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FRAUNHOFER-INSTITUTE FOR LARGE STRUCTURES IN PRODUCTION ENGINEERING IGP

ON OUR WAY INTO THE FUTURE

ANNUAL REPORT 2019

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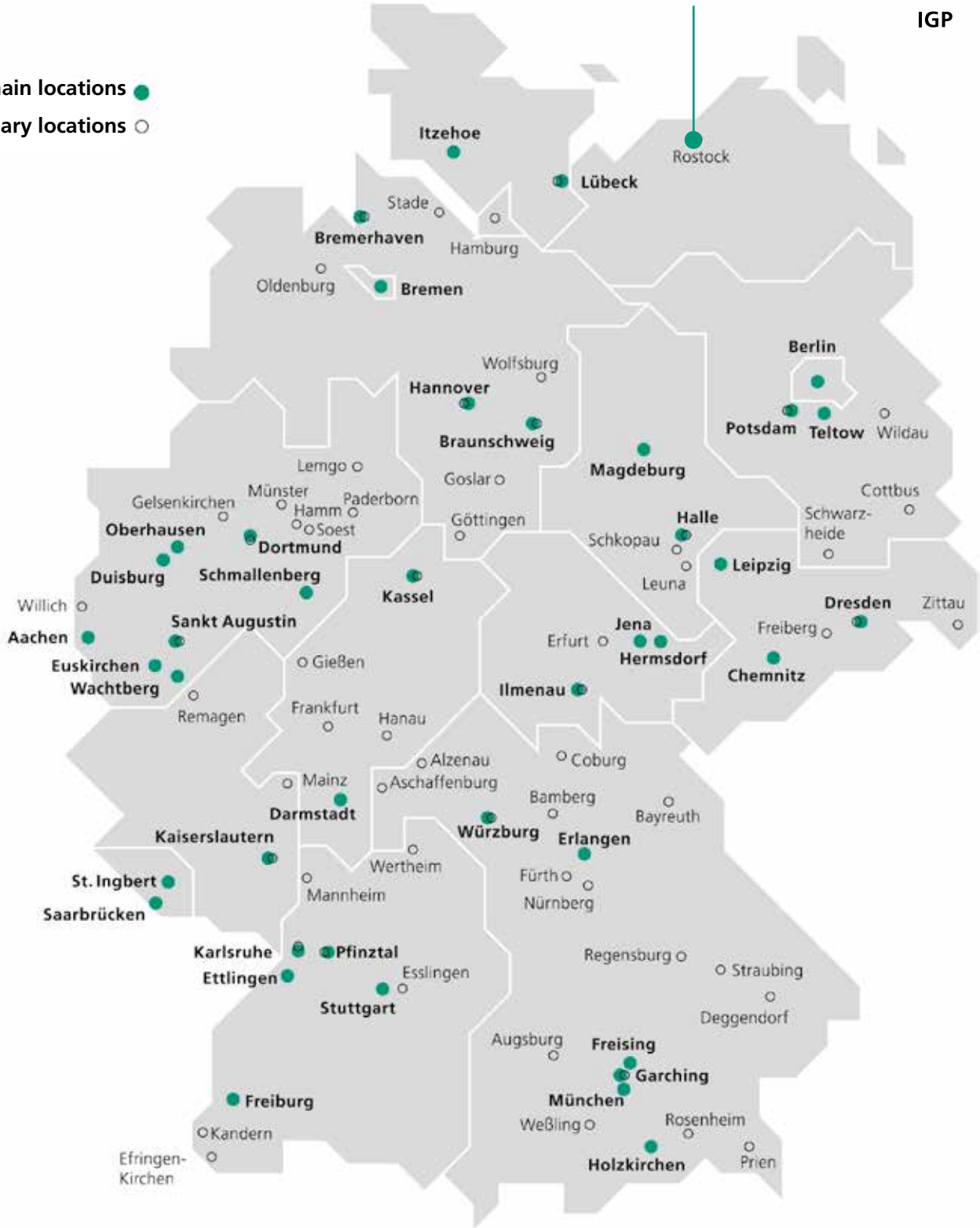
main locations
secondary locations



ANNUAL REPORT 2019
ACTIVITIES AND RESULTS OF FRAUNHOFER IGP

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GREETING

Prof. Dr-Ing. Wilko Flügge, Director of the Fraunhofer Institute for Large Structures in Production Engineering IGP. Image: Fraunhofer IGP Rostock

Dear Readers and Friends of Fraunhofer IGP,

I am pleased to welcome you once again to our current annual report. The turbulent times of the past have now somewhat overshadowed this review of 2019, but we would like to show that we are continuing to pursue the issues in the interests of our partners.

I can promise you that despite all the changes in everyday life and especially to working conditions and patterns, we at Fraunhofer IGP will continue to prepare, develop and advance exciting topics so that they can be implemented in industry. The present report will provide some examples and act as a catalyst in places. For example, we have not been able to celebrate appropriately the good news received at the end of 2019 that we have been granted institute status as of 1 January this year. We have also had to cancel the topping-out ceremony for our new building, but work is proceeding – and on schedule too! It is a symbol that we will continue to stay on the ball and constantly embrace new challenges.

We shall indeed hold a celebration at a suitable time, because even with all the reports, technology must also be fully appreciated to be understood and we are keen not to deny you this opportunity. We have once again put together a new ‚bouquet' of projects and topics in this report to give you an impression of how diverse and complex our solutions to your challenges can be. We are also introducing you to some of the people behind the projects, because we know that they are responsible for directing the results and the quality of our projects. You should use this report as a source of inspiration for tomorrow's innovations. Above all, stay healthy, so that we can continue to drive forward key issues together in the future.

We look forward to discussions with you!

With kind regards from the Hanseatic and
University City of Rostock,

Prof. Dr.-Ing. Wilko Flügge
Director Fraunhofer IGP

Institute Director Prof. Wilko Flügge (left) and Deputy Director Prof. Knuth-Michael Henkel on site at the fourth construction phase of Fraunhofer IGP. Image: Fraunhofer IGP Rostock

OVERVIEW OF THE INSTITUTE

RESEARCH FACILITY BECOMES INSTITUTE

Fraunhofer IGP in the south of Rostock is expanding further. Image: Fraunhofer IGP Rostock

What will innovative production of large structures look like in the future? The Fraunhofer Institute for Large Structures in Production Engineering IGP in Rostock is conducting research into this. The institute develops innovative concepts for product and process innovations. The research focus is on future-oriented industries such as shipbuilding and steel construction, energy and environmental technology, rail and commercial vehicle manufacturing as well as mechanical and plant engineering. The formerly independent research group was made into a Fraunhofer Institute at the beginning of 2020 and is now the first institute of the Fraunhofer Society to be headquartered in Mecklenburg-Western Pomerania. The decision behind this move was taken on 22 October 22 2019 at a meeting of the Executive Board of the Fraunhofer Society. Increasingly large and more complex structures have to withstand extreme mechanical and climatic stresses.

To address these challenges, a project group was founded in Rostock in 1992 by the Fraunhofer Institute for Manufacturing Engineering and Automation IPA. In 2017, this group became the independent Fraunhofer Institute for Large Structures in Production Engineering IGP, which has officially been an institute of the Fraunhofer Society since 2020.

The scientists primarily specialise in finding alternatives that reduce the burden on the environment and workers. The aim of their research is to develop holistic solutions that enable more cost-effective and high-quality production.

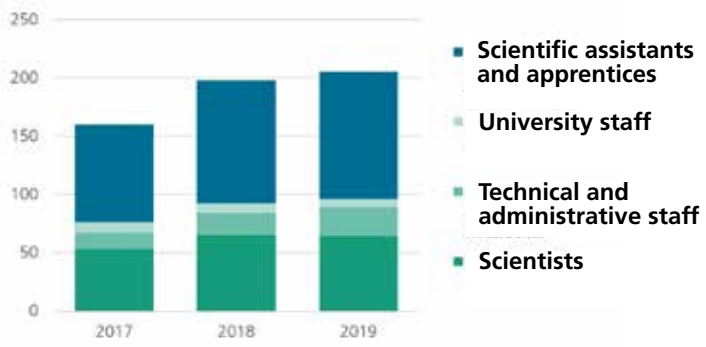
Strong research partner in north-east Germany

„Resource-saving solutions for specialist production challenges are a crucial component in central industrial sectors in Germany and Europe", explains Prof. Reimund Neugebauer, President of

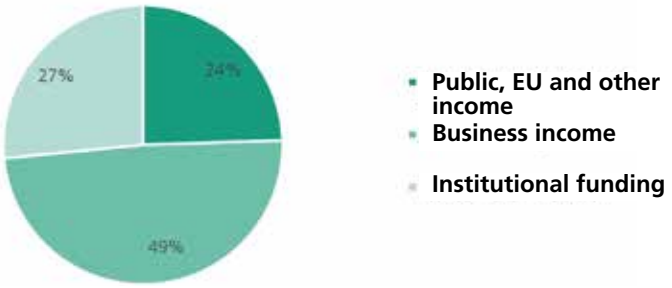
the Fraunhofer Society, on the founding of the institute, adding: „With the opening of the Fraunhofer IGP, Germany is taking a leading position in the development of efficient large-scale structures in production – a decisive contribution to making industrial value chains sustainable and future-proof versus international competition."

