ForWind
Zentrum für Windenergieforschung

Bremen
Hannover
Oldenburg

ForWind
2018 - 2023

Research, Projects, Co-operations

www.forwind.de

20 Jahre ForWind - 2003 - 2023

ForWind
Zentrum für Windenergieforschung
Bremen
Hannover
Oldenburg

> **Wind energy research in the German northwest sets standards**

Table of contents

Matthias Schubert
Chairman ForWind advisory board
Managing director wyncon consultants

ForWind in 2024

Navigating corporate strategy in the wind industry is currently a major challenge: bright sunshine on the horizon, but the waves of the storm that has just passed are still crashing hard.

For research institutes in particular, the budget deficit of 60 billion euros resulting from the constitutional judgement with subsequent massive funding cuts is an existential challenge. The innovative design of a transition to renewables is threatened with a full stop.

In these troubled waters, ForWind has nevertheless been able to launch a number of significant projects and, above all, set the course for the future with new research infrastructure.

The HiPE-LAB at the University of Bremen will be able to test the environmental and operational loads of power electronics, which are key technologies for renewable energy generation.

At the University of Hanover, the extensive expansion of the large wave current channel was put into operation, which allows hydrodynamic analyses of the foundations and anchoring of offshore turbines.

The WiValdi wind energy research park was also a major infrastructure investment. This open-air laboratory for the latest generation of wind turbines is operated by the Wind Energy Research Association. This partnership between DLR, IWES and ForWind once again demonstrates the power of collaborative research in turbulent times.

20 Jahre ForWind - 2003 - 2023

Dr. h.c. Ir. Jos Beurskens
Chairman of the advisory board
from 2006 to 2018

20 Years of ForWind

This report provides a highly informative overview of the wind energy activities of ForWind and its partners during the last 6 years of its 20 years existence. Its observations bring me to the conclusion that ForWind has developed from a regional player to a major player on both German and international levels. This is due to the independent, high quality, academic and applied research ForWind has been pursuing from its establishment in 2004.

The research increasingly involves verification of analytical results and models on both dedicated laboratory scale and wind farms and turbines in the open air.

ForWind's work on research and education has been essential for sustaining the spectacular growth of wind energy's contribution to a sustainable energy system in the recent three decades.

Given the present extremely challenging national and international ambitions and policies to integrate wind energy into our energy systems, the importance of analytical and independent R&D close to industrial and policy implementers needs, will further increase. Think of far offshore sites, hybrid and hydrogen-only production, long distance gas and electricity transport, supply security and infrastructure safety.

If ForWind maintains its frontline position and adapts to the future challenges, its future is secured for at least the next three decades!

20 Jahre ForWind - 2003 - 2023

Introduction

With this publication we look at the development of ForWind between 2018 to 2023 and appreciate the first 20 years of ForWind's existence. Despite the pandemic, the six years covered were a period with extensions of ForWind's research infrastructures, new members joining and a number of innovative research projects brought underway.

In Oldenburg research work in the 2017 built WindLab and the Turbulent Wind Tunnel began. Together with new HPC clusters installed at Oldenburg University and two of them dedicated for wind energy research, this presents a unique opportunity for wind physics research in future projects. In Hannover the Test Center Support Structures (TTH) was expanded in 2020 to include working space for 24 additional researchers and in 2023 the New Large Wave Current Flume (GWK+) started operating, making this a test facility for offshore and coastal engineering research that is unique in the world. ForWind Bremen saw an increased focus on research in wind turbine power electronics with the operation of the HiPE-LAB.

All of these facilities add to the already impressive infrastructures present in the German Research Alliance Wind Energy (FVWE). This unique strategic cooperation between the German Aerospace Centre (DLR), the Fraunhofer Institute for Wind Energy Systems (IWES), and ForWind – started with the project "Smart Blades – development and construction of smart rotor blades" in 2012. In 2023, after five years of planning and research in the DFWind project, the partners inaugurated the WiValdi Research Wind Farm.

Despite the vast research infrastructures and laboratories, which are operated and used by the ForWind members, the comparison of research results with reality remains a challenge. Complete verification and validation under real external conditions is only possible to perfection in or on real plants.

For several research questions this is impossible to do in commercially operated wind power plants or turbines. WiValdi is therefore a very exciting opportunity. The research wind turbines as well as the many accompanying met masts offer world class opportunities for the wind energy research community and the entire sector. ForWind, DLR, and IWES are looking forward to many thrilling joint research projects yet to come at Krummendeich.

We are excited that the ForWind network is part of the Collaborative Research Centre 1463 at Leibniz Universität Hannover. In the DFG funded research collaboration on "Integrated Design and Operation Methodology for Offshore Megastructures" new concepts are being developed for the offshore wind turbines of tomorrow. They are intended to make a significant contribution to the success of the energy transition. As part of the Collaborative Research Centre, the researchers will therefore develop a method with the digital twin that integrates all the details about the condition and dynamic behaviour of the support structure and rotor blades as well as knowledge about the effects of changing environmental and operating conditions.

All ForWind members are especially grateful to the Federal Ministry for Economic Affairs and Climate Action (BMWK), including the supporting Project Management Jülich (PtJ), and the Ministry for Science and Culture of Lower Saxony (MWK), who are the most prominent sponsors of ForWind's research projects. In addition, the Federal Ministry for Education and Research (BMBF), the German Research Foundation (DFG), the European Commission (EC), and other regional and national sponsors supported us in tackling the challenges of and developing innovations for the wind energy sector.

ForWind is based on interdisciplinary cooperation and as such, we appreciate the stimulating teamwork with our national and international partners from research and industry. Together we will continue to support the entire sector in increasing the value of wind energy to the maximum.

Last but not least, we would like to thank all members of the ForWind Advisory Board for their always very valuable comments, counseling and suggestions as well as all ForWind staff for their unprecedented efforts and enthusiasm.

20 Jahre ForWind - 2003 - 2023
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FORWIND TIMELINE

2004

ForWind starts operations with Leibniz Universität Hannover and Carl von Ossietzky Universität Oldenburg as the founding members

2005

ForWind is the co-ounder of the German section of the EAWE (European Academy for Wind Energy) - the first of many national and international networks and partnerships

2009

Universität Bremen joins ForWind as the third partner, giving the cooperation a unique position in the German research landscape

2012

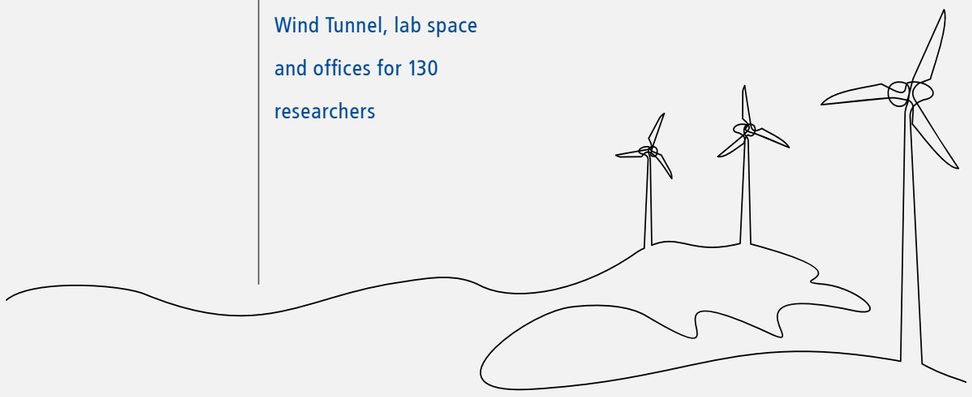
Together with DLR and Fraunhofer IWES the Research Alliance Wind Energy (FVWE) is founded. 600 scientists do their research under the new partnerships banner

2018

ForWind unveils the new WindLab in Oldenburg housing the Turbulent Wind Tunnel, lab space and offices for 130 researchers

2023

The inauguration of the GWK+ in Hannover and the Test Wind Farm WiValdi show that ForWind is still growing and evolving in its 20th year



20 Jahre ForWind - 2003 - 2023

20 YEARS OF WIND ENERGY RESEARCH

RAIMUND ROLFES, JOACHIM PEINKE

Twenty years ago, a group of four scientists from the universities of Hannover and Oldenburg initiated what would become ForWind. With support from the Lower Saxony government, a foundational structure and funding were established, leading to the commencement of research activities under this new entity in 2004. Subsequent years witnessed numerous contributions to conferences and journals, alongside a steady growth in scientific partnerships. In 2009, the University of Bremen joined, forming the current consortium. Presently, 30 research groups across the three universities collaborate on various projects.

At its inception, the research infrastructure was primarily laboratory-scale. Over the past two decades, ForWind has expanded to include a number of large-scale testing sites, which distinguish it globally. Notable facilities include the turbulent wind tunnel, the large wave current flume GWK+, the GeCoLab generator converter test bench, the test center support structures and the HiPE-LAB for high performance electronics testing. These facilities, while impressive individually, are integrated into a strategic research environment, creating a comprehensive testing landscape that synergizes the strengths of the different institutes and research traditions.

By consolidating the scientific expertise of three universities, the research center has become a recognized national and international partner in wind energy research. Its broad scientific contributions, lecture series, conferences, trade fair appearances, and participation in international events have significantly enhanced networking with industry and political entities and increased its visibility. ForWind currently plays a crucial role in scientific organizations and contributes to the development of research agendas.

“ ForWind plays a significant role in scientific organizations - nationally as well as internationally

This is achieved on a European level through long-term involvement in the European Technology and Innovation Platform ETIPWind and the European Energy Research Alliance EERA JP Wind as well as the International Energy Agency. ForWind’s international visibility has also been increased through its engagement in the European Academy on Wind Energy (EAWE). Under the EAWE banner ForWind has organized the TORQUE conference in 2012 (Oldenburg), the WESC conference in 2021 (Hannover) and the EAWE PhD seminar in 2023 in Hannover.

On the national basis it collaborates closely with DLR and Fraunhofer IWES within the Research Alliance Wind Energy (FVWE). These partnerships enhance the institute’s capacity for large-scale testing and research. Examples of such collaborative efforts include the Test Center for Support Structures and the WiValdi research wind farm. Furthermore, the institute actively participates in the German Renewable Energy Research Network, focusing on setting research priorities and developing implementation strategies for research topics and funding concepts.

Initially, ForWind's research focused on wind physics and offshore support structures. This scope has considerably been broadened to encompass all aspects of wind energy turbines, wind parks, and clusters, as well as their integration into the future energy system.. ForWind is focusing on foundational research but at the same time looks for practical application in close cooperation with partners from industry. The institute is home to the only German Collaborative Research Centre for wind energy: the CRC 1463 Integrated Design and Operation Methodology for Offshore Megastructures.

The contributions from wind energy research are in high demand internationally and are simultaneously highly attractive to many students. In light of the current global challenges regarding climate and energy issues, a significant need for action becomes evident, necessitating the formulation of new, wind energy-specific research questions. The contribution of wind energy is increasingly becoming a central, active element of energy supply, which requires viewing energy conversion in wind energy systems in the complex interplay between the electrical grid, heat generation, and energy storage. The characteristic approach of ForWind's research will help address these scientific challenges and will

20 Jahre ForWind - 2003 - 2023

lead to increased understandings of the atmosphere, turbine and support structure technology, plant and grid planning and construction, sustainable operation of turbines and farms as well as the environmental and social interactions of wind energy.

ForWind is thankful for the opportunities for growth, specialization and diversification it has received over the past 20 years. A number of persons and institutions have played key roles in bringing about our success story and we think of them fondly. We take the developments of the past two decades as a renewed motivation to seek out new frontiers and break fresh ground and we are looking forward to taking on these coming challenges.

“ ForWind is thankful for the long-standing support and looking forward to future challenges

FUTURE CHALLENGES FOR WIND ENERGY RESEARCH

The transformation of the energy system from fossil to renewable energies, necessitated by global warming and the global energy crisis, poses major challenges for society.

As stated in the European Green Deal of the European Commission, a strongly accelerated expansion of onshore and offshore wind energy is necessary to become the first climate-neutral continent by 2050.

For some years now, however, the amount of new capacity needed to achieve this has fallen short of the required figures. At the beginning of February 2023, the German government announced a forced expansion of wind energy by 2030. The creation of the political framework conditions and the administrative facilitation of the expansion of wind energy in Germany are decisive preconditions for achieving the climate targets.

However, the development of larger, more efficient, reliable and digitally networked wind turbines and wind farms is also indispensable.

What innovations are needed to make wind one of the world's most important sources of low-cost electricity generation?

Already in 2019, an international team of scientists with the participation of ForWind has identified the three biggest challenges for wind energy research. In order to exploit the full potential of wind energy and meet the global demand for clean energy, further innovations are necessary.

These are the tasks facing the entire scientific community and the findings in the various research fields must be implemented quickly and boldly by industry and politics in order to achieve further progress.

