proofing fluid power drives and systems.

Publications & Link

www.ifas.rwth-aachen.de/group/com
Research Scope & Current Projects

Ceramic Flat Spool Valve
Cylindrical spool valves made of steel have two major disadvantages. The non-adjustable annular gap between spool and bushing leads to dissipation through leakage and the wear of the control edges leads to a change of the operating behavior. In cooperation with the IWM of RWTH Aachen University, a flat slide valve made of ceramic is being developed which avoids the mentioned weak points.

Decentralized Hydraulic Axis with High-Speed Components
An electro hydraulic actuator (EHA) with a high speed power unit for demanding requirements of mobile applications for compactness and power density is being developed in cooperation with the MSE of RWTH Aachen University. Therefore a new high speed internal gear pump is designed in order to achieve a speed level increase and thus an increase in power density of the hydraulic system.

Acoustic Emission of Pneumatic Components
The excitation of pneumatic systems causes structure-borne noise and airborne noise, which is perceived by people as unpleasant and affects the hearing. By means of a specially developed measuring method and a holistic simulation model, the primary sound sources are identified. This enables the incorporation of acoustical optimization into the early development process of products.

Investigation of Cylinder Block – Valve Plate Contact in Axial Piston Machines
A combination of experimental and theoretical approaches is used on the basis of a self-developed simulation program to obtain information on the tribological contact. Gap heights in the range of a few micrometers and contact friction are measured realistically on a fully functional 160 kW pump and modeled numerically.
The “Tribology & Fluids” research group focuses on the research of pressure fluids and the holistic understanding of tribological systems in hydraulic and pneumatic applications.

Investigations of the various tribological and pressure fluid issues are carried out on different levels of abstraction ranging from tribometer investigations to complex multi-body systems. The aim is to be able to ensure the transferability of the findings to real systems, enabling an application-oriented optimization of existing tribological systems. In parallel to experimental investigations, analytical and simulative models and methods for describing the observed effects are created, extended and validated whenever possible. By use of these methods local critical states in tribological systems can already be evaluated and optimized during the design process.

IFAS has extensive experience and expertise in the development and operation of highly specialized tailor made test benches. Amongst others, unique test rigs for the determination of pressure-dependent fluid properties (up to 8000 bar), friction forces in sealing systems at relative speeds of up to 10 m/s, leakage and entrainment rate of rod sealing systems have been designed and are in operation. Furthermore, a variety of tribometers for the investigation of abstracted contacts under the influence of various lubrication conditions and material pairings are in operation. Additionally, an oil laboratory enabling standardized tests, e.g., capillary viscosimetry, HFRR and SLBOCLE, is available.

The research results intend to improve the physical and/or empirical understanding of the tribological contacts and systems, thus enabling modelling for an efficient and durable component and fluid design, as well as for lifetime prediction.
Research Scope & Current Projects

BioHydra
Novel and sustainable water/polymer based hydraulic fluids are developed within the BioHydra project, which is conducted with industrial partners and the Fraunhofer research organization. At IFAS, extensive wear tests are carried out to gain insight into the operational capability of the fluid in real hydraulic systems.

Metallic Sealing
The leak-free sealing using poppet valves has a significant importance in hydraulics, especially in regard to fail safe and counter-balance valves. Nevertheless, the sealing mechanism has not been fully explored and is thus investigated within this public research project. For this purpose, coupled structure-fluid simulations including complex contact models over a very broad scale range are carried out and validated by means of experiments in cooperation with the Peter-Grünberg-Institute of FZ Jülich.

Electrostatic Charging of Fluids and Components
Ash- and zinc-free hydraulic fluids with a very low conductivity are increasingly employed in hydraulic applications. As a result, electrostatic charges are no longer conductively dissipated in the liquid and spontaneous discharges occur, especially in the filter. At IFAS the influences on the charges are examined.