The number of employees at the Institute continues to rise steadily. The research facility is currently being expanded in a fourth construction phase to include a production hall with lab and office space. "We have been a reliable and strong research partner of industry in Mecklenburg-Western Pomerania and beyond for many years. In the past two years we have been able to further expand our cooperation. We will continue to actively apply our expertise in the field of large structures in the future", says Institute Director, Prof. Wilko Flügge.
In the new Fraunhofer IGP building, scheduled for completion in 2021, the future topic "Shipyard 4.0" will be in focus. Among other aspects, the Institute has specialised in research on production technology and processes, as well as on materials subsea. As a member of the Smart Ocean Technology research group,Fraunhofer IGP will also be represented in the Digital Ocean Lab. Among other projects, the IGP is currently involved

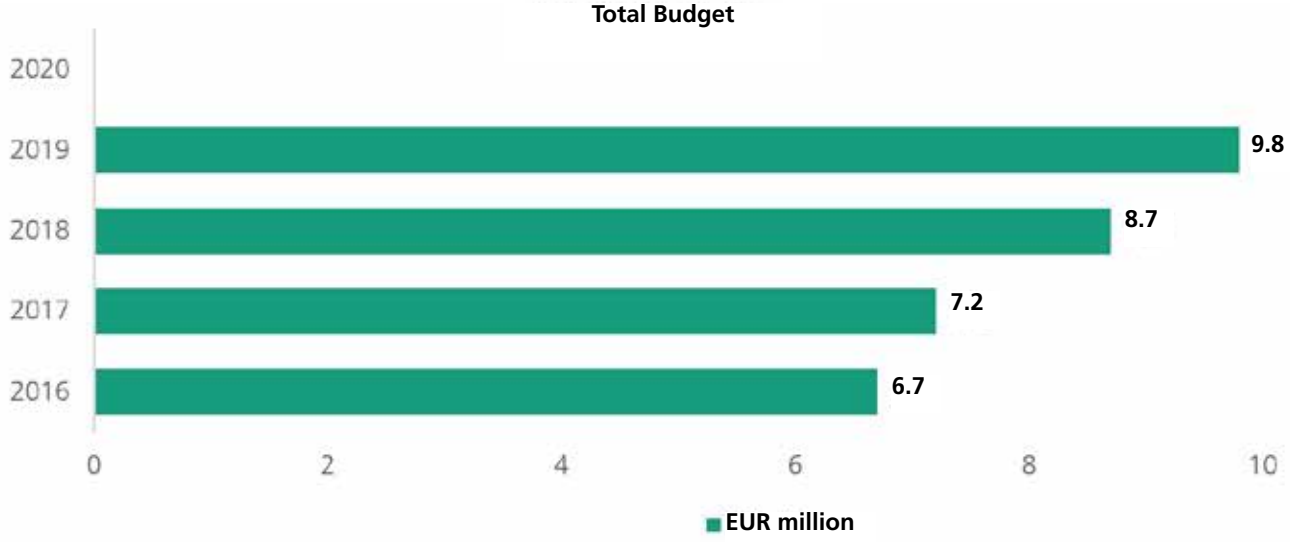
Number of employees



Income 2019



Total Budget



in the core development of the German Ministry of Education and Research „OWSplus - Floating Offshore Wind Solutions" project. Here, the alliance partners are developing solutions for the next evolutionary stage of regenerative power generation.

Employee numbers

In 2019, the total number of staff employed at Fraunhofer IGP rose to 205, with the majority of our scientists holding a degree in engineering or industrial engineering. The work of the Fraunhofer team is supported by a total of 109 research assistants and, as in the previous years, the team will be joined by three trainees. In cooperation with the chairs of manufacturing technology and joining engineering, seven university employees work closely with Fraunhofer IGP in both research and education.

Earnings and total budget

Earnings for 2019 amounted to a total of EUR 9.8 million. With economic returns of 50%, budget targets were also once again achieved in 2019. The Fraunhofer Institute in Rostock also maintained a balanced budget in 2019, with a positive carry-over. The overall budget continued to show steady growth.

ORGANIGRAM OF THE FRAUNHOFER INSTITUTE FOR LARGE STRUCTURES IN PRODUCTION ENGINEERING IGP
As at: July 2020

Director Prof. Dr. Ing. Wilko Flügge		**Deputy Director** Prof. Dr.-Ing. habil. Knuth-Michael Henkel	**Institute assistants** Dipl-Ing. Sabine Wegener Virginie Rogge	**Senior Professor** Prof. Dr.-Ing. Martin-Christoph Wanner
Manufacturing Technology Prof. Knuth-Michael Henkel	**New Materials and Processes** Dr.-Ing. Nikolai Glück	**Production Systems and Logistics** Dr.-Ing. Jan Sender	**Administration** M.Eng. Lisa Knaack	**Teaching** Dr.-Ing. Ulrich Kothe
Joining and Forming by Plastic Deformation M.Sc. Pascal Froitzheim	**Adhesive Bonding Technology** M.Sc. Linda Fröck	**Production Organisation** Dr.-Ing. Jan Sender	**IT Services** Dipl.-Wirt.-Ing. Marcus Baier	**Technical Services** Dipl.-Ing. Kay Müller
Mechanical Joining Technology Dipl.-Ing. Maik Dörre	**Fibre Composite Technology** Dipl.-Ing. Stefan Schmidt	**Automation Engineering** Dipl.-Ing. Steffen Dryba	**Public Relations** Mag. Silke Schulz	**Accredited Test Laboratory** M.Eng. Holger Brauns
Thermal Joining Engineering Dr.-Ing. Andreas Gericke	**Coating, Weathering and Corrosion Protection** Dr.-Ing. Michael Irmer	**Measuring of Large Structures** Dr.-Ing. Michael Geist	**Quality Management** Marietta Flügge	**Inspection, Monitoring and Certification Body according to LBO** Prof. Dr.-Ing. Ralf Glienke

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FIRST CONSTITUENT MEETING OF THE FRAUNHOFER IGP BOARD OF TRUSTEES

Fraunhofer IGP has been an independent research group since 2017 and an institute since 2020. Within the Fraunhofer Society, the Board of Trustees supports the institute directors and the executive board with help and advice. It includes representatives from the worlds of science, business and politics. On 21 May 2019, the Fraunhofer IGP Board of Trustees met for the first time.

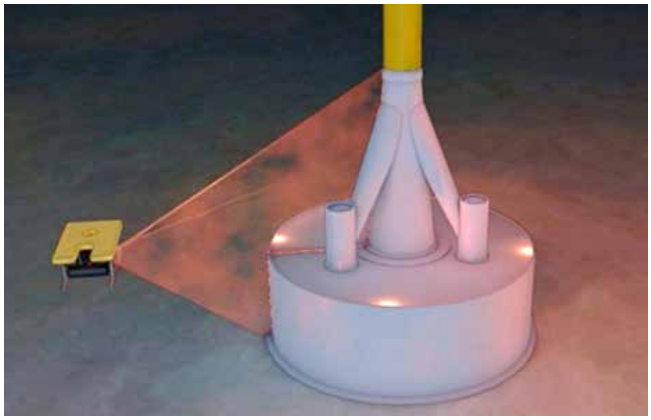
In this first meeting, the members of the new Board were appointed. Dr Johannes Landes, as representative of the Executive Board of the Fraunhofer Society, handed over the certificates of appointment to all those nominated. They include Dr Andreas Dikow (Webasto SE), Harald Jaekel (Peene Werft), Ulf Mauderer (Business Association of Mecklenburg-Western Pomerania), Prof. Dr Marion Merklein (University of Erlangen), Georg Michels (Salzgitter AG), Dr Thomas Kühmstedt (Ostseestaal GmbH & Co. KG), Prof. Dr Wolfgang Schareck (Rector of the University of Rostock), Ralf Svoboda (Ministry of Economics M-V), Holger Wandsleb (Ministry of Education of Mecklenburg-Western Pomerania), Dr Johannes Landes and Dr Hendrik Gorzawski from the Fraunhofer Society as well as Institute Director Prof. Dr Wilko Flügge.
The first official act of the newly appointed Board was the election of a chairman. Dr Thomas Kühmstedt from the company Ostseestaal was elected unanimously.

In the session that followed, Institute Director Prof. Flügge gave an overview of the current situation of the research facility. Together with Prof. Schareck, he presented various core elements of a future Ocean Technology Campus project in which Fraunhofer IGP will participate. Among other aspects, Fraunhofer IGP will focus on the areas of subsea welding, bonding and 3-D surveying. Engineers from IGP were also given the opportunity to present their project work at the meeting. Pascal Froitzheim, Group Head of Joining and Forming by Plastic Deformation, presented the project for the Development of a Handling System for Automated Cold Plastic Forming. The research is being conducted in conjunction with the metal processing company Ostseestaal and the University of Rostock. Frederik Schmatz from Production Organisation group introduced the Human-Robot Collaboration in Aircraft Structure Assembly project.

Both these projects underpin the previously agreed direction of the research institution. Prof. Flügge highlighted Fraunhofer IGP's USPs. The Board of Trustees further approved his proposed focus on production technology for large structures, with particular reference to shipbuilding. At this first meeting, the Board of Trustees recommended the Executive Board of the Fraunhofer Society to grant institute status as soon as possible. This recommendation was implemented, with the Executive Board resolving at a meeting on 22 October, 2019 that, as of 1 January 2020, Fraunhofer IGP would become the first Fraunhofer Institute headquartered in Mecklenburg-Western Pomerania.

1 The participants and members of the then newly founded Board of Trustees from the left: Ulf Mauderer, Holger Wandsleb, Ralf Svoboda, Harald Jaekel, Dr Andreas Dikow, Dr Thomas Kühmstedt, Prof. Wolfgang Schareck, Prof. Marion Merklein, Georg Michels, Prof. Wilko Flügge as well as Dr Hendrik Gorzawski and Dr Johannes Landes. Image: Fraunhofer IGP

SUBSEA@FRAUNHOFER – JUNE MEETING AT THE INSTITUTE



In mid-June, all the institutes involved in the new Fraunhofer@ Subsea consortium met at Fraunhofer IGP to discuss key points for the further development of joint projects and collaborations. Besides the IGP and IGD from Rostock, the IOSB, IKTS, IZM and IBTM are also involved. Among other topics discussed by the participants were synergy effects that might be achieved by the institutions and potential common research topics. After the meeting, the participants involved in the Ocean Technology Campus met to discuss further plans.

VISIT FROM THE PRESIDENT OF THE FRAUNHOFER SOICETY

On 12 August 2019, Prof. Wilko Flügge and his deputy Prof. Knuth-Michael Henkel received a distinguished visitor at the Institute. Prof. Reimund Neugebauer, President of the Fraunhofer Society, participated in the 15th Business Sail, an event that is part of the Hanse Sail maritime festival. Together with companies from the region and the research institutions of the Fraunhofer Society, the green light was given for the „Ocean Technology Campus Rostock", which is being built in the Fischereihafen district of Rostock. Before Prof. Neugebauer continued his journey on Monday, he was guided through the facility by Prof. Flügge and informed about the status of the fourth construction phase.

FIRST APPEARANCE AT THE NEVA TRADE FAIR IN ST. PETERSBURG

Fraunhofer IGP made its debut at NEVA, the Russian trade fair, which took place from 17-20 September in St. Petersburg. NEVA is a trade fair and conference for shipbuilding, shipping and offshore technology as well as being the largest forum of its kind in Russia. The scientists presented the achievements and current status of research at the Institute. Prof. Wilko Flügge gave a lecture on „Industrial maritime research" in the context of a workshop. Fraunhofer IGP and the participating companies used the opportunity of the event to draw attention to the advantages of Mecklenburg-Western Pomerania as a strong business location.

FRAUNHOFER IGP HOSTS 46TH ROSTOCK CHAMBER OF COMMERCE TECH EVENING

About 70 interested visitors came to the Institute for an event on "Value creation in Mecklenburg-Western Pomerania – Robotics in industrial applications". Before speakers took the stand on 24 September, guests were taken on a tour of the research facility. Dr Jan Sender from Fraunhofer IGP gave an overview of the „Status Quo and Trends in Robotics". Dr Lars Greitsch from MMG Mecklenburger Metallguss GmbH, Torsten Lüskow from Hanseatic Rohr GmbH, Norman Nieland from Holz Egger Wismar and Andreas Schroeder from S.K.M. Informatik GmbH explained the areas of application for robotics in their companies.