First challenge:
Wind resources and wind currents

A better understanding of wind resources and currents in the area of the atmosphere where wind turbines generate electricity

Second challenge:
Increasingly large wind turbines

Structural and system dynamics of the world's largest rotating machines - scalability, transport, construction and recycling

Third challenge:
Future Power grids

Designing and operating wind turbines in a way that supports and promotes the reliability and resilience of the electricity grid

20 Jahre ForWind - 2003 - 2023

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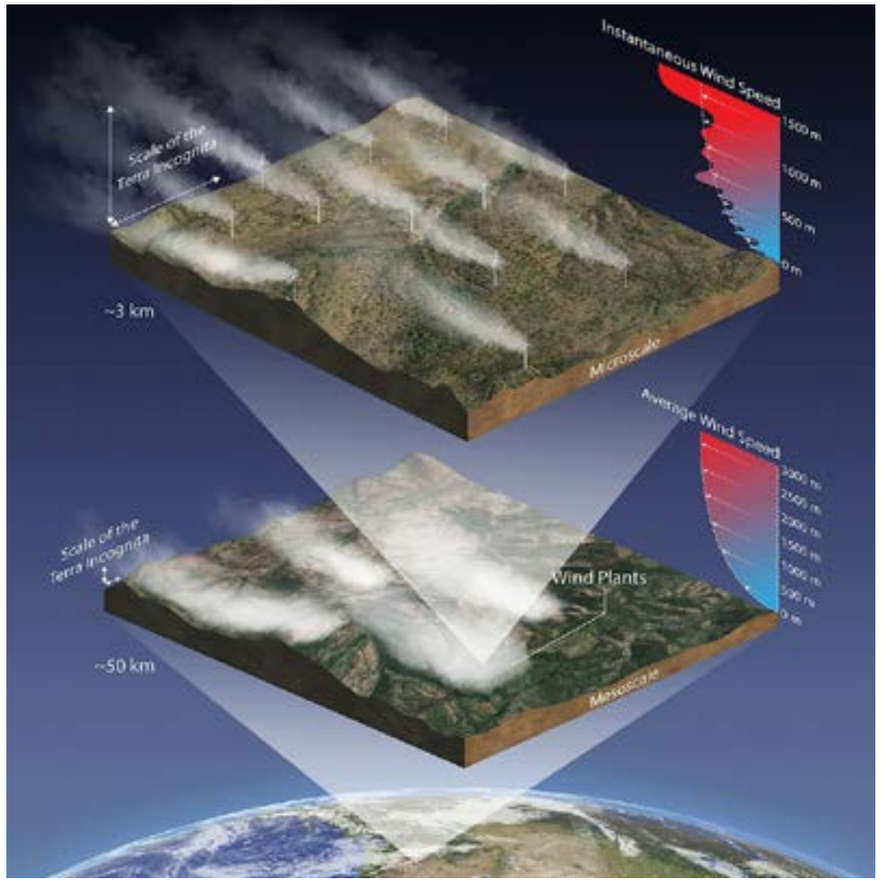
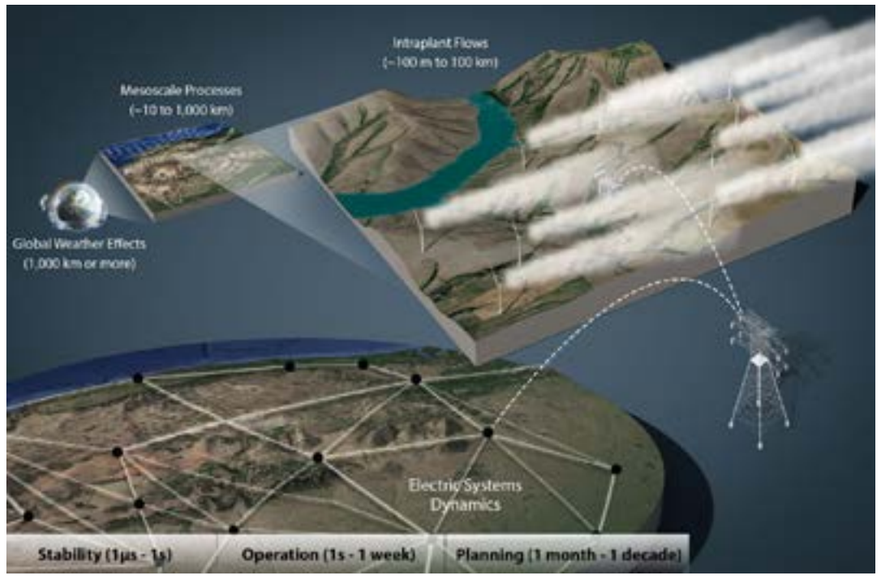




Overview

ForWind by the numbers

More than 240 dissertations

In the past six years alone almost 250 PhD students successfully contributed to the research work at the 30 university institutes that make up ForWind.

More than 80 joint projects

Research projects are our lifeblood, whether we initiate them or work alongside our partners. With each new project our expertise grows.

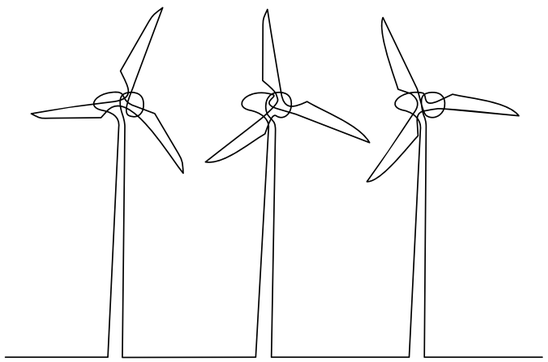
More than 90 million € in third party funds

All the work we did the past 20 years is funded externally. This way we stay independent and flexible to take on current topics and questions in our research.

30 institutes and research groups

ForWind gathers the experience and knowledge of 30 academic institutions and professors under one roof - all contributing to the future of energy.

> **Field research, lab experiments and simulations are the cornerstones of our science**



FORWIND IS TAKING ON THE DEMANDING TASK OF ADDRESSING THE MAJOR SCIENTIFIC CHALLENGES IN FUTURE WIND ENERGY RESEARCH WITH DEEP PHYSICAL AND ENGINEERING UNDERSTANDING

Numbers and data are essential to the work at ForWind. From the support structures of offshore wind energy turbines, blade design, loads on power electrics, grid integration and finally the wind itself we collect data, measure and test.

Our work is based on three foundations:
1. Recording and measuring data in situ. Using scanners, sensors as well as systems we design and develop in house, we look at every possible aspect of wind energy data.
2. Measuring and validating in lab situations. We use wind tunnels and other testing sites to recreate real field conditions.
3. Testing and running simulations on high performance computer systems. Based on our data we develop innovative models for future research and industry use.

We need to be able to reproduce our measurements from the field in our numerous testing sites. Creating realistic test conditions for the various stresses and loads for wind turbines and parks is the main use of our infrastructure.

The data collected through work with our research infrastructure is then used to model and formulate numerical descriptions. We aim to create simulations of the highly complex conditions surrounding wind energy systems.

The closer we get to the real conditions using our supercomputers, the easier it is for uns and the industry to build on this research and take wind energy to the next level.

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FORWIND OLDENBURG

Carl von Ossietzky Universität Oldenburg

With three research groups ForWind Oldenburg has a focus on wind energy systems and wind physics. Honoring Oldenburg University's long standing tradition in renewable energy research, the ForWind headquarters as well as the turbulent wind tunnel are today housed on the Oldenburg campus. State of the art high performance computer technology and close cooperation with partners from the FVWE are creating an environment perfect for interdisciplinary research with a strong focus on commercial applications. Another research focus in Oldenburg is information technology and thus the other Oldenburg ForWind members are researching digitalization and energy systems.

- WIND ENERGY SYSTEMS
- TURBULENCE, WIND ENERGY AND STOCHASTICS
- FUNDAMENTALS OF TURBULENCE AND COMPLEX STRUCTURES
- DIGITALIZED ENERGY SYSTEMS
- SYSTEM ANALYSIS AND OPTIMISATION

FORWIND HANNOVER

Leibniz Universität Hannover

15 institutes of Leibniz Universität Hannover are ForWind members, most of them coming from the field of engineering science. In Hannover the ForWind researchers have access to a number of unique research facilities, which are constantly upgraded and expanded. Much of the research has applications in offshore wind energy technology. So it is fitting that Hannover is also home to the CRC 1463 Offshore Megastructures, with the aim of designing and operating future offhsore wind turbines using digital twins. Other research focal points are grid integration, meteorology and developing and improving generator gear and converter of wind turbines. Hannover offers a specialization on wind energy within its master studies of civil engineering and of power engineering.

- DRIVE SYSTEMS AND POWER ELECTRONICS
- CONCRETE CONSTRUCTION
- ELECTRIC POWER SYSTEMS
- GEOTECHNICAL ENGINEERING
- ELECTRICAL ENGINEERING AND MEASUREMENT TECHNOLOGY
- COMMUNICATIONS TECHNOLOGY
- MACHINE DESIGN AND TRIBOLOGY
- CONCRETE CONSTRUCTION
- METEOROLOGY AND CLIMATOLOGY
- STEEL CONSTRUCTION
- STRUCTURAL ANALYSIS
- TURBOMACHINERY AND FLUID DYNAMICS
- WIND ENERGY SYSTEMS
- BUSINESS INFORMATICS
- HYDRAULIC, ESTUARINE AND COASTAL ENGINEERING

FORWIND BREMEN

In 2009 the University of Bremen joined ForWind as its third member. Together with the two universities from Lower Saxony the cooperation today bundles all academic wind energy research in the German Northwest. Putting a focus on production technology and automation as well as grid technology and electronics, the wind energy research in Bremen complements the interdisciplinary and application oriented approach of ForWind as a whole. Among the unique features at ForWind Bremen is a Krogmann 15/50 research wind turbine and the HiPE-LAB - a laboratory for testing multimodal loads of high power electronics. With all three universities combined ForWind is made up of 30 institutes and research groups. All three universities are equally represented in the ForWind management board and coordinate research projects among the ForWind partners.

- METROLOGY, AUTOMATION AND QUALITY SCIENCE
- MECHANICAL ENGINEERING
- PLANNING AND CONTROL OF PRODUCTION AND LOGISTICS SYSTEMS
- AUTOMATION
- ELECTRICAL DRIVES, POWER ELECTRONICS AND DEVICES
- INTEGRATED PRODUCT DEVELOPMENT
- MARINE ENVIRONMENTAL SCIENCES

Early Career Researchers

Providing talents with the opportunity to shine

FORWIND - A GOOD PLACE TO START A SCIENCE CAREER

In the various ForWind teams, everyone gets direct insights into the diverse fields of wind energy research. Whether as a student assistant or researcher at PostDoc level: ForWind offers the ideal environment for early career researchers, who want to contribute to the success story of wind energy. Young researchers at ForWind have the chance to visit and work with research partners such as major national research institutions, international universities and numerous industrial partners, enabling them to test and validate research and knowledge in practice.

Early career researchers are given every opportunity to contribute at international conferences and present the results of their work. Every year ForWind organizes their own Wind Physics Symposium, where research insights from PhD projects and ongoing studies are shared and discussed. Another annual event is the EAWE PhD Seminar, which is organized by young researchers and brings together PhD candidates from the field of wind energy research from around the world for three days of talks, presentations and networking. In 2023 the event attracted 140 Ph.D. students from Europe to Hannover. It was hosted by the CRC Offshore Megastructures.

NETWORKING

ForWind - National research partnerships

ForWind is active in regional, national and international networks. Building trust, bringing partners together and furthering the goals of wind energy research through cooperation are some of our stated goals.

The Research Alliance Wind Energy, founded in 2012, combines the know-how of more than 600 scientists and generates groundbreaking stimulus for the energy supply of the future.

The community of the research alliance has an international appeal and opens up synergies for upcoming major projects in the wind industry.

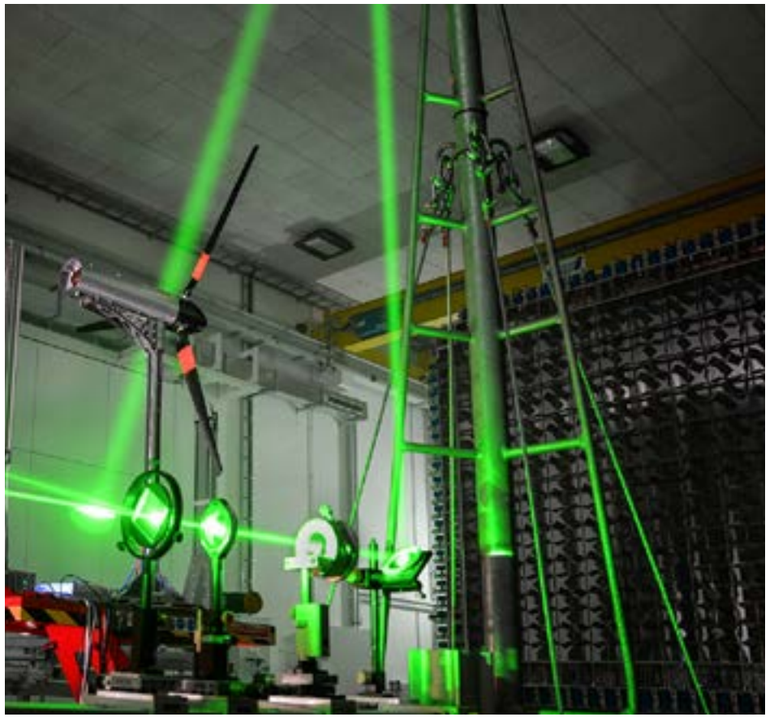
Through a number of past, ongoing and future projects ForWind and Fraunhofer IWES have built a lasting, dependable and highly productive research alliance.