Tailor Made Fuels from Biomass (TMFB)
As part of the cluster of excellence “Tailor Made Fuels from Biomass” diesel fuels based on biomass are developed. A central research question in this context is the injectability of these fuels in the combustion chamber. The currently unknown fluid properties under the pressure conditions in the rail represent a crucial aspect for this issue. To gain further insight, high-pressure test rigs are developed and operated at IFAS.
In the context of the industrial internet of things and preventive maintenance, the need for accurate and novel simulation models is constantly increasing. Therefore, advancing simulation methods and their experimental validation are the focus of the “Simulation Development & Validation” research group.

Independent of the component or system, it is crucial to begin with the underlying physics before starting to build or develop a model in a computational environment. Nevertheless, in some instances empirical data for model abstraction is inevitable. In either case, the numerical model necessitates validation using experimental set-ups. The choice of the experimental set-up plays a fundamental role in terms of a time and resource efficient model development process. Whenever possible, simulation results at IFAS are validated with experimental data.

Wherever state of the art tools reach their limits, new or enhanced simulation tools and methods can be researched and developed. Our experience with multi-fold projects, various simulation environments and a well-equipped test field allow us to efficiently set-up and validate simulations for complex systems as well as specific detached physical phenomena.

Although fluid power machines and phenomena have been developed and researched for many decades, the holistic simulation including every detail or physical property is not yet possible. The current research scope includes, e.g., gap heights in displacement machines, cavitation, sealing mechanisms, rubber sealing fatigue or gas injection systems. The accurate research and simulation of fluid power phenomena, components and systems will be essential to reach the goals of IIoT in hydraulics and pneumatics.

Publications & Link

www.ifas.rwth-aachen.de/group/sim
Research Scope & Current Projects

**CNG Injection System**
Compressed natural gas (CNG) is a promising alternative for conventional liquid fuels due to several advantages. The improvement of a CNG driven engine requires a direct injection system. A time efficient simulation of the system is imperative for a successful engine design. In cooperation with an industrial partner such a simulation model is being developed.

**Dissolved Air in Hydraulic Systems**
Gas cavitation has always been a major problem in hydraulic systems leading to cavitation erosion which ultimately results in component failure. Its prediction requires accurate physical knowledge of the mechanisms behind the air dissolution process as well as fluid specific characteristics, e.g., diffusion coefficient and solubility. These issues are the research focus of a DFG-funded project in conjunction with a model development to predict air bubble growth.

**Water Radial Piston Pump**
Sufficient lubrication of tribological contacts within pumps and motors is always a crucial aspect and especially demanding when substituting hydraulic oil by water as pressure fluid. A prototype and simulation model of a high pressure radial piston pump for water applications is developed within a governmentally founded project.

**Dynamic Sealing Simulation**
The description of friction between two rough surfaces is difficult to calculate especially if the material is deformable rubber. Although rubber seals appear in every technical application, their physical treatment is not fully understood yet. In conjunction with the development of a new physical model at the FZ Jülich a dynamic sealing simulation model is built up within a governmentally founded project.
Former Academic Staff

Directors
Backé W., em. Univ.-Prof. Dr.-Ing. Dr. h.c. mult., Aachen (†)
Murrenhoff H., Univ.-Prof. Dr.-Ing. i. R., Aachen

Chief Engineers
Lück J., Dr.-Ing. i.R., Wetter
Heinen R., Dr.-Ing. i.R., Drolshagen
Riedel H., Prof. Dr.-Ing. i.R., Köln
Helduser S., Prof. Dr.-Ing. i.R., Krefeld
Weingarten F., Dr.-Ing. (†)
Murrenhoff H., Univ.-Prof. Dr.-Ing. i.R., Aachen
Saffe P., Dr.-Ing., Aventics, Laatzen
Haas H.-J., Dr.-Ing., Parker Hannifin, Chemnitz
Jacobs G., Univ.-Prof. Dr.-Ing., RWTH Aachen University, Aachen
Lehner S., Dr.-Ing., Linde Hydraulics, Aschaffenburg
Fischer M., Dr.-Ing., ARGO-HYTOS, Kraichtal-Menzingen
Bauer F., Dr.-Ing., Hydac System, Sulzbach/Saar
Meuser M., Dr.-Ing., MAN Diesel & Turbo, Oberhausen
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1973
Brodowski W., Dr.-Ing. (†)
Hamburger N., Dr.-Ing. i.R., Paris
Hömburg K., Dr.-Ing. i.R., Mettmann
1974
Bialas V., Dr.-Ing. i.R., Hilden
Hahmann W., Dr.-Ing., Kempen
1975
Böckmann R.-D., Prof. Dr.-Ing. i. R., Wettenberg
Causemann P., Dr.-Ing., ZF Sachs, Schweinfurt
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1981
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1992
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Klein A., Dr.-Ing., Akebono Europe, Gonesse, Frankreich
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Remmelmann A., Dr.-Ing., John Deere, Mannheim
Ristic M., Dr.-Ing., Bosch Rexroth, Lahr a. M.
Sanchen G., Dr.-Ing., Hilti, Schaan, Liechtenstein