NØRD – MVS FIRST DIGITAL CONGRESS HOSTED BY FRAUNHOFER IGP

A full programme was presented on 7 November at the Rostock research facility. The first Digital Congress M-Vs took place among other events at Fraunhofer IGP. One of the keynote speakers was Dr Holger Heyn from Volkswagen AG. The event kicked off with a digital greeting from Minister-President, Manuela Schwesig. Christian Pegel, Minister for Energy, Infrastructure and Digitisation in Mecklenburg-Western Pomerania, put in a personal appearance. For a whole day, visitors were able to attend presentations and workshops to find out how the state of Mecklenburg-Western Pomerania is driving forward digitisation and the goals that have already been achieved.

FINNISH DELEGATION VISITS THE ROSTOCK RESEARCHERS

In November, the Rostock scientists of Fraunhofer IGP received a delegation from Turku, Finland. Dr -Ing. Alexander Zych had represented the IGP at the Fraunhofer Day in Turku in September, where he met his Finnish colleagues and without further ado, a return visit to Rostock was arranged for November. Among the guests were representatives of the city administration of Turku, Turku University of Applied Sciences and the Machine Technology Center. The city representatives as well as those from industry and science showed great interest in further expanding the cooperation with Fraunhofer – including in Rostock.

THE INSTITUTE IS GROWING
FOURTH CONSTRUCTION PHASE

***1** & **2:** Professors Wilko Flügge (left) and Knuth-Michael Henkel visit the construction site to see how the fourth construction phase project is progressing. Images: Fraunhofer IGP*

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FRAUNHOFER IGP HEADING TO THE FUTURE – WITH NEW FACILITIES AND FOURTH CONSTRUCTION PHASE

The foundation stone for today's Fraunhofer IGP was laid in Rostock in 1992. At that time, the scientists began their work as the Rostock project group of the Fraunhofer IPA (Fraunhofer Institute for Manufacturing Engineering and Automation IPA, Stuttgart) in Warnemünde. Since 2004, the facility on the science campus in Rostock south has grown in a number of construction phases to more than 6,000 m2 of lab and office space.

Another 2,000 m2 will be added. In March 2019, work began on the fourth phase of construction. New offices, laboratories and a further testing hall are being built directly next to the existing building. The investment volume for the new building is around EUR 14 million.

Institute Director Prof. Wilko Flügge explains: „In our new building the Shipyard 4.0 project will set a new focus. We have grown so fast in recent years that we urgently need the additional space, not just so that we have more space for our constantly growing team, but also so that we can work even more successfully and intensively with our partners in industry. The new workshop enables us to commission and test equipment for the production of large structures in actual scale dimensions.

A fast-motion video clip of the construction progress in 2019 can be viewed online at:
https://bit.ly/38vsoTp
Or simply scan the QR code to watch!

The existing building is on the left. This was built in three construction phases between 2004 and 2013. The construction work for the fourth phase, which can be seen on the right of this image, began in March 2019 and is provisionally scheduled for completion in spring 2021. Image: Fraunhofer IGP

THE FRAUNHOFER IGP AWARD 2019 – FUTURE AND INNOVATION AWARD GOES TO OSTSEESTAAL IN STRALSUND

Since 2018, the Fraunhofer Institute for Large Structures in Production Engineering has presented the Fraunhofer IGP award. In this, the second year, the award went to Ostseestaal GmbH & Co KG. In cooperation with the scientists of the Fraunhofer IGP, the Stralsund-based company is in charge of the HakU project for the automation of a production process that previously relied on the experience of the plant operator. „We see this award as a future and innovation prize. Our aim is to highlight the technological, economic, ecological and social benefit that is gained through the close cooperation between the research institution and its industrial partners", says Prof. Wilko Flügge, Institute Director of Fraunhofer IGP, in describing the award.

The HakU project

Since 2016, Fraunhofer IGP has been working together with Ostseestaal and the University of Rostock in a project to develop a handling system for automated cold plastic forming (HakU). The three-dimensional forming of heavy plates for shipbuilding, fascia construction, mould construction and the field of renewable energies all depend on a multi-stage cold plastic forming process which facilitates free bending. The positioning of the heavy plates is handled by a crane system. Control of the process is contingent on the experience and purely subjective assessment of the plant operator. To increase the efficiency of the process and to archive the experience of plant operators, scientists at Fraunhofer IGP, the University of Rostock and the employees of Ostseestaal are working on automating this handling system.

(l to r) Harry Schellhorn and Maximilian Müller from Ostseestaal with Tobias Handreg and Pascal Froitzheim. Image: Fraunhofer IGP

Award winners 2019 – Ostseestaal from Stralsund

"The exciting thing about this project is the transfer of the purely subjective perception of the plant operator into an objective, calculable and automated process control. We can adapt some of the results for other production plants. All in all, this will reduce throughput times and save production costs. Energy consumption is reduced, since a number of production steps are no longer necessary, making manufacturing so much more efficient. With this project, Ostseestaal is helping to enhance Stralsund as a business location and the German state of Mecklenburg-Western Pomerania as a supplier to the maritime industry, aviation and energy sector", explains Prof. Flügge.

„We appreciate the highly effective cooperation with Ostseestaal. In Project Manager Harry Schellhorn, I have a contact who supports us with a great deal of experience and expertise in the field of automation and cold plastic forming. We are pleased with the trust, the courage and the willingness of Ostseestaal to modernise an integrated production system during operation. Questions arising can be addressed openly and directly on both sides. This makes it easier to work quickly and purposefully on solutions and to remedy the many small ‚teething problems' in such a complex plant," says Pascal Froitzheim.

COMPETENCES

MANUFACTURING TECHNOLOGY

GROUPS:

Joining and Forming by Plastic Deformation
Mechanical Joining Technology
Thermal Joining Engineering

NEW MATERIALS AND PROCESSES

TEAMS:

Adhesive Bonding Technology
Fibre Composite Technology
Coating, Weathering and Corrosion Protection

PRODUCTION SYSRTEMS AND LOGISTICS

GROUPS:

Production Organisation
Automation Engineering
Measuring of Large Structures

JOINING AND FORMING BY PLASTIC DEFORMATION

JOINING AND FORMING BY PLASTIC DEFORMATION

The focus of the research in joining by deformation is on questions relating to the joining of lightweight construction materials, such as fibre reinforced plastics or wrought aluminium alloys both as joints using purely deformation and in combination with adhesive bonding. The main fields of application for the joining methods in question are within the mobility sector (aircraft, rail and automotive industries).

The research covers both the initial qualification of the deformation or setting process of the joint and the analysis of the load-bearing capacity of the joint under static and cyclic loading and in the event of a crash. A particular focus here is on the fracture-mechanical evaluation of the joints with respect to crack initiation, crack propagation and fracture behaviour. Furthermore, the properties of the joints are analysed over the service life, and topics such as corrosion resistance, leak tightness, electrical conductivity or the possibilities of (non-destructive) testing (NDT) are examined.

The focus of the research into forming by plastic deformation centres on fundamental questions of forming and deformation of component structures. The main emphasis here is on the development of prediction models and the derivation of process control concepts for cold and hot plastic forming, predominantly for the forming of large steel plates with material thicknesses of more than 5 mm. These have to be evaluated and optimised with respect to their real-time capability for integration into machine control systems.

.

This is new:

The group's machinery has been expanded to include a 100kN forming press for experimental testing and sampling of new types of joining and forming processes.

ACTIVITIES

- Application-specific development and optimisation of deformation joining processes of lightweight construction materials
- Process integration of joining by deformation through innovative setting device concepts and ergonomic workplace design
- Establishment of quality assurance procedures, for example by monitoring the setting process or by NDT methods
- Material and joining testing under mechanical load (static, cyclic, mechanical cracking)
- Forming of heavy plates and development of simplified predictive models for technical control integration
- Development of self-learning systems for joining and forming by plastic deformation processes (AI)
- Process simulation during joining and forming by means of numerical FEM (ANSYS, LS-Dyna, etc.)
- Analysis methods for sensitivity and damage analysis during joining and forming (material and metallography)

Group Head

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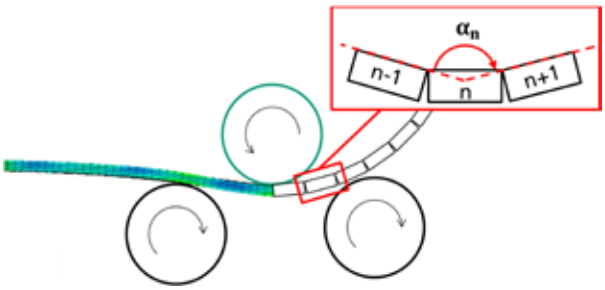
FRICTION-BASED CRACK INITIATION – AT WHAT POINT DOES THE CLINCH JOINT FAIL?

Due to their efficiency, deformation joining processes requiring no pre-holing are increasingly used in the mobility sector. The focus is on processes that do not require the use of an auxiliary joining part, such as clinching. There is currently an acceptance problem in the field of aircraft construction, due to a lack of knowledge on the failure-behaviour of clinch connections under cyclic loading. The aim of the research project is therefore the detailed analysis of crack initiation on clinch connections and the prediction of the crack location and remaining service life of these connections. A central task is to demonstrate the impact of friction-based crack initiation on the failure behaviour of clinch connections.

For further details on this project, please see:
https://www.igp.fraunhofer.de/en.html

SIMPLIFIED REPLACEMENT MODEL FOR PROCESS CONTROL FOR ROLL BENDING LARGE SHEET THICKNESSES

The industrial roll bending of heavy plates in small batches is currently controlled exclusively manually. This has the consequence that the efficiency and economy of the forming process is dependent on the experience of the system operator. Consequently, in order to optimise the process, an objective real-time-enabled control approach based on a simplified substitute model is being developed in the context of the research project. With the help of experimental and numerical investigations plus a sensitivity analysis of the influencing factors, the substitute model can be specifically adapted for industrially relevant space parameters. Using the substitute model leads to a sustainable improvement in control of the roll bending process, especially for SMEs.



For further details on this project, please see:
https://www.igp.fraunhofer.de/en.html

CONCEPTION OF AN ADAPTIVE PROCESS CHAIN FOR MECHANICAL JOINING

Production-related fluctuations in component production lead to increasingly smaller tolerance zones in the production process and therefore to higher costs. The networking of production data for individual production steps is insufficient and correlations between these data are unknown.

It therefore also follows that the potential for expanding the tolerance range is also unknown. The aim of this research project is the analysis and networking of the production steps of a selected product on the basis of the production data.

To achieve this, experimental and numerical analyses are carried out along the production chain. The production data are first subjected to a sensitivity analysis and then the correlation between production steps is analysed. In this way, tolerance specifications can be extended and costs reduced. For further details on this project, please see:
https://www.igp.fraunhofer.de/en.html

MECHANICAL JOINING TECHNOLOGY

MECHANICAL JOINING TECHNOLOGY

Growing demands on the manufacture of energy and resource efficient products and environmental aspects are leading in many branches to an increasing use of lightweight construction concepts. The associated use of new types of material has given rise to a renaissance in particular of mechanical joining technologies in recent years. In order to give due consideration to this development, the Fraunhofer IGP is developing innovative and cost-effective solutions to the associated problems.