Fraunhofer IWES members are part of ForWind and both institutes share office and lab spaces in Oldenburg and Hannover.

Through the Forschungsverbund Windenergie and the highly influential project work for the Forschungspark Windenergie at Krummendeich ForWind and the DLR have formed a close partnership.

The DLR has a Wind Energy department located in Braunschweig, working on the aerodynamics and aeroacoustics of wind turbines as well as future technologies for efficient and quiet wind farms.

The Energy Research Center Lower Saxony (EFZN) is a joint scientific center of the universities of Braunschweig, Clausthal, Göttingen, Hannover and Oldenburg. As a central research, networking and communication platform, it bundles the energy research competencies of the university locations, with ForWind covering the wind energy research line.



20 Jahre ForWind - 2003 - 2023

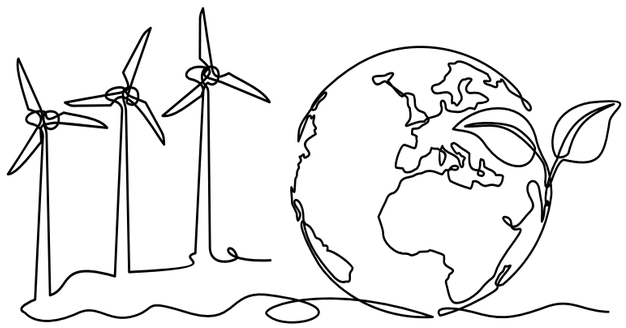
ForWind - International research partnerships

EAWE is an international non-profit organization that promotes and supports the development of wind energy science. The goal is to exploit wind energy to its full potential for the benefit of the world. The EAWE holds annual international conferences on wind energy research, a yearly PhD seminar and publishes its own research journal.

The IEA Wind TCP is an international co-operation of 24 countries and sponsor members that share information and research activities to advance wind energy deployment. The IEA Wind TCP is a vehicle for member countries to exchange information on the planning and execution of national large-scale wind system projects, and to undertake co-operative research and development (R&D) projects called Tasks.

EERA is a membership-based, non-profit association, constituting the largest low-carbon energy research community in Europe and a key player in the European Union's Strategic Energy Technology (SET) Plan. EERA JP Wind Energy is a collaboration among major European public research organisations with substantial research and innovation efforts in wind energy.

ETIPWind activities combine two prior initiatives: the European Wind Energy Technology Platform (TPWind) and the European Wind Industry Initiative. The ambition is to define and agree on concrete research and innovation (R&I) priorities and communicate these to the European institutions and other decision making bodies in order to support the EU's ambition of a decarbonised economy by 2050.



Research projects

Researching wind energy in the laboratory, in simulations and in situ

RESEARCH HIGHLIGHTS FROM THE PAST SIX YEARS

CRC 1463 OFFSHORE MEGASTRUCTURES

For the operation of future wind farms, precise information on the condition and dynamic behavior of the support structure and rotor blades as well as knowledge of the effects of changing environmental and operating conditions is required for each individual turbine throughout its entire service life. Classical simulation models are usually identical for all turbines in a wind farm and focus mainly on load capacity. Aspects such as manufacturing, installation, and operation and dismantling, on the other hand, are given lower priority.

As part of the Collaborative Research Center (funded by the Deutsche Forschungsgemeinschaft DFG), the researchers are therefore developing the digital twin, a method that integrates all these details. The digital twin is a coupled overall model of an individual wind turbine, which is adapted to the current state of the real structure (the real twin) with the help of measurement data. This results in a digital model that describes individual real turbines and plants over their entire life and is continuously adapted to the current state.

RESEARCH PARTNERS AND COOPERATIONS OF CRC 1463

Coordinator:
Leibniz Universität Hannover

Carl von Ossietzky Universität Oldenburg
Technische Universität Dresden
Technische Universität Darmstadt

Deutsches Zentrum für Luft- und Raumfahrt

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ForWind Zentrum für Windenergieforschung
Bremen Hannover Oldenburg

FORWIND RESEARCH IS FUNDED BY:
Bundesministerium für Wirtschaft und Klimaschutz
Niedersächsisches Ministerium für Wissenschaft und Kultur
DFG Deutsche Forschungsgemeinschaft

SmartBlades 2

ForWind-Beteiligte: Hannover, Oldenburg
Laufzeit: 2016 - 2019
Förderer: BMWK
Partner: DLR, Fraunhofer IWES

The project is concerned with the further development of intelligent rotor blade technologies with the aim of reducing mechanical loads on a wind turbine. The project builds on the research results of the "SmartBlades" research project (2012-2016).

DFWind 1

ForWind-Beteiligte: Hannover, Oldenburg, Bremen
Laufzeit: 2016 - 2023
Förderer: BMWK
Partner: DLR, Fraunhofer IWES

DFWind Phase 1 serves to prepare the research-related upgrading of the basic infrastructure for the WiValdi research wind farm. This infrastructure was funded by the Lower Saxony Ministry of Science and Culture.

DFWind 2

ForWind-Beteiligte: Hannover, Oldenburg, Bremen
Laufzeit: 2020 - 2024
Förderer: BMWK
Partner: DLR, Fraunhofer IWES, WRD Wobben GmbH

In phase 2 of the project, the wind turbines will be built, erected and instrumented in parallel. All systems are networked with each other via the central data acquisition system and initial validation tests are carried out.

ConUp

ForWind-Beteiligte: Oldenburg, Bremen
Laufzeit: 2019 - 2023
Förderer: BMWK
Partner: Windrad Engineering GmbH, Deutsche WindGuard GmbH, EnergieKontor GmbH

Research into a methodology for the safe application of hardware or software modifications to wind turbines to increase yield and extend service life. An additive system for monitoring critical operating parameters is being developed in the joint project.

PreciWind

ForWind-Beteiligte: Hannover, Bremen
Laufzeit: 2020 - 2023
Förderer: BMWK
Partner: Deutsche WindGuard GmbH, InfraTec GmbH, LASE GmbH

As part of the PreciWind project, a mobile thermographic measurement system is being developed to continuously record and analyse the dynamic flow behaviour of rotor blades on wind turbines during operation

RAVE-OWP Control

ForWind-Beteiligte: Oldenburg
Laufzeit: 2017 - 2020
Förderer: BMWK
Partner: Universität Stuttgart, Global Tech GmbH

Combining current industrial development and academic research for the design and more economical operation of future large offshore wind farms through numerical testing of the modular wind farm controller for a large wind farm

HyRoS

ForWind-Beteiligte: Bremen
Laufzeit: 2015 - 2019
Förderer: BMWK
Partner: Leibniz-Institut für Verbundstoffe, SAERTEX GmbH & Co KG, Hermes Systeme GmbH, K.L. Kaschier- und Laminier GmbH, WRD Wobben GmbH

As part of the project, a multifunctional protection of rotor blades is to be developed on the basis of a hybrid material solution. This is to be achieved by protecting the leading edge from erosion using a novel combination of materials.

HiPE WiND

ForWind-Beteiligte: Bremen
Laufzeit: 2017 - 2022
Förderer: BMWK
Partner: Fraunhofer IWES

The aim of the project is to investigate the high-performance electronics for wind turbines under real multimodal environmental and load conditions, to research their causes of failure and to develop concepts for optimising their robustness.

WindIO

ForWind-Beteiligte: Bremen
Laufzeit: 2020 - 2023
Förderer: BMWK
Partner: Pumacy AG, Fibretech GmbH, CONTACT GmbH, Deutsche WindGuard GmbH, SWMS Consulting GmbH

The overarching goal of the WindIO joint project is to build a cyber-physical system based on a digital twin of the research wind turbines in operation and to create standardised interfaces for integrated configuration management

WEA-Akzeptanz

ForWind-Beteiligte: Hannover
Laufzeit: 2017 - 2020
Förderer: BMWK
Partner: Senvion GmbH

Under the motto "From the sound source to psychoacoustic evaluation", the project has set itself the goal of objectifying the noise effect on a resident of a wind turbine by developing an overall acoustic model and thus making it predictable.

TransWind

ForWind-Beteiligte: Hannover
Laufzeit: 2020 - 2023
Förderer: BMWK
Partner: Nefino GmbH, Deutsche WindGuard GmbH, WIV GmbH, Spitzner Engineers GmbH, IPH gGmbH

The TransWind research project pursues the overarching goal of analysing the end-of-life issue of wind turbines in Germany from various perspectives at micro and macro level using a transdisciplinary approach for optimising the end-of-life strategy.

Zukunftskonzept Windenergieforschung

ForWind-Beteiligte: Hannover, Oldenburg, Bremen
Laufzeit: 2021 - 2025
Förderer: MWK Niedersachsen

As part of the zukunft.niedersachsen funding programme of the MWK Lower Saxony and the Volkswagenstiftung, the funding is intended to support the generational change in professors at the two ForWind universities in Lower Saxony (Oldenburg and Hannover) in order to continue the successful wind energy research as an important part of the universities and to integrate new content in the course of future research within ForWind. The funds are to be used for personnel costs as well as material and investment costs.

20 Jahre ForWind - 2003 - 2023

Ho-Pile

ForWind-Beteiligte: Hannover
Laufzeit: 2018 - 2022
Förderer: BMWK
Partner: Fraunhofer IWES

The most commonly used support structure for offshore wind turbines is the monopile. In this project, the test data and derived models evaluated in the previous TANDEM project for static monopile load-bearing behaviour are to be further developed

Add2ReliaBlade

ForWind-Beteiligte: Hannover
Laufzeit: 2021 - 2024
Förderer: BMWK
Partner: Fraunhofer IWES, TPI Composites GmbH, TECOSIM GmbH, Wölfel Engineering GmbH

Rotor blades are designed with optimum material and safety parameters. The aim is to predict the structural reliability of rotor blades and thus increase their cost-effectiveness through better material utilisation and more sensible maintenance concepts.

WinConFat

ForWind-Beteiligte: Hannover
Laufzeit: 2022 - 2025
Förderer: BMWK
Partner: TU Dresden, BAM, RWTH Aachen

Continuous condition monitoring of the supporting structure is of great importance for the safe operation of wind turbines. A modular concept for monitoring systems for lifetime-accompanying condition monitoring is to be developed.

Ventus Efficiens

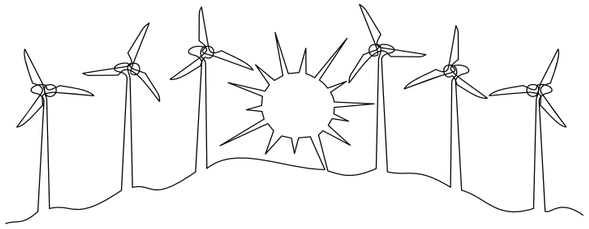
ForWind-Beteiligte: Hannover, Oldenburg
Laufzeit: 2015 - 2020
Förderer: MWK Niedersachsen
Partner:

The object of the research project is to increase the efficiency of (offshore) wind turbines in the energy system. Although they are manufactured, installed and operated to a high standard today, a continuous increase in efficiency is essential.

WindGiski

ForWind-Beteiligte: Hannover
Laufzeit: 2021 - 2024
Förderer: BMUV
Partner: Nefino GmbH, ARSU GmbH, HS Bremerhaven, IPH gGmbH, LEE Niedersachsen / Bremen

The main objectives of the project are the development and evaluation of an AI-based GIS for the identification of potential areas for wind turbines, in order to improve the number and quality of future designated potential areas.



marTech

ForWind-Beteiligte: Hannover
Laufzeit: 2017- 2023
Förderer: BMWK
Partner: TU Braunschweig

The aim of marTech is to advance aspects of technology development for support structures for offshore wind turbines through accompanying scientific research in a significantly expanded, large-scale test facility in the Large Wave Flume in Hanover.

WERAN plus

ForWind-Beteiligte: Hannover
Laufzeit: 2018 - 2023
Förderer: BMWK
Partner: PTB Braunschweig, Jade Hochschule, FCS Flight Calibration Services GmbH

The results of the WERAN project make it possible to measure and dynamically simulate the signal changes caused by wind turbines or other obstacles to terrestrial navigation and radar systems in the transmission channel.

HBDV

ForWind-Beteiligte: Hannover
Laufzeit: 2018 - 2022
Förderer: BMWK
Partner: TU Clausthal, RWTH Aachen, Fraunhofer IWES, Leibniz-Institut für Werkstofforientierte Technologien

The aim of the overall project HBDV is to gain a better understanding of the wear and fatigue behaviour of oscillating and highly loaded slewing rings.