2000 Völker B., Dr.-Ing., MSA, Karlstadt a. M.
Czink A., Prof. Dr.-Ing., Hochschule Aschaffenburg, Aschaffenburg
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Mundry S., Dr.-Ing., Caterpillar Global Mining Europe, Lünen
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Baum H., Dr.-Ing., Fluidon, Aachen
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van Bebber D., Dr.-Ing., Ford Forschungszentrum, Aachen

2003 Breuer D., Dr.-Ing., Bosch Rexroth, Horb
Bublitz R., Dr.-Ing., Parker Hannifin, Kaarst
Hantke P., Dr.-Ing., Bosch Rexroth, Lahr a. M.
Schmidt M., Dr.-Ing., Liebherr-Components, Deggendorf

2004 Boldt T., Dr.-Ing., Weber Hydraulik, Güglingen
Breit H., Dr.-Ing., Dr. Breit GmbH, Heiligenhaus
Jansen R., Dr.-Ing., Aker Solutions, Erkelenz
Meindorf T., Dr.-Ing., Fluitronics, Krefeld
Zhang X., Dr.-Ing., Quaker Chemical, Shanghai, China

2005 Schuster G., Dr.-Ing., Robert Bosch, Heilbronn
Deeken M., Dipl.-Ing., Liebherr-MCCtec, Rostock
Hoppermann A., Prof. Dr.-Ing., Hochschule Niederrhein, Krefeld
Goerres M., Dipl.-Ing., Merkel Freudenberg Fluidtechnic, Schwalmstadt
Schütz B., Dr.-Ing., Robert Bosch, Stuttgart *

2006 Gauchel W., Dr.-Ing., Festo, Esslingen
Schultz A., Dr.-Ing., Magnet-Schultz, Memmingen
Zaun M., Dr.-Ing., gwk Gesellschaft Wärme Kältetechnik, Kierspe
Gaunecshea E., Dr.-Ing., Bucher Hydraulics, Neuheim, Schweiz