The field of mechanical joining technology involves various research focuses in light alloy and steel construction, in rail vehicle construction and in general motor vehicle and machine engineering. We elaborate branch-specific solutions together with our clients. The right choice and command of the joining methods go a long way to determining the functionality, reliability and safety of a construction right from the start of the product development. At the same time, the optimum joining technology for the particular application helps to save costs and material during production and use. The scope of activities extends from the advice on the choice of the optimum joining technologies through the analysis of the load-bearing strength right up to the derivation of suitable dimensioning rules, depending on the demands of the particular application.

The theoretical considerations are supported by the accredited test laboratory of the Fraunhofer IGP that, with the most modern testing technology, is able to carry out extensive experimental studies into materials, fasteners, joints and coating systems under standardised conditions.

This is new:

Since May 2020, M.Sc. Maik Dörre has been Group Head of Mechanical Joining Technology. He has been employed at Fraunhofer IGP since 2015 and had already worked as a student assistant at the institute before that. Dr Christian Denkert successfully completed his PhD with distinction on December 9, 2019. Maik Dörre and Matthias Schwarz have both successfully completed their advanced training as specialist fastening engineers.

ACTIVITIES

- Consulting on current trends and developments in joining technology (screws, rivets, lockbolts, blind fasteners, functional carriers/elements)
- Preparation of expert opinions and testing concepts for connections in light metal alloy and steel construction (ZiE, abZ/abG, ETA)
- Determination of static friction coefficients according to DIN EN 1090-2 appendix G and TL/TP-KOR steel structures
- Numerical simulation (FEM) with parameterised model building
- Investigation of the fatigue strength of materials and fasteners according to DIN 50100 and DIN 969
- Wöhler tests for the determination of FAT classifications in line with DIN EN 1993-1-9 and FKM guidelines
- Development of measuring algorithms and test methods for non-regulated joining processes
- Derivation of maintenance concepts from preload-force-time behaviour („mechanical maintenance-free“)
- Performance of torque/tension force tests according to DIN EN ISO 16047
- Seminars on the calculation of bolted joints according to DIN EN 1993-1-8 and 9 (Eurocode 3) and VDI 2230 (Part 1)
- Certification/external monitoring of building product manufacturers in the capacity of officially recognised test station in accordance with the German state building regulations.

Group Head

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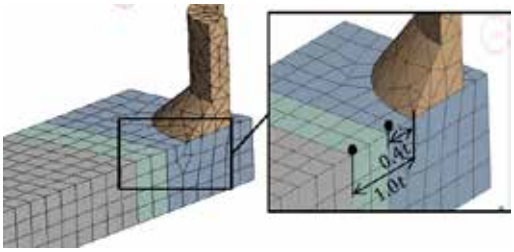
RE-STRESSED HYBRID CONNECTIONS WITH LOCKBOLTS & HIGH-STRENGTH BOLTS

Slip-resistant bolted connections shall be used wherever the mechanical joints are subjected to impact, vibration and/or load reversal to prevent effectively movement of the connected parts if loaded mainly in shear.

The load-bearing capacity is activated by friction that is a result from the preload of the bolt and the slip factor μ in the slip planes. Commonly, the slip factors that can be achieved for typically anti-corrosion coatings in steel structure are low despite the complex pre-treatment of the faying surfaces. By applying a suitable structural adhesive on the slip planes, significantly higher slip factor and consequently, increases in load capacity, can be achieved. As part of the ongoing research project, the combination of slip-resistant connections and structural adhesives are under deep Investigation. For further details on this project, please see:
https://www.igp.fraunhofer.de/en.html

VIBRATION RESISTANCE BY PRESSING-IN SHEET METAL SECTIONS

For fastening attachments in „thin-walled" sheet metal structures, functional elements inserted by forming technology offer an extremely economical alternative to welded bushings. In addition to the static strength and the load-bearing capacity under crash loads, their fatigue resistance is always a relevant issue. The research project aims to generate a method of proving fatigue resistance by means of using the local stress theory for sheet metal sections influenced by forming technology. That for example occur as a result of a process sequence during the insertion of functional element. The local stress theory is also compared with the nominal S-N curves of the detail category examined on the formed sheet metal section in S-N-Tests.

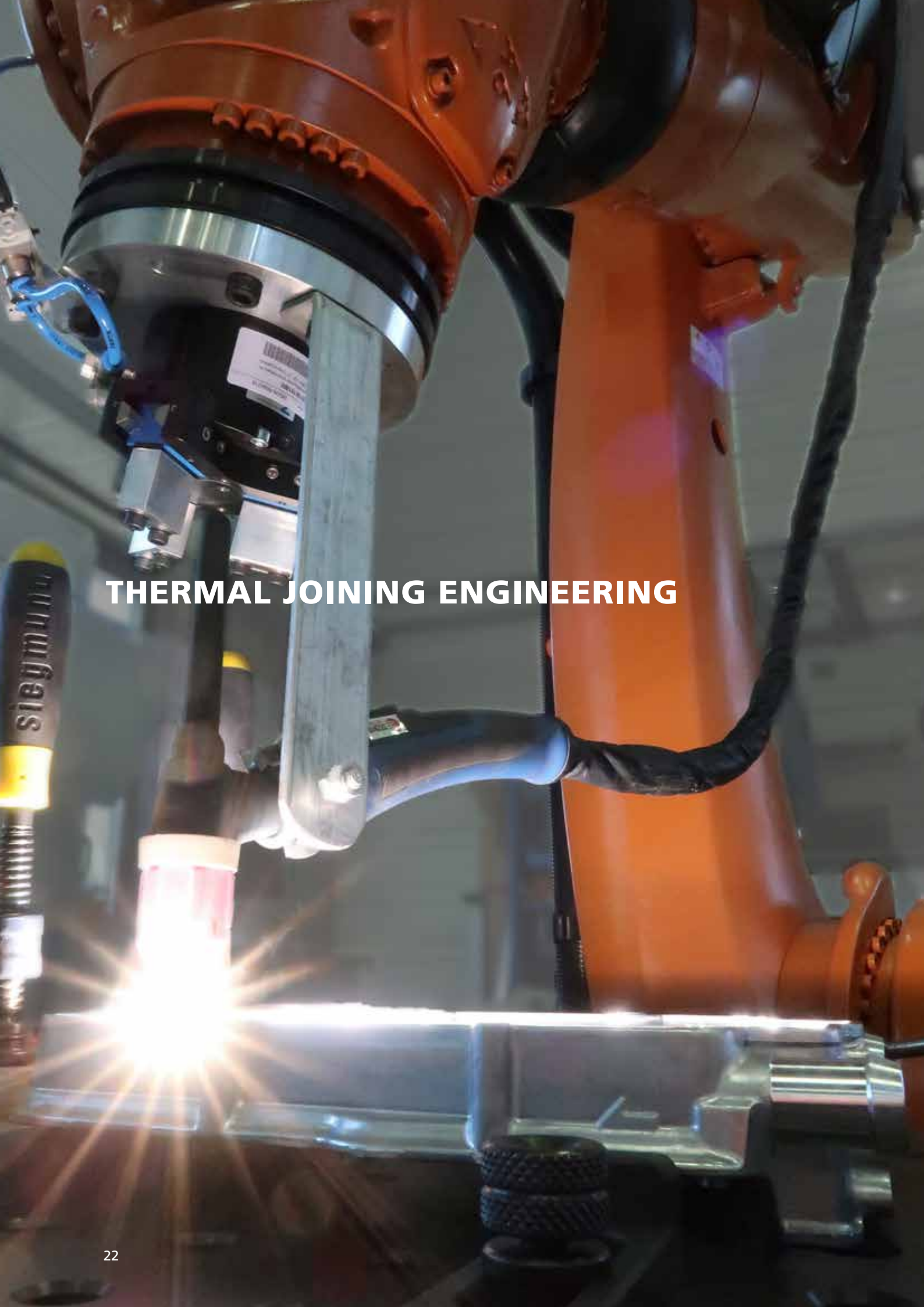


For further details on this project, please see:
https://www.igp.fraunhofer.de/en.html

EXPANSION OF THE APPLICATION LIMITS OF BLIND FASTENERS FOR CONNECTING HIGH STRENGTH MARTERIALS

In the field of steel and lightweight metal construction, there has been a trend to the use of high-strength steels in recent years. Over time, these constructions are subjected to predominantly (static) and not predominantly (fatigue) loads. The use of blind riveting technology in these constructions raises questions from the structural engineer's point of view, which are addressed in the current research projects at Fraunhofer IGP. The aim is the development of design rules, which consider the higher material strengths already during planning stage. With these design concepts a more economical design should be possible.

For further details on this project, please see:
https://www.igp.fraunhofer.de/en.html



THERMAL JOINING ENGINEERING

THERMAL JOINING ENGINEERING

Thermal cutting, coating and joining processes play a central role as value-added and quality determining manufacturing steps in a large number of production processes. In highly industrialised branches, welded joints and welding processes, in particular, have to satisfy constantly growing and changing demands with respect to cost-effectiveness, flexibility and quality. These include, for example, high-quality processing of modern materials with often high demands on the mechanical and technological properties with consistent process reliability, the assurance of the part integrity of welded components of innovative lightweight steel constructions subject to high static and cyclic loads, increases in the cost-effectiveness of welding processes through modern automation solutions, and the introduction of highly productive welding methods to increase competitiveness as an answer to the growing pressure of costs in globalised markets.

In order to find long-term and sustainable solutions to the resulting technological and economic challenges, the Thermal Joining Engineering group at Fraunhofer IGP is continuously engaged in innovative research and development on current and future issues in the fields of shipbuilding, structural steel work, onshore and offshore wind energy. We always strive to holistically evaluate technological, metallurgical and design aspects of the respective welding applications within the value-added chain.

This is new:

The group has changed its name. Welding Engineering has become Thermal Joining Engineering. Group Head Dr -Ing Andreas Gericke explains: „The change of name was necessary to communicate and represent our core area of welding technology as well as our other skills in the area of soldering and thermal spraying, which have grown sustainably and successfully over the years. In this way, we aim to be more visible to potential customers and continue strategic growth in these areas".