ReCoWind

ForWind-Beteiligte: Hannover, Bremen
Laufzeit: 2018 - 2022
Förderer: BMWK
Partner: Fraunhofer IWES, ConverterTec Deutschland GmbH, Infineon Technologies AG

Frequency converters are essential components of modern wind turbines. The aim of the ReCoWind project is to conduct further research into the causes and mechanisms of the early and unforeseen failure of frequency converters in wind turbines.

ReCoWind2

ForWind-Beteiligte: Hannover, Bremen
Laufzeit: 2023 - 2026
Förderer: BMWK
Partner: Fraunhofer IWES, Ingenieurbüro Hoffmann GmbH, RWE Renewables GmbH

The ReCoWind2 project extends the root cause analysis from low-voltage to medium-voltage converters and deepens it with regard to other potentially failure-relevant influencing factors.

HAPT 2

ForWind-Beteiligte: Hannover
Laufzeit: 2021 - 2025
Förderer: BMWK
Partner: Fraunhofer IWES

The aim of the HAPT2 project is to determine the requirements for roller bearings for their use as rotor blade bearings in wind turbines. The project will close fundamental knowledge gaps for the use of three-row roller bearings as rotor blade bearings.

20 Jahre ForWind - 2003 - 2023

SmartWeld

ForWind-Beteiligte: Hannover
Laufzeit: 2021 - 2025
Förderer: BMWK
Partner: Fraunhofer IWES, Bundesanstalt für Materialforschung und –prüfung, Salzgitter Mannesmann Forschung GmbH, Jörss – Blunck – Ordemann GmbH

As part of the SmartWeld project, the potential of constructive lightweight construction methods is being utilised through the continuous availability of all relevant data along the production chain for the resource-efficient production of large-scale steel structures.

NewSkin

ForWind-Beteiligte: Hannover
Laufzeit: 2020 - 2024
Förderer: EU - Horizon 2020
Partner: 36 partners in total. See website for details

The NewSkin project aims to create an Open Innovation Test Bed (OITB), which will provide a news set of innovative processes to manufacture nano-enabled industrial and consumer products as well as the necessary testing capabilities

AVIMo

ForWind-Beteiligte: Hannover
Laufzeit: 2019 - 2022
Förderer: BMWK
Partner: Fraunhofer IWES, Wölfel Engineering GmbH + Co. KG

The overall project determines the correlation between ship movements and delays in offshore wind projects. Ship movements have a strong influence on the feasibility of offshore work.

Coastal Futures

ForWind-Beteiligte: Hannover
Laufzeit: 2021 - 2024
Förderer: BMBF and federal states
Partner: 9 project partners and 5 associated partners in total. See website for details

The transdisciplinary project Coastal Futures is developing innovative modeling tools to examine future use scenarios and climate change impacts, to develop and evaluate future scenarios and conservation measures in coastal areas.

Func2Ad

ForWind-Beteiligte: Hannover
Laufzeit: 2023 - 2025
Förderer: BMWK
Partner: DLR, INVENT GmbH, Capgemini Engineering Deutschland S.A.S. & Co. KG, Zeisberg Carbon GmbH

The overall aim of the project is to develop a holistic, innovative bonding technology for wind turbine rotor blades. A particle-modified adhesive is to be developed that enables inherent structural monitoring as the main innovation

HyTowering

ForWind-Beteiligte: Hannover
Laufzeit: 2018 - 2021
Förderer: BMWK
Partner: MKP GmbH

The HyTowering project involves large-scale tests on modular hybrid wind turbine towers made of cement (in the lower section) and steel in the upper section, which can be used to derive design models and test monitoring concepts.

WindRamp

ForWind-Beteiligte: Oldenburg
Laufzeit: 2020 - 2023
Förderer: BMWK
Partner: DLR - Institut für Vernetzte Energiesysteme, METEK GmbH, Energy & Meteo Systems GmbH, Abacus Laser GmbH

The objectives of the WindRamp project are to improve grid operation management and optimise electricity trading processes by researching and testing an observer-based shortest-term forecast of wind farm output based on lidar wind measurements.

X-Wakes

ForWind-Beteiligte: Oldenburg
Laufzeit: 2019 - 2023
Förderer: BMWK
Partner: Fraunhofer IWES, Universität Tübingen, UL International GmbH, Helmholtz-Zentrum hereon, KIT, TU Braunschweig

The main objective of the X-Wakes project is to record the changes in wind conditions for the operation of offshore wind farm clusters during the large-scale expansion of offshore wind energy utilisation.

C^2-WAKES

ForWind-Beteiligte: Oldenburg
Laufzeit: 2023 - 2026
Förderer: BMWK
Partner: Fraunhofer IWES, Helmholtz-Zentrum hereon, RWE Offshore Wind GmbH

The overall objective of the C^2-Wakes project is to investigate whether and how large-scale wake effects can be reduced and the yield of wind farm clusters can be increased in the planned expansion of offshore wind energy.

Windpark-RADAR

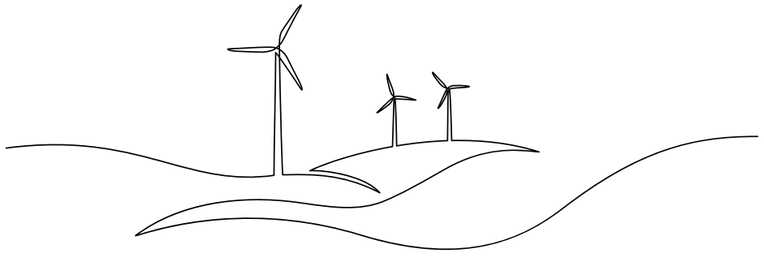
ForWind-Beteiligte: Oldenburg
Laufzeit: 2020 - 2025
Förderer: BMWK
Partner: Fraunhofer IWES

The overall aim of the project is to characterise a dual-Doppler wind radar and to qualify it for applications in wind energy use and research. Four possible applications are being analysed and the suitability of the use of dual-Doppler radar assessed.

FLOAWER

ForWind-Beteiligte: Oldenburg
Laufzeit: 2019 - 2024
Förderer: EU
Partner: Ecole Centrale de Nantes, Politecnico die Milano, Universität Stuttgart, NTNU, DTU, Universität Rostock

The EU-funded FLOAWER project will train 13 early stage researchers (ESRs) to design better performing, economically viable floating wind turbines while addressing offshore wind energy industry needs.



20 Jahre ForWind - 2003 - 2023

WiSAbigdata

ForWind-Beteiligte: Oldenburg
Laufzeit: 2019 - 2023
Förderer: BMWK
Partner: Fraunhofer IWES, Universität Duisburg-Essen, Deutsche Windtechnik X-Service GmbH, Ocean Breeze Energy GmbH & Co KG, Ramboll GmbH, OFFIS e.V.

The aim of the 'WiSA big data' project is to contribute to the early detection and diagnosis of faults in wind turbines by analyzing operating data with high temporal resolution and thus to support decisions in maintenance planning and implementation.

MOUSE

ForWind-Beteiligte: Oldenburg
Laufzeit: 2022 - 2026
Förderer: BMWK
Partner: Fraunhofer IWES

Project MOUSE will improve planning and operating simulations for wind turbines. Different physical phenomena across several orders of magnitude and time scales are studied using machine learning methods.

EMUwind

ForWind-Beteiligte: Oldenburg
Laufzeit: 2021 - 2025
Förderer: BMWK
Partner: Fraunhofer IWES, Universität Stuttgart

In the project wind field measurements are carried out with remote sensing methods in order to create the basis for the validation of load calculations and to investigate measurement strategies for the detection of special wind field properties.

DIMOR

ForWind-Beteiligte: Oldenburg
Laufzeit: 2022 - 2025
Förderer: BMWK
Partner:

The project aims to improve aerodynamic models for the design of large rotors of wind turbines in order to further reduce the energy production costs. Improved accuracy of these models will reduce the development risks of very large wind turbines.

SmartYaw

ForWind-Beteiligte: Oldenburg
Laufzeit: 2022 - 2025
Förderer: BMWK
Partner: eno energy systems GmbH

The "SmartYaw" project aims at further research and industrial testing of wind farm control concepts to increase yields in densely arranged wind farms in order to use the limited onshore space more economically, efficiently and in a more nature-friendly way.

FORWIND RESEARCH IS FUNDED BY:
Bundesministerium für Wirtschaft und Klimaschutz
Niedersächsisches Ministerium für Wissenschaft und Kultur
DFG Deutsche Forschungsgemeinschaft

Research infrastructure

RESEARCH WIND FARM WIVALDI

The Wind Energy Research Park (WiValdi) enables full-scale research to develop technologies to increase the acceptance, efficiency and cost-effectiveness of wind turbines. Various institutes and facilities of DLR and the partners from the Wind Energy Research Alliance the Fraunhofer Institute for Wind Energy Systems – Fraunhofer IWES and ForWind – Center for Wind Energy Research operate the research park, which can be used by the broad research community.

At the heart of the test field, the only one of its kind in the world, are two commercial multi-megawatt class wind turbines. One of the turbines stands in the wake of the other. One of the most important research questions: How will turbulence from the front turbine affect the rear wind turbine? To find out, a so-called measuring mast array developed by ForWind is located between them.

The arrangement of sensors specially developed for WiValdi at the University of Oldenburg makes it possible for the first time to measure the turbulent wind conditions between turbines with high temporal and spatial resolution. The towers and rotor blades of the turbines are also equipped with measuring systems planned and developed by ForWind members at the universities of Bremen and Hanover.

20 Jahre ForWind - 2003 - 2023

LARGE WAVE CURRENT FLUME GWK+

The new GWK+ (Large Wave Current Flume) has been inaugurated at the Coastal Research Centre of Leibniz Universität Hannover and the Technical University Carolo Wilhelmina zu Braunschweig. The expansion was made possible as part of the marTech project, funded by the BMWK.

The researchers at ForWind now have at their disposal an experimental facility that is unique in the world, in which the simultaneous stress of swell and current on offshore wind turbines can be realistically investigated.

GWK+ at a glance

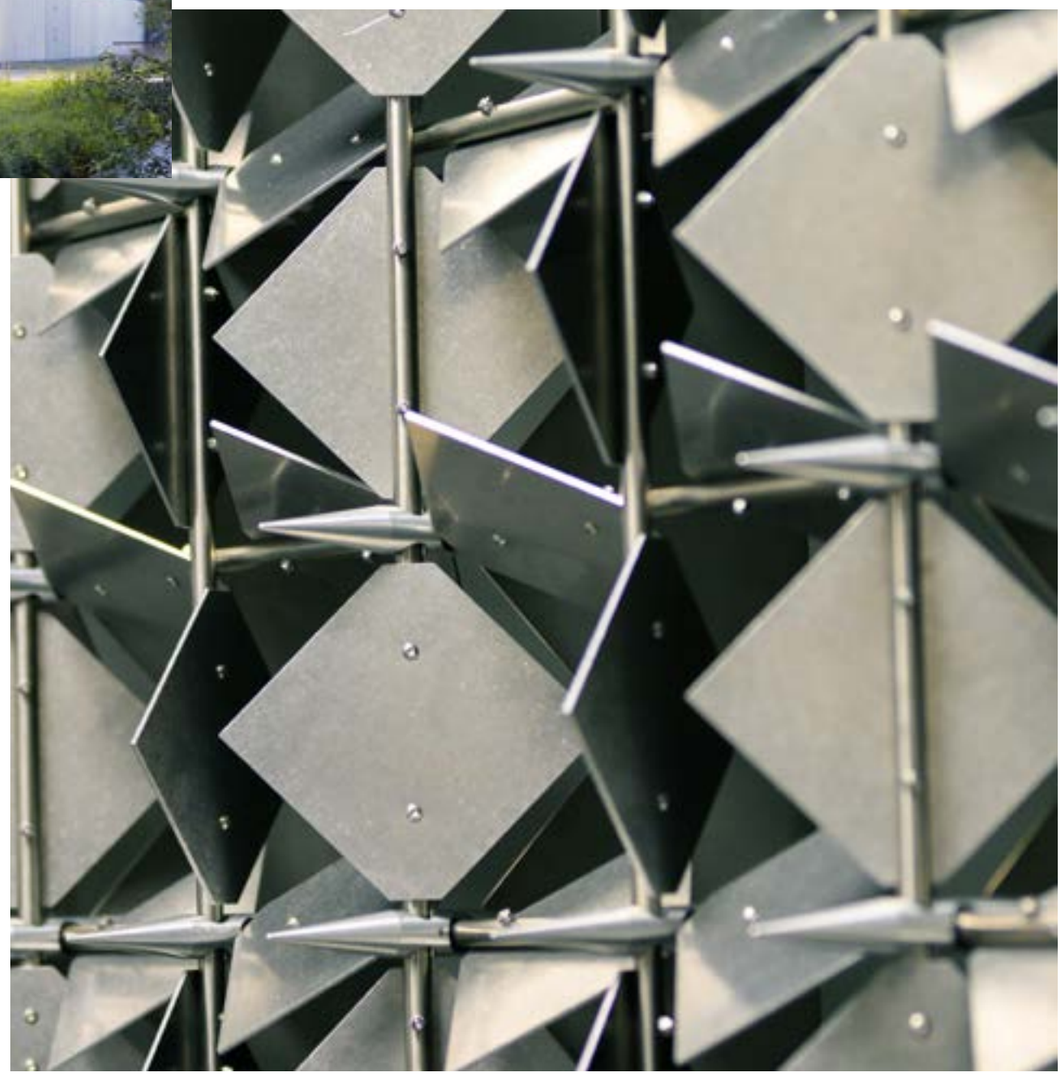
300m
LENGTH

3m
WAVE HEIGHT

20 m^3/s
MAXIMUM FLOW

6m
BEDDING DEPTHS

2023
CONSTRUCTION COMPLETE



WINDLAB AND TURBULENT WIND TUNNEL WITH ACTIVE GRID

In 2017, the ForWind WindLab was inaugurated on the Campus of Carl von Ossietzky Universität Oldenburg. The heart of the new building with 2,300 square metres of usable space is a turbulent wind wind tunnel, with the help of which the interplay of atmospheric currents with wind farms, wind turbines and their components. wind turbines and their components. In this way, exact data on the operating behaviour of wind turbines and large offshore wind farms.