1996

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<th>Year</th>
<th>Name</th>
<th>Institution/Company</th>
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<td>2007</td>
<td>Scharf S., Dr.-Ing.</td>
<td>Jungheinrich, Norderstedt</td>
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<td>Göhler C., Dr.-Ing.</td>
<td>XCMG European Research Center, Krefeld</td>
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<td>Palmen A., Dr.-Ing.</td>
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<td>Kohmäischer T., Dr.-Ing.</td>
<td>Danfoss Power Solutions, Neumünster</td>
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<td>Dittmer H.-J., Dr.-Ing., Ingenieur-Büro</td>
<td>Sindelfingen  *</td>
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<td>2008</td>
<td>Stammen C., Prof. Dr.-Ing.</td>
<td>XCMG European Research Center, Krefeld</td>
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<td>Palmens A., Dr.-Ing.</td>
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<td>2009</td>
<td>Schlemmer K., Dr.-Ing.</td>
<td>Moog Industrial Group, Luxemburg</td>
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<td>Verkoyen T., Dr.-Ing.</td>
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<td>Fritz S., Dr.-Ing.</td>
<td>Varian Medical Systems</td>
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<td>Torikka T., Dr.-Ing.</td>
<td>Bosch Rexroth, Lohr  *</td>
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<td>Wohlers A., Dr.-Ing.</td>
<td>Hydac Filtertechnik, Sulzbach/Saar</td>
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<td>2010</td>
<td>Reichert M., Dr.-Ing.</td>
<td>Hydac Engineering, Steinhausen</td>
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<td>Kühnlein M., Dr.-Ing.</td>
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<td>Verkoyen T., Dr.-Ing.</td>
<td>XCMG European Research Center, Krefeld</td>
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<td>2011</td>
<td>Enekes C., Dr.-Ing.</td>
<td>Klüber Lubrication, München, München</td>
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<td>Leonhard L., Dipl.-Ing.</td>
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<td>Siempelkamp, Krefeld</td>
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<td>Dipl.-Wirt. Ing., GHH</td>
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<td>Piepenstock U., Dipl.-Ing.</td>
<td>Hydraulische Antriebstechnik P&amp;G, Altena</td>
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<td>Fatemi A., Dr.-Ing.</td>
<td>Robert Bosch, Stuttgart</td>
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<td>Bosch Rexroth, Hamburg</td>
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<td>Ibrahim M., Dr.-Ing.</td>
<td>Benha University, Kairo, Ägypten</td>
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<td>González R. G., Dr.-Ing.</td>
<td>Festo, Esslingen *</td>
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<td>Nafz T., Dr.-Ing.</td>
<td>Bosch Rexroth, Horb  *</td>
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<td>2012</td>
<td>Drumm S., Dr.-Ing.</td>
<td>Wirtgen Group, Windhagen</td>
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<td>Ewald J., Dr.-Ing.</td>
<td>Bosch Rexroth, Lohr a. M.</td>
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<td>XCMG European Research Center, Krefeld</td>
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Mechatronische Systeme zur Pulsationsminderung hydrostatischer Verdrängereinheiten, 2007

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Entwicklung eines piezobetätigte Schaltventils mit Busanbindung für den untätigten Einsatz in der Wasserhydraulik, 2005

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Hoppermann, Andreas
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Ibrahim, Mohamed
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Verschleiß und Lebensdauerabschätzung von Dichtungen in pneumatischen Sitzventilen, 2008

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Development of Hydrostatic Drive Trains for Wave Energy Converters, 2014

Kim, Sunghun
Measurement of effective bulk modulus and its use in CFD simulation, 2012

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Meindorf, Thomas
Sensoren für die Online-Zustandsüberwachung von Druckmedien und Strategien zur Signalauswertung, 2005

Meuser, Marcell
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Prust, David
Entwicklung einer auf trockener Adhäsion basierenden Greifvorrichtung, 2011

Reichert, Maxim
Development of high-response piezo-servovalves for improved performance of electrohydraulic cylinder drives, 2010
Reinertz, Olivier
Miniaturisierung servopneumatischer Rotationsantriebe, 2014

Riedel, Christian
Massenstrombasierte hydraulische Systemsimulation im Ein- und Zwei-phasenmodell, 2014

Robens, Niko
Entwicklung und Auslegung von Endlagendämpfungen für hoch-dynamische Zylinderantriebe, 2016

Roosen, Klaus
Hydraulische Stellantriebe mit Nebenstromregelung, 2002

Schrank, Katharina
Eindimensionale Hydrauliksimulation mehrphasiger Fluide, 2015

Schumacher, Jan
Alterungs- und Verschleißverhalten von Druckübertragungsmedien und hydraulischen Ventilen, 2013

Sgro, Sebastian
Concepts of Hydraulic Circuit Design Integrating the Combustion Engine, 2014

von Grabe, Christian
Effizienzsteigerung durch Abluftnutzung bei pneumatischen Antrieben, 2015

von Dombrowski, René
Modellierung der Partikelverteilung in hydraulischen Systemen, 2015

Wohlers, Alexander
Tribologische Simulationsmodellbildung dynamischer Dichtungen, 2012

Zaun, Michael
Elektro rheologische Ventile als Stellelemente in Zylinderantrieben, 2007

Zhang, Xingang
Alterungsmechanismen ökologisch verträglicher Druckflüssigkeiten, 2004

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