ACTIVITIES

- Application-oriented development and optimisation of thermal joining, cutting and coating processes
- Determination of mechanical-technological and fracture-mechanical material, joint and component properties
- Analysis of welding processes by combined optical, electrical and thermal measuring methods
- Development and qualification of economical methods for improving the fatigue strength of welded structures
- Development and qualification of welding and soldering additives as well as thermal sprayed coatings
- Chemical analyses (spark emission spectrometry, carrier gas extraction to determine O, N, H content in various metals, energy dispersive X-ray spectroscopy EDX)
- Structural analysis and feature determination of Fe, Cu, Al and Ni-based materials by means of light and scanning electron microscopy (SEM)
- Determination of welding-related distortion as well as of residual stress states and development of countermeasures
- Automation of welding processes and development of monitoring systems
- External and construction supervision with mobile measuring and analysis technology
- Design and dimensioning of welded and soldered joints
- Welding technology, metallurgical and construction consultancy
- Development testing and inspection of subsea connection technologies

Group Head

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INDUCTION HEATING ENGINEERING TO IMPROVE THE WELD SEAM QUALITY FOR SUBSEA WELDING OF FINE GRAIN STEELS

The research project investigates the application of induction technology for pre- and post-heating in manual wet arc welding. Due to the influence of the media, there are high levels of hydrogen input and, due to the strong convection, high cooling rates after welding. As a result, critical material properties and cracks can result. The effective introduction of energy by means of induction is intended to be used for the practical compensation of subsea-specific risks during wet welding and consequently, also enabling the safe joining of high-strength steels. This is necessary for the economical and high-quality repair of structures in hydraulic steel engineering. Application guidelines for the use of induction heating engineering are in development.

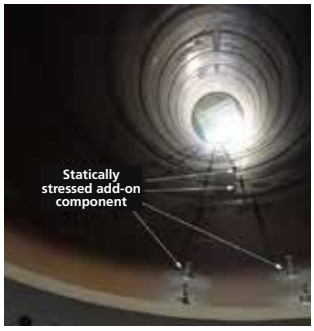
For further details on this project, please see: https://www.igp.fraunhofer.de/en.html

DEVELOPMENT OF A MOBILE ELECTROSLAG (ES) CHANNEL WELDING SYSTEM FOR CONSTRUCTION SITE APPLICATIONS

The welding processing of thick-walled sheets is necessary for many constructions in the maritime sector in constrained positions and under construction site conditions. ES duct welding is a welding process for single- layer welding of vertical seam connections which is particularly economical and with low distortion. However, the inadequate level of knowledge about welding metallurgy and the lack of system technology mean that it is rarely used. The aim is therefore to develop a mobile ES duct welding system for use on butt and T-joints, as well as to adapt the system technology, welding engineering and welding metallurgy of ES duct welding to European manufacturing specifications.

For further information: https://www.igp.fraunhofer.de/en.html

USE OF ARC BRAZING TO JOIN COMPONENTS ON STEEL STRUCTURES SUBJECT TO HIGH VIBRATION LEVELS



In steel construction, it is necessary to weld attachments without a primary load bearing function to structures subject to vibrational stress, which has an influence on the service life and design of high-strength steels. The project investigated whether arc brazing with copper-based solders is suitable for the substitution of welding processes in steel construction. The investigations show that the use of arc brazing to join attachments can extend the service life of the entire construction by up to 500% without the need for post-weld treatment. For example, there is a saving of 50 tonnes in weight on a tubular steel tower for wind turbines without reducing the static load-bearing capacity of the payload parts.
For further details on this project, please see: https://www.igp.fraunhofer.de/en.html

NEW MATERIALS AND PROCESSES

ADHESIVE BONDING TECHNOLOGY

FIBRE COMPOSITE TECHNOLOGY

COATING, WEATHERING AND CORROSION PROTECTION

NEW MATERIALS AND PROCESSES

This area of Fraunhofer IGP addresses both current joining issues of lightweight and composite construction and the development and adaption of production methods for fibre composite parts. Further main research focuses are the effects of ageing on materials, adhesive bonded joints and coatings by means of laboratory ageing in an artificial climate. In cooperation with the accredited test laboratory at the Fraunhofer IGP, materials, joints and coating systems are tested and qualified under standardised conditions. In addition, new testing methods for special applications are developed and employed.

In the field of adhesive bonding technology, the range of services offered by Fraunhofer IGP extend from the bonding-optimised design of parts and assemblies, through the planning and dimensioning of bonded joints right up to the development and qualification of the whole bonding process and the joint.

The focus in the field of fibre composite technology lies on the holistic optimisation of large fibre composite constructions such as the rotor blades of wind turbines, ship superstructures and applications in civil engineering. The work extends from the development of flame-resistant materials through production engineering up to the determination and calculation of indicators.

In the field of corrosion protection and artificial ageing, Fraunhofer IGP's focus in on the development and qualification of innovative corrosion protection systems with improved properties and the identification of ageing influence.

This is new:

Since 2020, the individual divisions of the former Adhesive Bonding Technology, Fibre Composite Technology and Corrosion Protection group have formed their own teams. The Adhesive Bonding Technology team is headed by M.Sc. Linda Fröck, while M.Sc. Stefan Schmidt heads up Fibre Composite Technology. Dr-Ing. Michael Irmer leads the Coating, Weathering and Corrosion Protection team. The teams all come under the umbrella of the New Processes and Materials department, which is overseen by Dr -Ing. Nikolai Glück.

ACTIVITIES

- Design and qualification of bonding processes and bonded joints through adhesive selection and surface pre-treatment as well as the development of bonding processes
- Development of automation solutions for adhesive technology applications
- Development of composite manufacturing processes and structures
- Design and dimensioning of fibre composite components
- Determination of characteristic values for materials and compounds by static and cyclic tests and polymer analysis
- Analytical and numerical calculation of adhesive joints and fibre composite structures
- Specification and qualification of corrosion protection systems
- Climate simulation and accelerated laboratory ageing for materials, coatings, assemblies and processes
- Bonding process development and component tests under simulated real conditions in a climate chamber
- Development of test methods for combined mechanical and media loads for special application

Head of Department

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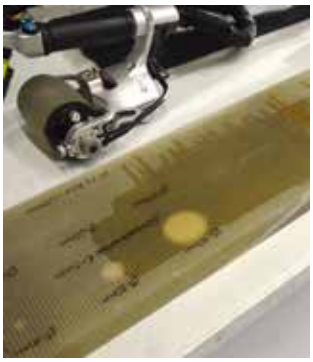
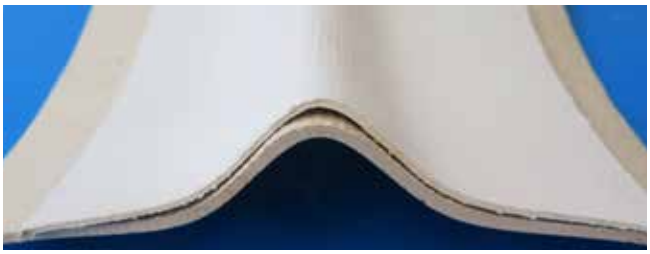
INSPECTION METHODS FOR RECURRENT TESTING OF HIGHLY ELASTIC THICK-FILM AND STRUCTURAL BONDS IN SHIPBUILDING APPLICATIONS



As a result of increasing lightweight construction requirements, adhesive technology is becoming more and more important as a joining process in shipbuilding. However, a lack of long-term experience in the maritime sector stands in the way of integrating adhesive technology into production. The aim is to find suitable inspection procedures and intervals for ongoing operations and to expand the experience with adhesive joints in the maritime sector. In order to achieve this, imperfections in adhesive joints typical for shipbuilding are analysed with regard to their damage potential and impact on service life. Based on the data obtained, meaningful inspection intervals are determined for the use of adhesive joints in shipbuilding. In addition, non-destructive inspection methods (NDT) for use in the shipyard as well as at sea are compiled and checked for applicability. For further details on this project, please see: https://www.igp.fraunhofer.de/en.html

NON-COMBUSTIBLE, FIBRE-REINFORCED COMPOSITE COMPONENTS ON COLD-CURING INORGANIC MATRIX SYSTEMS



In principle, the use of composite materials in shipbuilding is extremely promising due to the great freedom of design, high corrosion resistance and considerable weight savings. However, strict fire protection regulations prevent the use of conventional fibre-reinforced plastic composites (FRP) with organic matrices, which burn with the release of heat in case of fire. The solution to this problem is to substitute the plastics with inorganic, non-combustible matrix systems. Conventional manufacturing processes for FRPs cannot, however, be easily transferred to the inorganic materials.
The AnorKomp project focuses on the optimisation and processing of inorganic systems and processes for the production of corresponding composite components. For further details on this project, please see: https://www.igp.fraunhofer.de/en.html

FOKO-WIND – DEVELOPMENT OF FOIL COATING SYSTEMS AND THEIR APPLICATION TECHNIQUES AS CORROSION PROTECTION FOR OFFSHORE WIND FARMS

Offshore Wind Turbines are constantly exposed to wind, water and salt. The protection of the steel structures is guaranteed by high-performance coating systems. The application of these liquid coating materials is associated with enormous effort due to environmental conditions and quality monitoring in the coating process. With the development of a foil coating system, the demands on technical hall equipment can be reduced considerably. For example, there is no need for costly ventilation systems or explosion-proof areas. The development of an automated application system is in the pipeline. In combination with the foil coating system, the need for quality monitoring is significantly reduced. Moreover, fewer employees will be needed to work in hazardous areas.
Details here: https://www.igp.fraunhofer.de/en.html

PRODUCTION ORGANISATION

PRODUCTION ORGANISATION

In close cooperation with industrial partners, the Production Organization team at Fraunhofer IGP develops individual solutions for the design of tomorrow's production.
In the field of factory and logistics planning, the latest methods and tools from the Digital Factory, such as material flow simulation, 3D-layout planning and robot simulation, are applied. Among other things, this supports industrial partners in safeguarding their reorganisation or investment projects.
At shop floor level, the focus is on development and implementation of individual solutions for the smart factory in the context of Industry 4.0. These include IT-based production data capture systems, which are used in combination with the most modern positioning technology to increase the transparency of the production process. At the same time, it is becoming ever more important to ensure that employees are provided with digital information in a fast and flexible manner. In order to achieve these goals, assistance systems such as data spectacles, tablets, and other smart devices are used.
A further field of focus are ergonomic assistance systems. By using intelligent workplace systems and ergonomics simulation, assembly processes can be designed correctly and efficiently in terms of ergonomics. In addition, innovative production concepts based on human-robot collaboration are developed.

This is new:

Since 2020, Head of Group Dr -Ing. Jan Sender has also been head of the Production Systems and Logistics department, which unites the Production Organisation, Automation Technology and Measuring of Large Structures working groups under one roof.