20 Jahre ForWind - 2003 - 2023

With the help of the turbulent wind tunnel, the ForWind scientists can downscale characteristics of complex atmospheric wind fields and thus reproduce characteristic properties of a real wind field in the wind tunnel. The goal is to investigate turbulent flows and their effects on the components and performance of wind turbines.

The active grid can be used to generate a variety of different turbulent wind fields in the Oldenburg wind tunnel. On 80 individually controllable shafts a total of almost 1,000 diamond-shaped aluminium blades are mounted. In this way areas of the wind tunnel nozzle can be blocked and thus turbulence of different degrees is generated. The combination of an active grid with a wind tunnel of this size makes the ForWind channel unique.

COOPERATION

Six universities and research institutes are using the wind tunnel to conduct research with industry partners to increase the efficiency of wind farms and avoid technical risks.

INTERDISCIPLINARITY

The turbulent wind tunnel in Oldenburg's WindLab is operated by physicists, meteorologists, oceanographers and engineering scientists.

PERFORMANCE

The four turbines of the wind tunnel can create maximum windspeeds of up to 150 km/h. The active grid is used to create turbulent wind fields.

TEST CENTER FOR SUPPORT STRUCTURES (TTH)

Large-scale experimental studies are necessary to investigate the fatigue and load-bearing behavior of wind turbine foundations and support structures. Simulation results are validated based on the results. The test center is involved in numerous research projects and carries out extensive test campaigns on large structural components of onshore and offshore wind turbines.

Thanks to the extensive equipment at the TTH, it is possible to carry out a wide range of different test set-ups.

Support structures and foundation elements for wind turbines can be investigated experimentally on the 3D strong floor (9 x 18 m) and in the unique foundation testing pit (14 x 9 x 10 m) in order to validate calculation models, optimise structures and improve structural safety.

The aim is to increase the efficiency and service life of support structures.

20 Jahre ForWind - 2003 - 2023

ForWind Zentrum für Windenergieforschung
Breme Hannove Oldenbur

GECOLAB GENERATOR INVERTER TEST BENCH

The GeCoLab can be used to research both conventional and innovative converter and generator concepts, including converter-related control and methods for filter design in the MW range.

The implemented universal test bench is part of the TTH infrastructure and enables the investigation of steady-state and dynamic properties of electrical machines and converters, including converter-machine interactions. This includes studies of dynamics and system stability, steady-state and transient thermal loading, various methods of grid injection and control, and behavior in the event of grid faults such as voltage dips, phase shorts, or ground faults.

The universal test stand was built primarily, but not exclusively, for wind energy research. It enables the investigation of steady-state and dynamic properties of electrical machines and converters, including converter-machine interactions.

HIPE-LAB
HIGH POWER ELECTRONICS LABORATORY AT THE IALB

The laboratory for high power electronics HiPE-LAB at the IALB of the University of Bremen offers the unique opportunity to expose entire frequency converters with outputs of up to 10 MVA to electrical and climatic loads in almost any combination and to carry out tests to predict important lifetime issues. In the field of wind energy, the IALB works closely with the Fraunhofer IWES.

With a temperature range of -40 °C to +120 °C and relative humidity between 10 % and 95 % in the temperature range of +10 °C to +95 °C, the climatic conditions of all climate zones can be largely simulated in the HiPE-LAB. Dynamic, reproducible electrical load profiles enable accelerated aging under the appropriate climatic conditions.

Study opportunities

STUDY WIND ENERGY WITH FORWIND

Wind energy systems and turbulence as majors in Oldenburg: At the University of Oldenburg, majors can be set in the field of wind energy in the subject of physics. Content on wind energy is also taught in the subjects of computer science and economics. Postgraduate studies with a focus on renewable energies are also possible in Oldenburg.

Studying wind energy in Hannover: The interdisciplinary master's program "Wind Energy Engineering" is offered at Leibniz Universität Hannover. The Leibniz University als has a specialization on wind energy within its master studies of civil engineering and of power engineering..

Focus on wind energy at the University of Bremen: The University of Bremen offers courses on wind energy as part of the Systems Engineering degree program.

WINDSTUDIUM

ForWind supports and is involved in the two extra-occupational study programmes Wind Energy Technology and Management as well as Hydrogen for Professionals and Managers. The wind energy programme started in 2006 and today boasts a lively alumni network from Germany's wind energy industry.

EUROPEAN WIND ENERGY MASTER (EWEM)

ForWind is a co-initiator of this transnational double degree Master's course funded by the European Commission as an Erasmus Mundus Master's course. EWEM is supported by a international consortium of universities bringing together world leaders in research and teaching in the field of wind energy science.

Science Communication

Making influential research visible

Public experts

ForWind researchers are sought after experts by media, public institutions and governing bodies

Science communication

Working closely with the three universities, ForWind communicates research results to media and the professional press

Public science

ForWind engages with the public. Either in special formats or by inviting guests to our research infrastructure

Social media

ForWind is active communicating online. The dedicated community on selected social media platforms is steadily growing

20 Jahre ForWind - 2003 - 2023

Research Conferences

Connecting scientists for networked research

Wind Energy Science Conference 2021

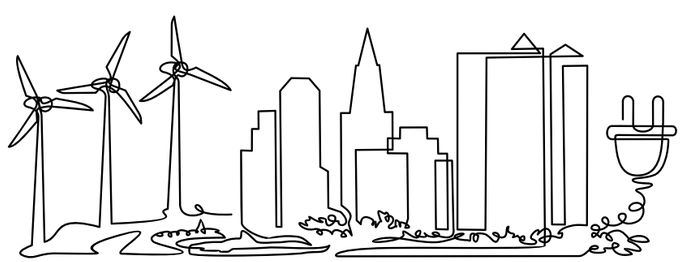
Despite the limitations posed by the COVID pandemic ForWind Hannover successfully organized WESC 2021 as an online event

Wind Physics Symposium

A yearly event at the WindLab in Oldenburg brings together national and international researchers from wind physics

Talks and lectures

ForWind researchers are invited to conferences, panel discussions and policy events to present their findings on wind energy science



20 Jahre ForWind - 2003 - 2023

New ForWind members since 2018

Prof. Dr. Jürgen Peissig

Prof. Dr Jürgen Peissig from Leibniz Universität Hannover joined ForWind in 2019. Peissig heads the "Communication Systems" department at the Institute of Communication Technology. His research focusses on areas of signal processing for audio and acoustics, specialising in signal processing for acoustic sensors and actuator arrays, audio signal processing for 3D virtual and augmented reality, and psychoacoustic modelling and perceptual evaluation of audio signals. With his research on signal processing in machine-to-machine communication with robust waveforms (FBMC) and reliable low-delay communication for telemetry, audio and video, Prof Jürgen Karl Peissig complements the broad spectrum of engineering and physical research in the field of wind energy within ForWind.

Prof. Dr.-Ing. Astrid Nieße

Energy informatics expert Prof. Dr Astrid Nieße joined ForWind in 2019 and holds the professorship for Digitalised Energy Systems in the Department of Computer Science at Carl von Ossietzky Universität Oldenburg. She previously taught and researched as Professor of Energy Informatics at the University of Hanover. Nieße also acts as head of the energy department at the university's affiliated institute OFFIS - Institute for Information Technology. Her research focuses on the digitalisation of energy systems using self-organising processes and software agents. At OFFIS, Nieße supervises application-related research projects in the field of the energy transition.

Prof. Dr.-Ing. Michael Haist

In 2020 Prof. Dr. Michael Haist from Leibniz Universität Hannover was accepted as a new member of ForWind. Haist succeeded Prof Dr Ludger Lohaus at the Institute for Building Materials in 2019. Haist's work focuses on digital construction and building material monitoring, novel multifunctional building materials and the mechanical load-bearing behaviour of concrete, in particular fatigue and creep. He also conducts research into the characterisation and modelling of cement paste from the nano to the macro level and new sustainable building materials.

Prof. Dr.-Ing. Johanna Myrzik

Joining ForWind in 2021 was Prof Dr Johanna Myrzik from the University of Bremen. Myrzik took over the Chair of Automation Technology (in Energy Supply) and the management of the Institute of Automation Technology at the University of Bremen, Faculty 1 Physics/Electrical Engineering in 2018 as a university professor. The institute develops new, intelligent technologies, methods, algorithms and services that enable intelligent, adaptive and reliable interaction between generation, storage, grid management and consumption across all voltage levels. Interdisciplinary and transdisciplinary research in energy grids is the hallmark of the Chair of Automation Technology, which specialises in the automation of future energy grids.

Prof. Dr. Elyas Ghafoori

Ghafoori took over the management of the Institute of Steel Construction at Leibniz Universität Hannover from Prof Dr Peter Schaumann and holds the professorship for steel, composite and lightweight construction. He joined ForWind in early 2023. His research focuses on steel structures for wind energy (e.g. offshore wind turbines) and robotic design/manufacturing. For Elyas Ghafoori, the main focus is on finding approaches for sustainability in steel construction in order to contribute to the goals of EU-wide climate neutrality by 2050. In view of the growing global demand for steel, such approaches are becoming increasingly important. This includes extending the life cycle of structures such as wind turbines through repairs and new materials.

Prof. Dr. Kerstin Avila

Kerstin Avila's research and teaching focuses on the "Fundamentals of Turbulence and Complex Systems". This research will be used to help shape the fluid dynamic developments of future wind turbines. She joined ForWind in 2023. Kerstin Avila has been working on turbulence and complex flow behaviour since her studies. In 2013, she completed her doctorate at the University of Göttingen and the Max Planck Institute for Dynamics and Self-Organisation. After spending time as a visiting scientist at the Institute of Science and Technology in Vienna and as a postdoc at the Friedrich-Alexander University Erlangen-Nuremberg, she has spent the last few years conducting research at the University of Bremen. In addition to her work on the propagation of turbulence, her research focuses on analysing non-linear resonances.

Prof. Dr. Björn Maronga

Björn Maronga was accepted as a new member of ForWind in 2023. Maronga is Professor of Boundary Layer Meteorology at the Institute of Meteorology and Climatology at Leibniz Universität Hannover. Research at the institute is carried out by two working groups and deals with current issues in the fields of radiation, environmental and polar meteorology.
In the field of boundary layer meteorology, research focuses on the investigation of turbulent atmospheric and oceanic boundary layer flows using large-eddy simulation. The parallelised LES model PALM was developed at the institute and is now one of the most powerful of its kind and is used by a number of international research groups, including ForWind.

Prof. Dr.-Ing. Vincent Oettel

In 2023 Prof Dr Vincent Oettel was accepted as a new member of ForWind. Oettel has been Professor of Concrete Structures at Leibniz Universität Hannover since 2021. He is Managing Director of the Institute of Concrete and Masonry Structures (IfMa) and a member of the Board of Directors of the Test Centre for Load-bearing Structures Hanover (TTH).
Vincent Oettel's research focuses on sustainable, modular and automated construction. This comes into play in the construction of the latest generation of wind turbines when it comes to aspects of longevity and resource-saving construction with a low CO2 footprint. However, new materials and improved calculation methods can also be used to prevent demolition and enable upgrades for existing wind turbines.

Prof. Dr.-Ing. Andreas Rauh

Prof. Dr.-Ing Andreas Rauh was accepted as a new member of ForWind in 2024. Rauh has been appointed to the professorship "Computer Engineering – Distributed Control in Networked Systems" at the Department of Computer Science at the Carl von Ossietzky University of Oldenburg in 2021. Prior to this, he spent a one-year research stay in Brest at the École nationale supérieure de techniques avancées (ENSTA). His research focuses on state and parameter estimation for dynamic systems with stochastic and quantity-based uncertainties, their reliable simulation and their robust and optimal control. With Andreas Rauh, the Oldenburg Department of Computer Science is now involved in ForWind with three departments and complements the broad spectrum of engineering and physical research in the field of wind energy.

ForWind Dissertationen 2018 - 2023

FORWIND OLDENBURG

Carl von Ossietzky Universität Oldenburg, Department für Informatik, Abteilung Systemanalyse und -optimierung, Prof. Dr.-Ing. Axel Hahn

2018, B. Weinert. Ein Framework zur Architekturbeschreibung von sozio-technischen maritimen Systemen
2023, J. Möller. Datenmanagement für dezentrale maritime Forschungs- und Entwicklungsdaten im Testfeldkontext

Carl von Ossietzky Universität Oldenburg, Department für Informatik, Abteilung Digitalisierte Energiesysteme, Prof. Dr.-Ing. Astrid Nieße

2023, S. I. Holly. Dynamic Communication Topologies for Distributed Energy System Optimization Heuristics

Carl von Ossietzky Universität Oldenburg, Institut für Physik, Windenergiesysteme, Prof. Dr. Martin Kühn

2019, L. Valldecabres. Very short-term forecasting of offshore wind power based on long-range remote sensing observations
2019, M. Vali. Model predictive control framework for power maximisation and active power control with load equalisation of wind farms
2019, M. Bromm. Deflection of wind turbine wakes by yaw misalignment – Simulation and field testing
2019, R. Ungurán. Lidar-assisted feedback-feedforward individual pitch and trailing edge flaps control of variable-speed wind turbines
2019, D. Trabucchi. Lidar measurments and engineering modelling of wind turbine wakes
2020, H. Beck. Reconstruction of Wind Turbine Wake Wind Fields with Long-Range LiDAR Measurements
2022, F. Berger. Wind tunnel experiments with a model turbine: Dynamic inflow investigation
2022, F. Theuer. Minute-scale power forecasts of offshore wind farms based on long-range lidar measurements and turbine operational data
2023, M. F. van Dooren. Doppler lidar measurement, modelling and wind field reconstruction
2023, A. Rott. Uncertainty reduction for robust wind farm control strategies

Carl von Ossietzky Universität Oldenburg, Institut für Physik, Windenergie und Stochastik, Prof. Dr. Joachim Peinke

2018, J. Schottler. Experimental Investigation of Wind Farm Effects Using Model Wind Turbines
2018, A. Hadjihosseini. Stochastic Analysis on Extreme Ocean Gravity Waves
2018, H. Rahimi. Validation and Improvement of Numerical Methods for Wind Turbine Aerodynamics
2018, P. Rinn. Reducing complexity of dynamical systems by means of Langevin processes
2018, M. Schramm. Application of the Adjoint Approach in Computational Fluid Dynamics for the Optimization of Aerodynamic Shapes in Wind Energy
2019, I. Neunaber. Stochastic investigation of the evolution of small-scale turbulence in the wake of a wind turbine exposed to different inflow conditions
2019, B. Dose. Fluid-structure coupled computations of wind turbine rotors by means of CFD
2019, L. Vorspel. Development of a Tool for Aerodynamical Optimization of Wind Turbine Rotor Blades Using the Adjoint Approachs
2019, D. Traphan. Unsteady rotor blade aerodynamics in wind turbines
2019, K. Schmietendorf. Power Grid Dynamics and Stability in Extended Kuramoto-like Models
2019, H. Hähne. Propagation of Fluctuations and Detection of Hidden Units in Network Dynamical Systems
2020, M. Schwarz. Wind turbine load dynamics in the context of intermittent atmospheric turbulence
2021, G. Molla Ahmadi Dehaghi. Characterization of Realizable Stochastic Based Dynamic LES in High Reynolds Turbulent Flows
2021, B. Schyska. Coaction of Input Parameters and Model Sensitivities in Numerical Power System Modeling
2022, K. Yassin. Numerical Simulation of Ice Accretion on Coated Wind Turbine Blades
2022, T. Wester. Tailored inflow fields and the resulting aerodynamic phenomena unfolded using particle image velocimetry
2022, L. K. Neuhaus. Generation of turbulence by means of active grids for wind turbine investigations
2022, S. Ehrich. Analysis of the effect of intermittent wind on wind turbines by means of CFD
2023, P. Phyo Lin. Characterization of Jump-Diffusion Stochastic Dynamics: Analysis and Applications on Real World Data
2023, A. Fuchs. Stochastic and non-equilibrium thermodynamical analysis of the turbulent cascade treated as a Markov process

Bildnachweise: ForWind/Carl von Ossietzky Universität Oldenburg Seiten 1, 2, 6, 10, 11, 12, 18, 21, 22, 34, 39. DLR Seite 32. Universität Bremen Seiten 20, 38. Leibniz Universität Hannover Seiten 13, 19, 24, 36, 37

FORWIND HANNOVER

Leibniz Universität Hannover, Institut für Geotechnik, Prof. Dr.-Ing. Martin Achmus

2018, M. Naarmann. Kluftinjektionen mit hohen Dichtheitsanforderungen
2020, P. S. Gütz. Tensile-loaded suction bucket foundations for offshore structures in sand
2021, D. Wolfrum. Wechselwirkungsverhalten von thermisch beanspruchten Rohren und zeitweise fließfähigen, selbstverdichtenden Verfüllbaustoffen
2021, M. M. Terceros Almanza. A new p-y approach to pile foundations with arbitrary dimensions under monotonic load in cohesive soils
2023, J.-E. S. Saathoff. Modelling of excess pore pressure accumulation in sand around cyclically loaded foundations

Leibniz Universität Hannover, Institut für Wirtschaftsinformatik, Prof. Dr. Michael Breitner

2018, A. Koukal. Contributions to Decision Support for Wind Energy, Literature Research Processes and Towards a Better World through Information Systems
2018, D. Eilers. Contributions to Data Analytics Techniques with Applications in Forecasting, Visualization and Decision Support
2018, C. Gleue. Data Mining und Big Data Analytics: Semantische Suche, Prognose und Entscheidungsunterstützung mit Künstlichen Neuronalen Netzen
2020, J.-H. Piel. Contributions of Information Systems Research to Decision Support for Wind Market Players
2020, J. H. Paßlick. Essays on Business Analytics, Digital Transformation, and Improved Literature Searches

Leibniz Universität Hannover, Institut für Baustoffe, Prof. Dr.-Ing. Michael Haist

2018, J. Hümme. Ermüdungsverhalten von hochfesten Beton unter Wasser
2019, K. Elsmeier. Einfluss der Probekörpererwärmung auf den Ermüdungswiderstand von hochfestem Vergussbeton
2019, H. Weicken. Experimentelle Methodik zur Bestimmung des autogenen Schwindens von Hochleistungsbetonen
2020, N. Scholle. Zum Bauteiltragverhalten von stahlummantelten Hybridrohren mit ultrahochfesten Beton
2020, C. Tomann. Wasserinduzierte Ermüdungsschädigung von Beton
2021, D. Beyer. Bewertungskonzept für das Potenzial einer Bindemittelzusammensetzung hinsichtlich einer schädigenden Alkali-Kieselsäure-Reaktion im Beton
2022, T. Schack. Bildbasierte Frischbetonprüfung zur digitalen Qualitätsregelung
2022, M. Kitahara. Distribution-Free Stochastic Simulation Methodology for Model Updating Under Hybrid Uncertainties
2023, J. Salomon. Efficient resilience analysis and decision-making for complex engineering systems

Leibniz Universität Hannover, Institut für Grundlagen der Elektrotechnik und Messtechnik, Prof. Dr.-Ing. Heyno Garbe

2023, C. Siebauer. Bildgebendes Verfahren zur Identifikation verborgener Objekte im Erdreich
2023, F. Burghardt. Störfestigkeit komplexer Systeme in Freifeld-Simulatoren

Leibniz Universität Hannover, Institut für Elektrische Energiesysteme, Prof. Dr.-Ing. Lutz Hofmann

2018, T. Leveringhaus. Netzoptimierung durch Wirk-und Blindleistungsredispatch auf Basis von konvexifizierten quadratischen Näherungen der Netzgleichungen
2019, M. Popp. Ordnungsreduktion hierarchisch gekoppelter dynamischer Systeme
2020, T. Lager. Untersuchung des transienten Verhaltens von Windenergieanlagen mit doppeltgespeistem Asynchrongenerator bei dreipoligen Kurzschlüssen
2021, J. Weidner. Beitrag zur statischen und transienten Stabilitätsanalyse in Verteilungsnetzen
2021, A. Pawellek. Entwicklung und Modellierung von Konzepten für das Engpassmanagement im Netzregelverbund
2022, T. Breithaupt. Integrierte Simulation der europäischen Strom- und Regelleistungsmärkte
2022, H. H. Huisinga. Strukturanalyse von differential-algebraischen Netzgleichungssystemen aus knotenorientierten Verfahren in Elektroenergiesystemen am Beispiel des erweiterten Knotenpunktverfahrens
2022, D. Mende. Modellierung von Maßnahmen der Leistungsflusssteuerung in einer nichtlinearen mathematischen Optimierung zur Anwendung im operativen Engpassmanagement elektrischer Energieversorgungssysteme
2023, A. Neufeld. Zur Einordnung, Analyse und Verbesserung der harmonischen Stabilität in elektrischen Energiesystemen
2023, M. Sarstedt. Technoökonomische Neugestaltung vertikaler Netzbetreiberinteraktionen auf Grundlage einer partikelschwarmbasierten Aggregation dezentraler Wirk- und Blindleistungsflexibilitäten der Verteilnetzebene
2023, N. Schäkel. Kurzschlussstromberechnung in Netzen mit Vollumrichteranlagen

Leibniz Universität Hannover, Institut für Kommunikationstechnik, Prof. Dr. Jürgen Peissig

2019, C. Le. Improving Spectral Efficiency Using Hybrid System Solution
2023, J. Bergner. Towards soundscape fingerprinting: development, analysis and assessment of underlying acoustic dimensions to describe acoustic environments

20 Jahre ForWind - 2003 - 2023

Leibniz Universität Hannover, Institut für Antriebssysteme und Leistungselektronik, Prof. Dr.-Ing. Axel Mertens und Prof. Dr.-Ing. Bernd Ponick

2018, O. Misir. Betriebsverhalten von Synchronmaschinen mit unsymmetrischer Ständerwicklung
2018, M. Dörrbaum. Gestaltung und Analyse elektromagnetischer Kippaktoren
2018, J.-N. Weber. Berührungslose Übertrager für elektrisch erregte Synchronmaschinen
2018, A. Merkert. Untersuchungen zum Einsatz von Siliziumcarbid-Leistungshalbleitern in Traktionsantriebsumrichtern
2018, T. Werner. Geberlose Rotorlagebestimmung in elektrischen Maschinen: Spannungsbasierte Verfahren für permanentmagneterregte Synchronmotoren
2018, B. Weber. Positionsgeberlose Regelung von permanentmagneterregten Synchronmaschinen bei kleinen Drehzahlen mit überabtastender Stromerfassung
2018, M. Zhang. Doppelgeneratorsystem für Laufwasserkraftwerke: Untersuchung des dynamischen Verhaltens, der Regelung, des Energieertrags und der Wirtschaftlichkeit
2018, S. Weber. Beitrag zur Zustandsüberwachung von IGBT-Modulen mit temperatursensitiven Parametern
2018, J. Emmrich. Dimensionierung motorintegrierter elektromagnetischer Aktoren zur Dämpfung von Rotorschwingungen
2018, E.-M. Bresemann. Das Stirnraumfeld und sein Einfluss auf Schlingströme bei Schenkelpolsynchronmaschinen
2019, J. Kucka. Quasi-two-level PWM Operation of Modular Multilevel Converters: Implementation, Analysis and Application to Medium-Voltage Drives
2019, T. Jonsky. Modellierung und Regelung von fünfphasigen Synchronmaschinen unter Berücksichtigung von Sättigungseffekten und Mehrfachanisotropien
2019, M. John. Frequency-Domain Modeling of Harmonic Interactions in Pulse-Width Modulated Voltage-Source Inverter Drives
2019, M. Hackbart. Berechnung des Einflusses von Dämpferwicklung und massivem Läuferballen auf den Stoßkurzschluss von Turbogeneratoren
2020, F. Oelkers. Fehlererkennung in Antriebssystemen mit permanentmagneterregten Synchronmaschinen
2020, M. Moriße. Über System- und Regelungsdynamiken von Windenergieanlagen und deren Einfluss auf die Umrichterlebensdauer
2020, F. Boseniuk. Parametrisierung von thermischen Modellen für permanentmagneterregte Synchronmaschinen mittels experimenteller Identifikations-Methoden
2020, J. Jürgens. Elektrisch erregte Synchronmaschinen für unterschiedliche Antriebskonzepte in Elektrofahrzeugen
2020, H. Schroeder. Wicklungskopflose Turbogeneratoren mit Mehrphasentransformatoren
2020, A. Rehfeldt. Verbesserte Berechnung von Magnetfeldern und Ummagnetisierungsverlusten in elektrischen Maschinen
2021, S. Zulk. Optimierung eines einphasigen PFC-Gleichrichters mit Wide-Bandgap-Leistungshalbleitern auf Basis domänenübergreifender Modelle
2021, J.-K. Müller. Untersuchungen zu Ausgangsfiltern in Siliziumcarbid-Antriebswechselrichtern
2021, S.-A. Vip. Zeiteffiziente Berechnung der Magnetgeräusche drehzahlvariabler elektrischer Maschinen
2021, J.-O. Stockbrügger. Analytische Bestimmung parasitärer Kapazitäten in elektrischen Maschinen
2021, A. Rosen. Modellierung und Regelung fehlertoleranter Antriebe mit permanentmagneterregten Synchronmaschinen für Elektrofahrzeuge
2021, C. Wohlers. Permanenterregte Synchronmaschinen hoher Drehmomentdichte
2021, S. Urbanek. Gestaltung von Rotoren permanentmagneterregter Synchronmaschinen für die Metalladditive Fertigung
2021, T. Buchali. Electric Five-Phase Actuators in Steering Systems for Autonomous Driving
2021, J. Andresen. Aktive Geräuschunterdrückung in einer permanentmagneterregten Synchronmaschine mit Hilfe von Stromoberschwingungen
2021, F. Quattrone. Elektromagnetische Gestaltung permanentmagneterregter Synchronmaschinen für den geberlos geregelten Betrieb im gesamten Drehzahlbereich
2022, E. Haschen. Transiente Simulation elektrisch erregter Synchronmaschinen mit Parameterfindung durch magnetische Ersatznetzwerke
2022, S. Lücke. Regelung von Induktionsmaschinen im gesamten Drezahlbereich ohne Gebersystem
2022, S. Udema. Elektrisch erregte Synchronmaschine mit kontaktlosem induktivem Übertragungssystem ohne zusätzlichen Wechselrichter
2022, T. Fricke. Compression System Losses in Large Salient Pole Synchronous Machines
2023, M. Gerlach. Einfluss von Wicklung und Isolierung auf das Schwingungsverhalten elektrischer Maschinen
2023, C. Sommer. Analysis and Comparison of Single- and Three-Phase Single Active Bridge Converters for Multi-kW Applications
2023, M. Dokus. Analysis of the Interoperability of Power-Electronic-Based Grid Converters
2023, D. Herwig. Applying Temperature-Sensitive Electrical Parameters to SiC Power Modules Considering Parasitic Effects
2023, K. Rashidreza. Design and Control of a Multiphase Interleaving DC-DC Converter with Loss Optimizing Operating Strategies for Electric Vehicles
2023, R. Dietz. Netzstützendes Verhalten verteilter Erzeuger im Niederspannungsnetz
2023, R. Kaiser. Gegenüberstellung der Materialeinzelkosten und der Verlustenergie im Fahrzyklus von Induktionsmaschinen mittels analytisch-numerisch-gekoppelter Methoden
2023, A. Hoffmann. Electric Potential Distribution in Three-Phase Windings under Pulse Voltage Stress
2023, J. Königsberger. Untersuchung eines vollintegrierten Aktorsystems zur Verringerung von Ratterschwingungen