ACTIVITIES

Factory Planning and Logistics – Digital Factory

- Productivity and potential studies for production systems
- Digital factory design by means of material flow and kinematic simulation to secure investment decisions
- 3D layout planning in a virtual reality environment for new planning and reorganisation projects
- Optimisation of production and logistics systems on the basis of lean production methods

Production planning and control - industry 4.0

- Design and implementation of intelligent algorithms for production planning and control
- Development of innovative software and hardware solutions for flexible production management (production control centre, fault management, etc.)
- Introduction of digital track and tracing systems based on Auto-ID technologies (RFID, localisation, etc.) for complete traceability of orders

Ergonomics and work design – workers of the future

- Ergonomic analysis at the workplace (including ergonomic simulation)
- Implementation of innovative work systems based on human-robot collaboration
- Development of ergonomic workplace systems and intelligent handling systems for weightless handling of loads
- Implementation of digital employee assistance systems for production, logistics and maintenance

Head of Department

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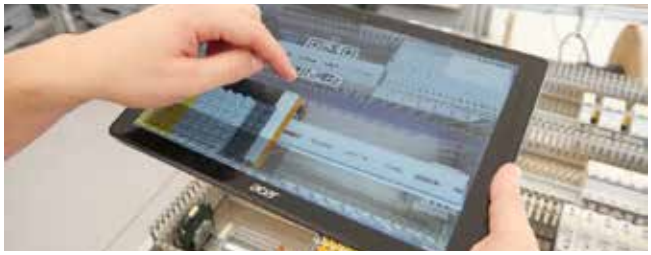
HUMAN-ROBOT COLLABORATION IN MECHANICAL JOINING TECHNOLOGY

In the course of digitisation and the safeguarding of competitiveness, there is a high demand for flexible automation solutions which are used for repetitive and stressful handling tasks. Due to increasing demands on flexibility for batch size 1, fully automated robot systems cannot be used economically. Here, human-robot collaborations (‚cobots') enable innovative solutions. Intelligent sensor technology eliminates the need for safety fences and this means that adaptive, compact and mobile robot cells can be implemented. The strengths of the human being (cognitive, motor, sensory abilities) are combined with those of the robot (precision, high payloads, long operating times), so that employees are de-burdened and productivity is increased. For further details on this project, please see: https://www.igp.fraunhofer.de/en.html

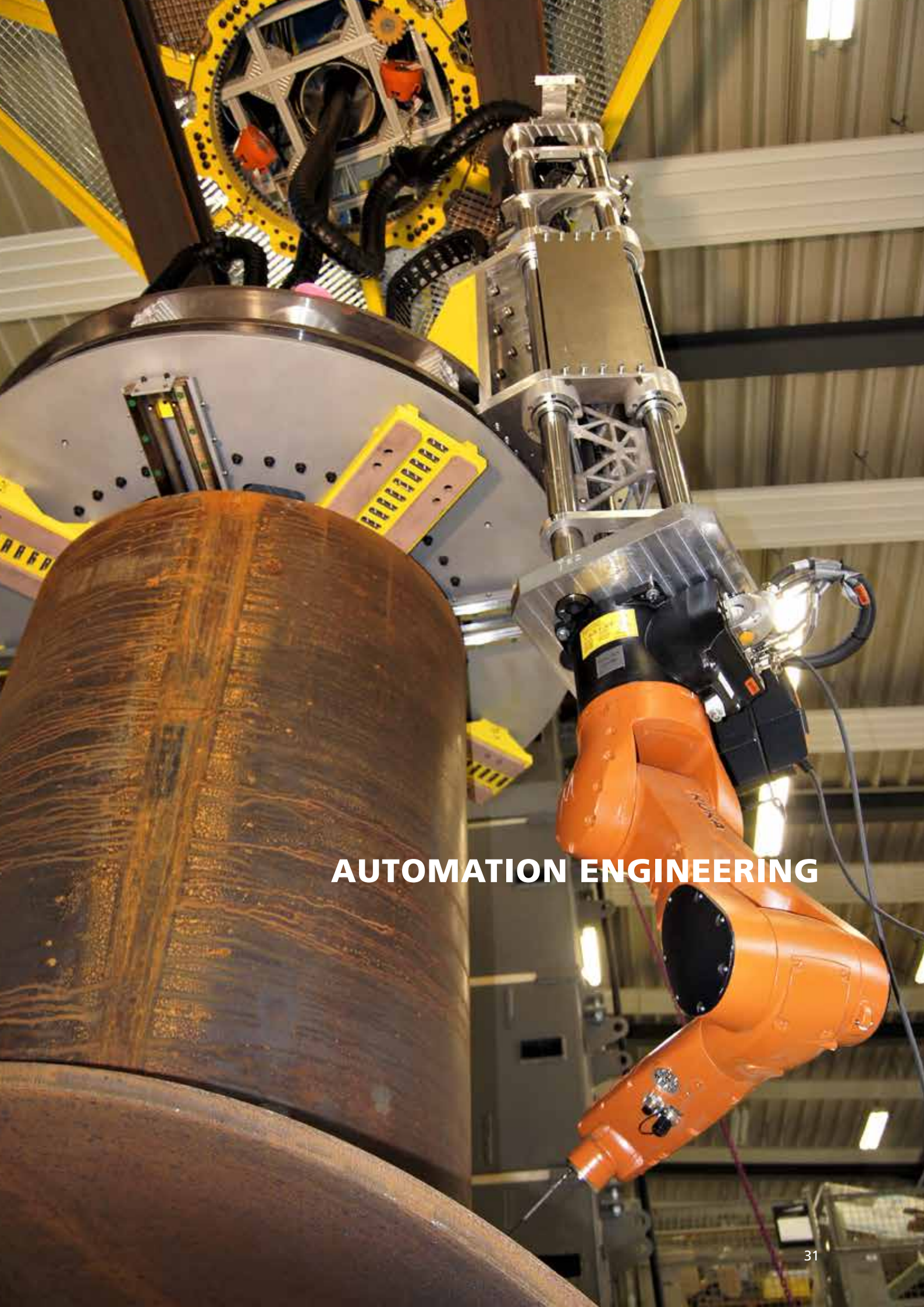
DIGITALISATION IN TRADES

TDespite the enormous importance of adhering to fixed deadlines in trade businesses such as interior fitters, the scheduling is largely analogous. In general, at present, the potential of digitisation is often not fully exploited in the trade sector. In order to exploit the full optimisation potential of this technology, a system
for complete digital assembly planning was developed in cooperation with a staircase manufacturer from Mecklenburg-Western Pomerania. All relevant data originates from defined interfaces to overarching production software systems and on-site digital data capture processes. Consistent data management, system-supported process structures and the application of role models allow for an increase in transparency of the holistic planning process.
For further details on this project, please see:
https://www.igp.fraunhofer.de/en.html

AUXILIARY SYSTEMS IN BATCH 1 ASSEMBLY SIZE



Particularly in the assembly of small batches up to batch size 1, attempts at automation are often uneconomical, so that humans are used due to their flexibility. Aiming for a smooth, fault-free process and a general reduction in throughput time requires auxiliary systems. Various approaches are being pursued and in a funded process innovation, a system for visual support as well as the process-dependent provision of the components to be installed in the control panel has been developed. This is based on the digital linking of the necessary components and work instructions with the respective process steps. The results include a projection for visual support of the process, optimised material supply and holistic process mapping. For further details, please see:
https://www.igp.fraunhofer.de/en.html



AUTOMATION ENGINEERING

AUTOMATION ENGINEERING

Automation plays a vital role in increasing the competitiveness of a company, especially in the context of Industry 4.0. In the production of large structures, in particular, the challenges lie in the small batch sizes and the large workpiece dimensions coupled with the large manufacturing tolerances of semi-finished products. When using robots in this environment, the cost of programming is a decisive factor in the use of robots. For this reason, our experts are working on automatic programming of such systems. Our solutions are being successfully implemented in the maritime industry. Their special feature is that they are based on analysis of 3D sensor data and require no connection to a CAD/CAM system. In addition to programming, the hardware requirements for the use of robots in the maritime industry are often not a given. Therefore, the team is engaged in the development and realisation of application-specific handling systems and end-effectors for various applications. In this context, we pursue a variety of paths. Our range of solutions extends from the classic robot cell, through the application of commercially available systems in mobile robot cells, to the complete development and implementation of application and industry-specific large and heavy-duty robot systems. The use of mobile robot systems, which enable the application of our robot technologies in new industries such as agriculture, is becoming increasingly important. We work closely with the specialist departments of the institute on an interdisciplinary basis.

This is new:

A state-certified technician and mechatronics engineer will strengthen the group in the prototypical implementation of our concepts. The SKM DCAM software is available for the offline programming of our robot cell for project work in the area of generative welding processes. An industrial 3D surface scan camera of the Cognex 3D-A5000 series extends our KUKA KR240 test field.

ACTIVITIES

Handling technology

- Development and realisation of robots and special kinematics designed to customer specifications
- Development of application specific end-effectors and devices

Control and regulation technology

- Development of individual robot and crane controls
- Integration of electric drive systems
- Measuring and sensor technology solutions for industrial use
- Process data processing and machine learning

Programming / sensor data processing

- Automatic robot programming
- Tool calibration and referencing
- Adaptive robot control

Robot applications

- In the field of joining, forming and generative processes
- Concept development of robot cells including the safety concept
- Selection and integration of tools and sensor technology
- Support for realisation

Group Head

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ADAPTER PIPES AND FLEXI PIPES

Hanseatic Rohr is a company that offers a comprehensive service for piping systems of all kinds within the maritime sector, both in new construction, at the shipyard or for repairs during the ongoing operation of the ship. This also includes fitting replacement or new pipelines. Many of these pipelines consist of adapter pipes, whose characteristic feature is that, based on the position of the flanges in relation to each other and the installation location, they can be manufactured in batch size 1 according to customer specifications. The production of these adapter pipes is currently carried out in a series of time-consuming, predominantly manual, sub-processes. This applies both to the actual production, as well as to upstream work stages, such as the analysis of the installation location and the drafting of the technical drawings. As a rule, the first sub-step is the definition of the pipeline geometry. This is carried out directly on site, whereby all measurements and additional photos for documentation purposes are recorded. The installation location is often difficult to view or access. Consequently, under these conditions it is often only possible to make a rough sketch by hand, which is then redrawn and refined later on in the development office and which also serves as the data basis for two processes running in parallel. On the one hand, it is integrated into a CAD tool for quality assurance and, on the other, it is the starting point for the actual manufacturing process.

In the manufacturing process, using the sketch as a guide, the pipe is firstly disassembled into the necessary individual component parts and the individual pipe segments prepared for welding. At this point, all the production steps from cutting to size and seam preparation to welding are carried out manually. The rigid pipe produced in this way is examined by an expert and compared with the CAD documentation. Where necessary, adjustments or corrections are carried out. Therefore, there is a long process chain, but it is also one that is highly flexible and can be adapted to different pipelines due to the very high manual work content.

The aim of this innovation is to improve the process chain in the future by targeted use of selected technical aids without compromising the flexibility of pipe production.

Due to the use of application-specific software for recording pipeline geometry, upstream processes can be combined and the documentation standardised. With the help of a mobile device, the software enables a sketch with all the necessary information to be made on site recording all the necessary dimensions and individual parts. In addition, photos taken can be directly assigned to the pipe geometry and documented by the software. The data supplied in this way is already prepared at this stage for the CAD tool, so that in future it will not only be a parallel process for quality control, but can also be directly integrated in the production process with the help of a script. CAD modelling is carried out automatically and can therefore be used directly to derive all the production-relevant data.

Although rigid pipes may be produced in very small batch sizes down to production of unique pieces, the precise definition of the product spectrum and frequent repetition of the process steps mean that a degree of automation can be usefully applied. One of the production steps is the welding of the round components. Due to the size of the components and the multilayer welding process, this step is cost-intensive if carried out manually. Robot systems, which are becoming increasingly cheap these days, can be installed here economically and efficiently so that the welding processes selected for the project can be automated with the use of robotics. The resultant partial automation of the upstream welding processes and the robot welding cell process chain saves customers time and money. Beyond this, the automatically generated documentation brings the benefit of consistently increased quality over the long term. For further details on this project, please see:
https://www.igp.fraunhofer.de/en.html

MEASURING OF LARGE STRUCTURES

MEASURING OF LARGE STRUCTURES

The main focus of the Measuring of Large Structures development team is on the capture, analysis and visualization of 3D measuring data in the field of production technology. An interdisciplinary team and a broad spectrum of digitalization methods for stationary and mobile applications are the basis of innovative solutions even under difficult conditions (e.g. underwater).

Using the latest measurement technology for capturing the shape and location of large structures provides the foundation for application-specific development of analysis and evaluation methods of geometric data. Together with industry partners, the research focus of 3D data-capturing develops concepts of measurement and quality management capturing the actual build state of various objects. A qualification of the measurement process for quality control as well as the development of the entire process chain of data acquisition is performed, the results are presented accordingly and the information is returned to the production process.

The research field data analysis focuses on solving fundamental questions regarding the interpretation of multidimensional sensory data. The overall objective is customized software engineering for the automated analysis of high-resolution 3D point clouds and additional data sources. With application-specific development for automated extraction of object-relevant information of 2D, 3D or higher dimensional data, modelling techniques are developed, measurement and analysis processes are automated and the state of the object is derived.

This is new:

We have expanded our competencies and increased the personnel in the field of evaluation and analysis of sound-based sensor systems for application in monitoring systems, production monitoring and, in particular, in combination with the existing competences in geometric 3D measurement technology (sensor data fusion).

ACTIVITIES

- Implementation and development of methods for geometric quality control as well as control of manufacturing processes by using modern 3D measuring methods
- Requirement-specific modelling of high-resolution point cloud datasets (reverse engineering)
- Analysis, consulting and conceptual design of measurement and testing processes as well as the derivation of recommendations for action to integrate the results
- Implementation of 3D tolerance analyses and measurement capability studies
- Creation of planning and simulation foundations based on 2D and 3D measurement data as well as data modelling for online programming of robots
- Application-specific software development for data evaluation, analysis and interpretation of point clouds
- Development of multi-sensor systems for the capture and interpretation of 3D data and integration of additional information sources
- Development of end-to-end systems for monitoring and interpretation of the current status of large structures, individual components, plants and processes (monitoring, lifecycle management, building information modelling)

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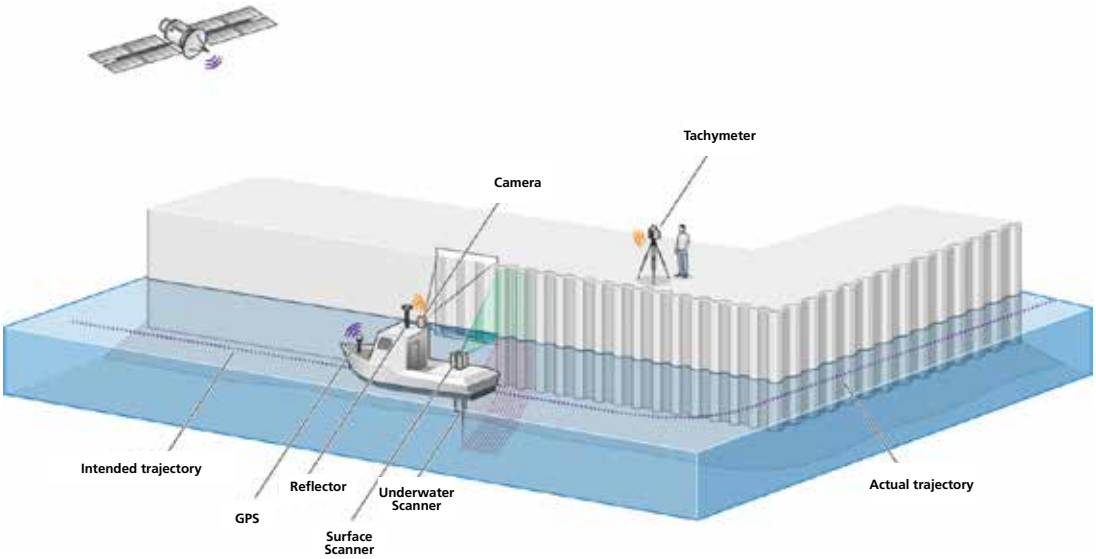
3D-HYDROMAPPER – HYBRID 3D INVENTORY DATA CAPTURE & MODEL-BASED TESTING OF WATERWAY STRUCTURES FOR SUSTAINABLE INFRASTRUCTURE LIFECYCLE MANAGEMENT



Water-side over and underwater data capture of a harbour structure by means of a multi-sensor system on a mobile carrier platform. Diagram: dhp:i

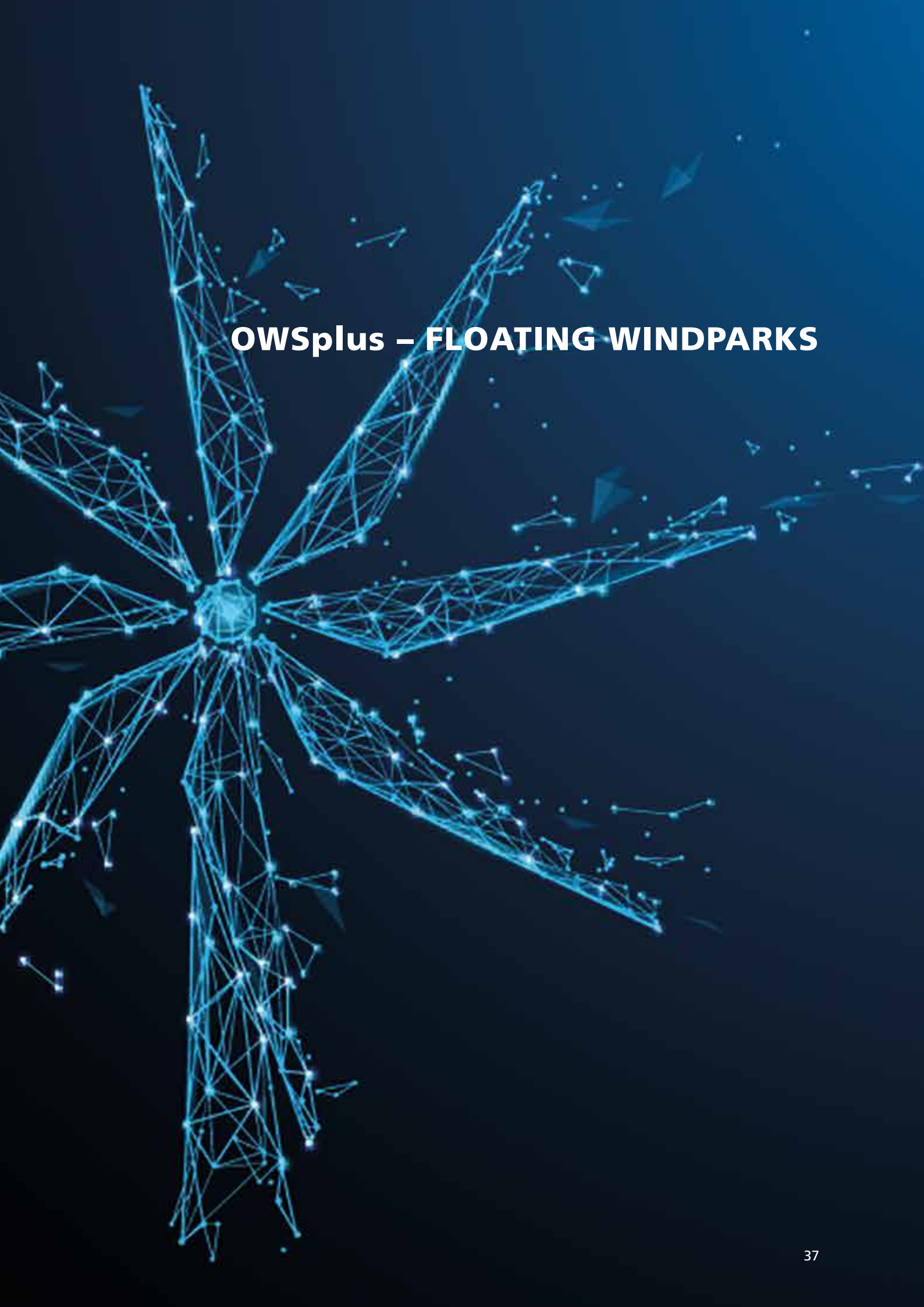
The ageing infrastructure of maritime and inland waterway transport needs to be regularly reviewed. Such inspections are carried out by diving engineers who inspect the structures visually. Automated inspection can considerably reduce personnel and time expenditure by improving the planning ability. The aim of this joint project is to achieve largely automated data capture processes, damage detection and modelling.

For this purpose, a platform is being developed with which the construction site inspection can be carried out on the water side. The platform is equipped with a hybrid multi-sensor system that records quality-assured and reproducible 3D data of harbour structures above and below the water surface (see Figure 1). On the basis of this area-based data, a geometric model is created, which is enhanced with further information. Especially relevant are the automatic derivation and classification of structural damage by means of pattern recognition methods and the analysis of the geometric model changes over time.

Using this model, the structure can be evaluated and appropriate measures initiated. The results will enable the port operator to focus on deploying a specific set of diving engineers for a considerably shorter period of time. This serves to increase both efficiency and safety at work. By creating and updating the building models, the port operator can devise the maintenance concepts and construction work following the building inspection transparently and safely. This has the benefit of significantly reducing both port facility downtimes and cost-intensive changes in the construction process. Complete digitisation of the construction data provides the basis for successful life cycle management.

In summary, the project addresses the development of IT-based hardware and software solutions for the combined 3D recording and modelling of surface and sub-sea structures and for the derivation of the damage classifications required for life cycle engineering, including the planning of maintenance measures. Due to the high degree of automation and associated increase in the availability of cargo handling, considerable cost and time savings can be expected for the port operators.