Leibniz Universität Hannover, Institut für Maschinenkonstruktion und Tribologie, Prof. Dr.-Ing. Gerhard Poll

2018, R. Böttcher . Untersuchungen zum Betriebsverhalten radial vorgespannter Zylinderrollenlager
2018, N. F. Bader. Traction in EHL-Contacts - the influence of local fluid rheology and temperatures
2018, A. Lang. Experimentelle und theoretische Untersuchungen zum Reibverhalten elastomerer Werkstoffe auf rauen Oberflächen
2018, B. Pfeifer. Beanspruchung von Kupplungskörpern
2019, M. Horn, Untersuchungen zur praktischen Umsetzung von Elastomer-Lagersitzen in Hochdrehzahl-Traktionselektromotoren
2020, H. Zhang. Torque Measurement on Wind Turbines and its Application in the Determination of Drivetrain Efficiency
2020, F. Schwack. Untersuchungen zum Betriebsverhalten oszillierender Wälzlager am Beispiel von Rotorblattlagern in Windenergieanlagen
2020, H. C. Liu. Traction prediction in rolling/sliding EHL contacts with reference fluids
2020, J. T. Terwey. Näherungslösungen für Reibung und Verschleiß in ölgeschmierten Wälzkontakten unter Berücksichtigung der realen Rheologie
2020, T. Skubacz. Experimentelle Untersuchungen zur Schmierstoff-Oberfächen-Wechselwirkung in nasslaufenden Reibsystemen am Beispiel von Synchronisierungen
2021, J. Cugliari. Investigation of Contact Mechanics and Friction of Rubber Compounds by Experimental Techniques and Numerical Simulations
2021, D. Bulut. Cavitation and film formation in hydrodynamically lubricated parallel sliding contacts
2022, M. P. Matus. Dichtheit von Radial-Wellendichtringen auf Gegenlaufflächen mit mesoskopischen Strukturen
2022, A. M. Maslak. Mechanische Hochfrequenzeigenschaften von Elastomeren aus signalverarbeitungsoptimierter Ultraschallspektroskopie
2022, P. M. Schüller. Untersuchungen zum Einfluss strukturierter Dichtkontaktflächen auf das Betriebsverhalten von Drehdurchführungen mit Rechteckdichtringen
2022, H. El Maanaoui. Lebensdauer-Vorhersage für Elastomerbauteile mit variabler Vorspannung und Temperaturabhängigkeit
2022, V. Pelzer. Analyse zum Dichtverhalten von rotierenden Radial-Wellendichtringen
2023, S. Wandel. Starvation in Oscillating Rolling Element Bearings
2023, J. I. Hwang. Damage accumulation based fatigue life prodiction of rolling bearings
2023, G. S. Fulari. Experimental investigation and finite element implementation of thermo-chemo-mechanical model in technical elastomers

Leibniz Universität Hannover, Institut für Meteorologie und Klimatologie, Prof. Dr. Björn Maronga und apl. Prof. Dr. Siegfried Raasch

2018, J. Fricke. Untersuchungen zum Einfluss erzwungener atmosphärischer Rollenkonvektion in Kaltluftausbrüchen auf den vertikalen turbulenten Transport in der atmosphärischen und der ozeanischen Grenzschicht mittels Large-Eddy-Simulationen
2021, T. Gronemeier. Advances in Urban Ventilation Assessments using Large-Eddy Simulation
2023, J. Schwenkel. Large-Eddy simulation of nocturnal radiation fog: Advances in microphysical representation and process-level evaluation
2023, O. Maas. Power output and wake effects of very large wind farms investigated by large-eddy simulations
2023, S. Giersch. High Resolution Numerical Simulations of Dust Devils in the Convective Boundary Layer- Effects of Detailed Process Representation on Vortex Development and Dust Release

Leibniz Universität Hannover, Institut für Windenergiesysteme, Prof. Dr.-Ing. Andreas Reuter

2020, M. Stammler. Endurance Test Strategies for Pitch Bearings of Wind Turbines
2020, F. Sayer. Sub-Component testing for structural adhesive joint assessment in wind turbine rotor blades
2021, F. Bürkner. Biaxial Dynamic Fatigue Tests of Wind Turbine Blades
2021, W. Popko. Impact of Sea Ice Loads on Global Dynamics of Offshore Wind Turbines
2023, T. Holst. Model-Based Analysis of Cure-Induced Stresses for a Short Fiber-Reinforced Epoxy Adhesive Used in Wind Turbine Rotor Blades

Leibniz Universität Hannover, Institut für Statik und Dynamik, Prof. Dr.-Ing. Raimund Rolfes

2018, K. Schröder. Advanced Model Updating Strategies for Structuctural Dynamic Systems
2018, S. Tsiapoki. Transmissibility-Based Monitoring and Combination of Damage Feature Decisions within Holistic Structural Health Monitoring Framework
2018, S.R. Nabavi. Failure Analysis of Polycrystalline Silicon-Based Photovoltaic Modules Considering the Effects of Residual Stresses and Mechanical Loading
2018, S. Scheffler. Ein neuer Modellierungsansatz zur systematischen numerischen Untersuchung des Versagensverhaltens von Verbindungen in FVK
2019, J. Häfele. A numerically efficient and holistic approach to design optimization of offshore wind turbine jacket substructures
2019, C. Hübler. Efficient probabilistic analysis of offshore wind turbines based in time-domain simlations
2019, M. Akterskaia. Global-local progressive failure analysis of composite panels including skin-stringer debonding and intralaminar damage
2020, R. Unger. Multi-scale constitutive modelling of nanoparticle/epoxy nanocomposites: Molecular simulation-based methods an experimental validation
2020, A. Haldar. Multistable morphing structures using variable stiffness laminates
2020, C.G. Gebhardt. Robust computational procedures for the nonlinear dynamic analysis of beam and shell structures (Habilitation)
2020, J. Fankhänel. A Multi-Scale Framework for Nanocomposites including Interphase and Agglomeration Effects
2021, N. Penner. Monitoring ambient angeregter baudynamischer Systeme durch mehrschichtige Perzeptren
2022, Ch. Gerendt. A finfite element-based continuum damage model for mechanical joints in fiber metal laminates under static and fatigue loeading
2022, M. Brod. Damage prediction of unidirectional fiber composites und cyclic loading with different amplitudes
2022, R. Berger. Mulit-Objective Structural Optimization of Repairs of Blisk Blades
2022, G. Balokas. Metamodel-based uncertainty quantification for the mechanical behavior of braided composites
2022, S. Wernitz. Damage localization in data-driven vibration-based structural health monitoring using linear quadratic estimation theory
2022, B. Daum. Damage Localization in Data-Driven Vibration-Based Structural Health Monitoring Using Linear Quadratic Estimation Theory (Habilitation)
2022, N. Safdar. A stochastic failure investigation of composites under combined compression-shear loads
2023, S. v.d. Broek. Tailoring structures using stochastic variations of structural parameters
2023, B. Hofmeister. Vibration-based damage localisation: Impulse response identification and model updating methods

Leibniz Universität Hannover, Institut für Stahlbau, Prof. Dr.-Ing. Peter Schaumann und Prof. Dr. Elyas Ghafoori

2018, A. Raba. Fatigue behaviour of submerged axially loaded grouted connections
2019, R. Eichstädt. Fatigue Assessment of Large-Size Bolting Assemblies for Wind Turbine Support Structures
2021, K. Schürmann. Fatigue Behavior of Automatically Welded Tubular Joints for Offshore Wind Energy Substructures
2022, P. Meyer. Schubtragverhalten von Verbunddübelleisten bei Stahlverbundträgern im Brandfall
2022, W. Weisheim. Intumescent coatings on steel structures exposed to natural fires
2023, S. Kelma. Probabilistic design of support structures for offshore wind turbines by means of non-Gaussian spectral analysis

Leibniz Universität Hannover, Ludwig-Franzius-Institut für Wasserbau, Ästuar- und Küsteningenieurwesen, Prof. Dr.-Ing. Thorsten Schlurmann

2018, A. Schendel. Wave-current-induced scouring processes and protection by widely graded material
2018, M. L. Wilms. Criteria of wave breaking onset and its variability in irregular wave trains
2021, M. Welzel. Wave-Current-Induced Scouring Processes Around Complex Offshore Structures
2022, A. Aghaei. Numerical modelling of aeration and hydroelasticity in slamming loads and responses of marine structures
2023, J. Landmann. Hydrodynamics of Bivalve Offshore Aquaculture
2023, M. Christopher. Operativer Hochwasserschutz – Eignung, Einsatz und Leistungsfähigkeit von Sandsackersatzsystemen in praxisorientierten Versuchsreihen
2023, G. Shiravani. Modelling of the cross-shore mixed sand transport under sheet flow conditions

Leibniz Universität Hannover, Institut für Turbomaschinen und Fluid-Dynamik, Prof. Dr.-Ing. Jörg Seume

2018, S. H. Teichel. Optimized Design of Mixed Flow Compressors for an Active High-Lift System
2018, D. Flores. Influence of Labyrinth Seals in Cavities on the Flow of an Axial Compressor
2018, K. Cengiz. Use of Detached Eddy-Simulation for Aerodynamics and Aeroacoustics of Blade Sections
2019, H. Kunte. Kennfelderweiterung einer Supersonischen Axialen Impulsturbine durch Variable Teilbeaufschlagung
2019, J. Aschenbruck. Durch Regenerationsbedingte Varianz Erzwungene Schwingungen von Turbinenschaufeln
2019, B. Drechsel. Einfluss Aerodynamischer Auslegungsparameter der Turbinenendstufe auf die Gehäusenahe Rotorabströmung
2020, T. Fischer. Aerodynamische Auslegung von Radialverdichtern für Aktive Kennfelderweiternde Maßnahmen
2020, L. Wein. Large-Eddy-Simulation von Deckbandlabyrinthdichtungen
2020, T. Hauptmann. Einfluss Regenerationsbedingter Varianzen der Schaufelgeometrie auf Erzwungene Schwingungen in einer Mehrstufigen Turbine
2020, C. Meinzer. Quantifizierung der Aerodynamischen Dämpfung
2020, J. Winstroth. Optische Erfassung der Rotorblattverformungen von Windenergieanlagen der Multi-Megawatt-Klasse durch digitale Bildkorrelation
2020, B. Ernst. Einfluss von Geometrie- und Materialunsicherheiten der Rotorblätter auf die Aeroelastik von Offshore-Windenergieanlagen
2021, C. Müller-Schindewolffs. Entwicklung eines Modells zur Vorhersage Stationärer Transitions-mechanismen in Niederdruckturbinen unter dem Einsatz von Skalenauflösenden Simulationen
2021, T. Wolff. Aeroelatische Lastminderung von Rotorblättern mit Aktiver Flexibler Hinterkante in Windenergieanlagen
2021, C. Keller. Einfluss Regenerationsbedingter Varianzen auf die Aeroelastik von Verdichterblisks
2021, D. Mimic. Turbine-Diffuser Interaction
2021, C. M. Hurfar. Similarity Conditions for Modal Sound Propagation in Turbomachinery Test Rigs
2022, S. Schwerdt. Transport Akustischer Moden durch einen Mehrstufigen Axialverdichter
2022, J. Hurlbrink. Analyse der Aerodynamischen Verlustmechanismen der Radhausströmung von Pkw und Entwicklung von Maßnahmen zur Luftwiderstandsreduktion
2022, D. Frieling. Modellbildung zum Einfluss der instationären Schaufelwechselwirkung auf die Profilverluste in axialen Strömungsmaschinen
2023, M. Amer. Operationelle Modalanalyse thermischer Turbomaschinen
2023, M. Zieße. Realitätsnahe Modellierung aerodynamischer Randbedingungen für hochaufgelöste Strömungsberechnungen in Niederdruckturbin-Kaskaden
2023, M. Maroldt. Aeroelastische Auswirkungen der Schaufel-Rotor-Interaktionin einem 1 1/2- stufigen Axialverdichter

Leibniz Universität Hannover, Institut für Massivbau, Prof. Dr.-Ing. Vincent Oettel

2019, S. Hartwig. Torsionstragmodell extern vorgespannter Kreisringsegmente mit trockenen Fugen
2020, M. Bode. Energetische Schädigungsanalyse von ermüdungsbeanspruchtem Beton
2021, K. Zdanowicz. Chemical Prestressing of Thin Concrete Elements with Carbon Textile Reinforcement
2021, S. Schneider. Frequenzabhängigkeit des Ermüdungswiderstandes von hochfestem Beton
2021, S. Zhang. Interface damage mechanism between concrete layers under temperature loads

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Universität Bremen, Bremer Institut für Messtechnik, Automatisierung und Qualitätswissenschaft, Prof. Dr.-Ing. habil. Andreas Fischer

2018, P. Zhang. Qualitätsregelungssystem eines laser-chemischen Ätzprozesses für die metallische Mikroproduktion
2018, P. Thiemann. In- und Post-Prozess-Messverfahren für die Erfassung von thermo-mechanischen Schädigungen
2018, A. Tausendfreund. Laser-optische Messverfahren zur Charakterisierung von Oberflächendefekten im Nanometerbereich
2018, C. Dollinger. Thermografische Strömungsvisualisierung an Rotorblättern von Windenergieanlagen
2019, J. Osmers. Realisierung eines akustischen Selbsttonometers unter Berücksichtigung der Biometrie des Auges
2021, A. von Freyberg. Automatische Partitionierung komplexer kombinierter Geometrien durch Ganzheitliche Approximation
2021, C. Vanselow. Einfluss von inhomogenen Brechungsindexfeldern auf die Particle Image Velocimetry
2022, M. Mikulewitsch. Modellbasierte optische und photothermische Schichtdickenmessung für den prozessnahen und In-Prozess-Einsatz in Fertigungsverfahren
2022, D. Gleichauf. Beiträge zur thermografischen Strömungsvisualisierung und Lokalisierung der laminar-turbulenten Transition an Rotorblättern von Windenergieanlagen
2023, Y. Schädler. Modellierung der Energiesystemtransformation in Deutschland basierend auf spatiotemporal hochaufgelösten Messdaten
2023, M. Pillarz. Modellbasierter Multi-Distanz-Messansatz zur optischen Messung der Verzahnungsgeometrie
2023, G. Behrends. Berührungslose kontinuierliche Topografiemessung auf bewegten Körpern

Universität Bremen, Fachgebiet Planung und Steuerung produktionstechnischer und logistischer Systeme, Prof. Dr.-Ing. Michael Freitag

2018, E. Nabati. Understanding and Fulfilling Information Needs of Stakeholders along Product Lifecycles - Applying Data Analytics in Product Life-Cycle Management
2019, M. A. Rolbiecki - Einfluss der Handhabung textiler Halbzeuge auf die Qualität von Preforms
2019, T. Beinke. Kooperative Errichtung der Offshore-Windenergie - Konzeptionelle Entwicklung einer lieferketten- und projektübergreifenden Logistikgestaltung
2020, T. Makuschewitz. Robust Production Capacity Allocation in Dynamic Supply Chains - An Approach based on Robust Stability of Multiclass Queueing Networks
2020, T. Funke. Stochastic Block Models als Erklärungs- und Vorhersagemodell von produktionslogistischen Systemen
2020, N. Servos. Prognose der Lieferzeit in mehrgliedrigen Transportketten: Entwicklung einer Methode zur Prognose der Lieferzeit unter Verwendung von Algorithmen des Maschinellen Lernens in mehrgliedrigen Transportketten
2022, P. Dittmer. Modellierung cyber-physischer Logistiksysteme in selbststeuernden Distributionsprozessen
2022, A. Haselsteiner. Offshore structures under extreme loads: a methodology to determine design loads
2022, M. Kück. Selbination - Ein hybrides Meta-Lernverfahren zur automatischen Selektion und Kombination geeigneter Prognosemodelle für die Produktionsplanung

Universität Bremen, Institut für elektrische Antriebe, Leistungselektronik und Bauelemente, Prof. Dr.-Ing. Nando Kaminski und Prof. Dr.-Ing. Bernd Orlik

2018, C. Bödeker. Extrinsische und intrinsische Beeinflussungen des Verhaltens von Siliziumkarbid-Leistungshalbleiterbauelementen
2018, M. Joost. Regelung elastisch gekoppelter Mehrmassensysteme
2019, C. Zorn. Alterung von Leistungshalbleitermodulen im Temperatur-Feuchte-Spannungs-Test
2019, A. Norbach. Untersuchung eines magnetischen Lagerungskonzepts einer rotierenden Schleifkugel für achsenlose Mikroschleifwerkzeuge und der auftretenden elektrodynamischen Effekte
2020, W. Holzke. Entwicklung eines Messsystems für Feldmessungen in Windenergieanlagen und echtzeitfähige Implementierung eines Lebensdauermodells zur Zustandsüberwachung von Leistungshalbleitern
2023, S. Behrens. Dynamische Kompensationsregelung mit adaptiver Parameternachführung für permanentmagneterregte Transversalflussmaschinen

Universität Bremen, Institut für Automatisierungstechnik, Prof. Dr.-Ing. Johanna Myrzik und Prof. Dr.-Ing. Kai Michels

2022, D. Pierl. Detektion und örtliche Eingrenzung von Leckagen in Fernwärmenetzen auf Basis eines numerisch-analytischen Fernwärmenetzmodells
2022, D. Ampofo. Enhancing voltage regulation in medium voltage distribution grids in Ghana using photovoltaic generation
2023, O. Feindt. Entwicklung von Konzepten zur optimalen Regelung verteilter regenerativer Wärmeeinspeisung in Fernwärmenetzen
2023, H. Holm. Control strategies and reduced models for the smart power cell
2023, M. Asmah. Grid integration of variable renewable energies in Ghana: Assessment of the impact on system stability

Universität Bremen, Institut für integrierte Produktentwicklung, Prof. Dr.-Ing. Klaus-Dieter Thoben

2018, E. Nabati. Understanding and Fulfilling Information Needs of Stakeholders along Product Lifecycles - Applying Data Analytics in Product Life-Cycle Management
2021, H. Dastyar. Optimal supplier development contract extensions despite flexibility requirements of industry 4.0
2022, A. Haselsteiner. Offshore structures under extreme loads: a methodology to determine design loads
2022, B. Knoke. Implications of human-machine interface (HMI) technologies for the applicability of training simulators in manufacturing

Universität Bremen, Bremer Institut für Strukturmechanik und Produktionsanlagen, Prof. Dr.-Ing. Bernd Kuhfuß und Prof. Dr.-Ing. Kirsten Tracht

2018, E. M. Moumi. Untersuchungen zum Rundkneten von Mikrobauteilen
2019, S. Huferath-von-Lüpke. Produktionsbegleitende Messeinrichtung basierend auf digitaler Holografie
2019, M. Hermann. Schmierstofffreies Rundkneten/Trockenkneten
2020, L. Langstädtler. Elektromagnetisches und elektrohydraulisches Impulsumformen in der Mikroproduktion
2021, P. Wilhelmi. Fördern und Positionieren von Teileverbunden in der umformtechnischen Mikroproduktion
2021, S. Ortmann-Ishkina. Konditionierung von Werkstücken durch Rundkneten
2022, T. S. Sievers. Einfluss des haptischen Feedbacks in virtuellen Montageszenarien

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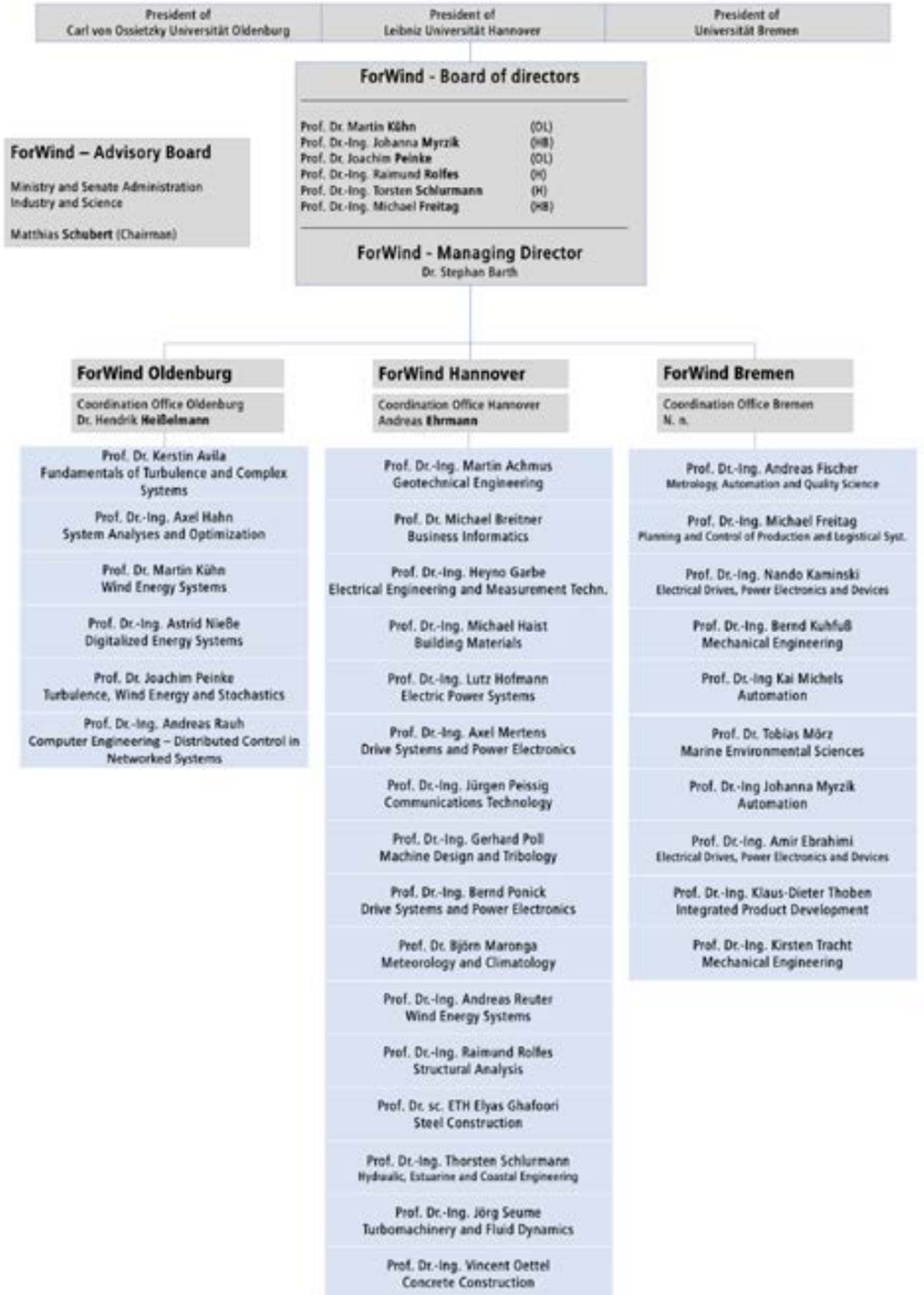

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