For more detailed information on this project, please see:
https://www.igp.fraunhofer.de/en.html



OWSplus – FLOATING WINDPARKS

FLOATING WIND PARKS: FRAUNHOFER IGP AS PARTNER IN THE OWSPLUS PROJECT – FLOATING OFFSHORE WIND SOLUTIONS

How entire offshore wind farms can „learn" to float is now being researched by 14 alliance partners from industry and science in Mecklenburg-Western Pomerania. The OWSplus project, funded by the German Ministry of Education and Research and the Innovative Regional Growth Core funding programme, was launched at Fraunhofer IGP in Rostock at the end of September 2019 as part of an official kick-off event.

The participating partners have set themselves no less a goal than to reach the next stage of evolution in the field of regenerative power generation. It is not possible to simply build a wind farm everywhere in the sea. In addition to political interests and environmental protection aspects, oceanographic and geological aspects influence development. Water depths of more than 60 metres make it impossible to install fixed structures. So far, there have been a handful of concepts for floating substructures – but these are not ready for industrial use and/or not economically viable. The OWS plus project aims to create structures that enable series production of the components.

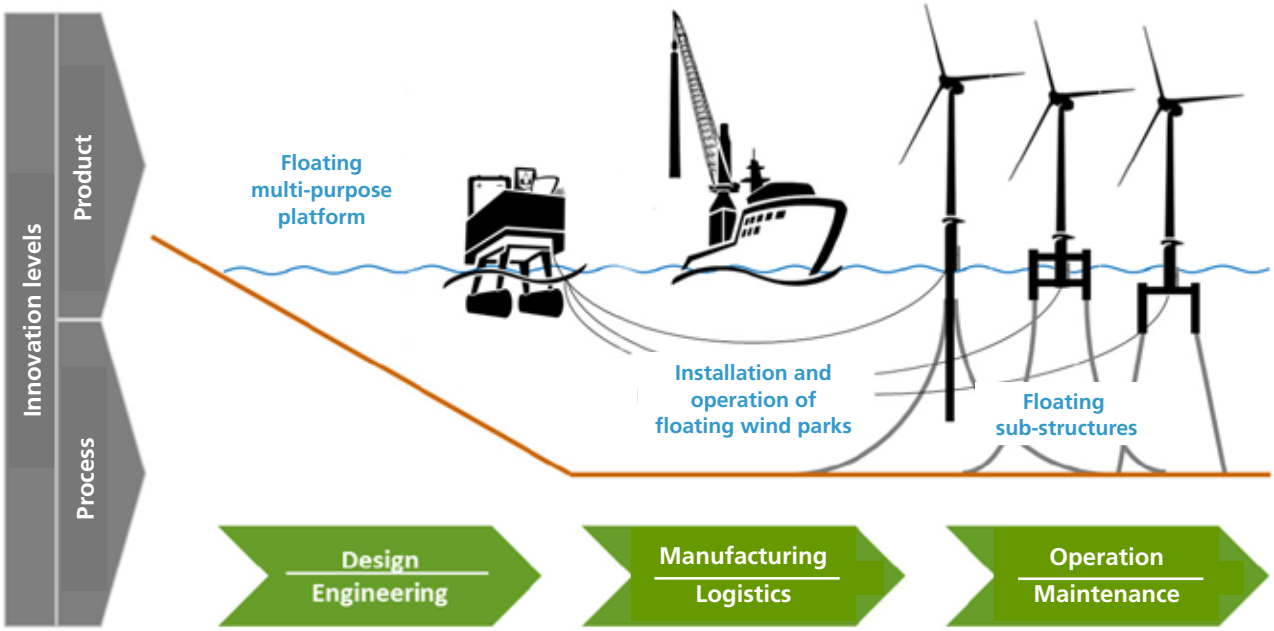
All project partners at the launch event at the end of September 2019. Image: Fraunhofer IGP Rostock

It is not just wind turbines that should be made to float. The transformer station will also be designed to „float" or even dive. These transformer platforms take over the transmission of electrical energy to the mainland. Among other aspects, they reduce energy loss. In this way, they enable energy to be transmitted over long distances. The system limits are set to be increased from 900 MW to 1600 MW, even at great distances from the coast.

A further issue is the maintenance and installation of the floating systems. They are designed to be adapted, also to environments which do not have the corresponding technology or maritime infrastructure. Practicable solutions for the transport and installation of floating offshore technology and suitable operation and maintenance concepts will also be created.

Fraunhofer IGP working on three sub-projects

The Fraunhofer Institute for Large Structures in Production Engineering IGP is one of two research institutions participating in the project. In three sub-projects, the scientists of Fraunhofer IGP are researching, among other topics, the development of vibration-resistant, insulated supporting structures for electrical systems and the corrosion protection of floating multi-purpose platforms. The scientists are also working on providing the metrological underwater structure analysis of floating wind farms. „We are very pleased to be able to participate in this major project. With our work, we aim to make an essential contribution to promoting the competitiveness of offshore wind power" explains Dr -Ing. Michael Irmer, adding: "Over the next three years, we will be able to develop solutions that will significantly increase the availability of floating wind turbines and the performance of floating transformer platforms. With OWSplus, we are taking an important step towards reliable and affordable renewable energy".



The aim of the project is to design floating wind parks. Diagram: OWSplus

The total investment volume for OWSplus is approximately EUR 28 million. The project is split into three collaborative projects: Joint project 1 - Floating substructures; Joint project 2 - Floating multipurpose platforms and Joint project 3 - Installation and maintenance of floating wind farms. The project partners include 12 companies and two scientific institutions. All the partners have many years of experience in the maritime industry and especially in the offshore sector. The OWSplus project is set to run for an initial term of three years.

Fraunhofer IGP is working on the following sub-projects in core growth areas of OWSplus:

Subproject 1:
Methods for the simulation-supported planning of various two-product-matrix manufacturing plants on the basis of real-time data.

Subproject 2.1:
Development of vibration-resistant, insulated supporting structures for electrical installation

Subproject 2.2:
Development of a technology for the automated corrosion protection of floating multi-purpose platforms

Sub-project 3.1:
Digital technology development for equipment-related installation management

Subproject 3.2:
Sub-sea structural analysis of floating wind farms

Project Management
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For more detailed information in the project and sub-projects, please see: https://bit.ly/3iymSV1 or simply scan the QR code above.

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INFORMATION FOR NEWCOMERS AND EXPERIENCED PROFESSIONALS

You think living for science and boosting the economy at the same time is not possible? Well it is! At Fraunhofer, it is precisely this paradox that is the key to success. Only those who break new ground can shape the future. By turning scientific findings into tangible products and services, you can make a significant contribution to growth, competitiveness and employment all over the world.

You think you can't do a PhD with a practical orientation? Here, you can! With us, you will not write your doctoral thesis alone. You will be integrated into our project teams from the very beginning and will be able to apply your knowledge in practice. At Fraunhofer, you will find the ideal mix of theory and practice.

A position at Fraunhofer IGP is more than just a job. With us, you benefit from close networking with business enterprises and exchanges with experts beyond your own location. We are looking for personalities who are committed to their field and want to help shape the future. We rely on your professional competence. Excellently equipped offices, laboratories and workshops as well as a culture characterised by team spirit creates the best conditions for project success.

Human Resources Manager

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INFORMATION FOR STUDENTS AND SCHOOL PUPILS

You're looking for more than just a student job! At Fraunhofer IGP, you will have the opportunity of getting a taste of practical work during your studies. We offer you a long-term cooperation and varied activities in different fields. Exciting tasks in dynamic teams and a friendly atmosphere await you. We know all about the challenge of combining studies and a job. That's why with us, you can arrange your working hours flexibly by individual arrangement. You may even find the topic for your final dissertation in one of our projects. We are always open-minded and will tackle any issues together with you. Come to us as an assistant and who knows, maybe you will stay on for your PhD.

Or are you looking for an internship? Depending on available capacity, we offer compulsory internships in accordance with the study regulations of the respective university and voluntary internships during your studies lasting up to three months as well as work experience for school pupils.

Trainees wanted! We offer our trainees the best possible start to their professional careers. This includes more than a first-class working environment: practical work with plenty of freedom. Armed with the Fraunhofer knowledge you will have acquired during your training, you will find excellent opportunities for a subsequent study course or as a qualified specialist opening up.

Human Resources Manager

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Find out about a career at Fraunhofer IGP in Rostock at:
www.igp.fraunhofer.de/de/karriere

Our technical employee Maria Schur at her desk in the Mechanical Joining Technology Lab. Image: Fraunhofer IGP Rostock

MARIA SCHUR – BREAKING DOWN STEREOTYPES: AN AUTOMOTIVE MECHATRONICS ENGINEER BRINGING THE WINDS OF CHANGE INTO THE LABORATORY

Fraunhofer EMPLOYEE Maria Schur is one of eleven technical-scientific employees at Fraunhofer IGP in Rostock. She is still the only woman in her working group – but she is keen to see more female support in the future.

Maria Schur has been working at the Fraunhofer Institute for Large Structures in Production Engineering IGP since the end of 2018. The 25-year-old from Rostock is a qualified automotive mechatronics engineer. Her interest in technology runs in the family. "My father is a master craftsman in heating, plumbing and ventilation. We have always driven old cars. They broke down at times. My father repaired the cars himself. I always wanted to know how the car worked. We repaired everything together – no matter what broke down at home", explains Maria. After an internship in a car factory, her decision was clear: Maria completed her training as a car mechatronics technician. „There were only three women in my training year", she recalls. "My colleagues in the factory were very sceptical at first and I had to prove to them that I could do the same job they were doing. Maria is a member of the Mechanical Joining Technology department at Fraunhofer IGP. She is the only woman in her group, but she is not the only female technical-scientific employee at the Fraunhofer IGP.

The number of female scientists is growing steadily

The mechatronics engineer is one of four technical employees and seven engineers. These eleven employees are joined by more than 60 scientific and technical staff. However, Fraunhofer is working on encouraging the next generation of women in the field of mechanical engineering: "Not counting the women in admin, we currently have eight female students working as research assistants. We would like to increase this number and so we are aiming to encourage students from the MINT fields (Maths, IT, Natural Science and Technology) to actively apply for a job with us", explains Human Resources Manager, Claudia Bäcker.

A varied range of tasks

"I get along very well with my colleagues. In any case, working here is completely different to working in an automotive workshop", says Maria happily. She is responsible for the laboratory in the group. Her position was newly created in 2018: „I had a great deal to do at the beginning to bring order and an overview into the laboratory. The work is certainly very varied. I prepare experiments. I have to deal with standards and regulations and also take on administrative tasks. I can and must undergo ongoing training. For sure, it's never boring here". Rostock-born Maria appreciates the good cohesion among colleagues as well as the fact that she can work freely and, above all, independently. In October 2020, Maria will start further training to become a state-certified technician – with support from Fraunhofer IGP, of course.

Women taking their first steps on the career ladder transform into technical experts

Lisa Knaack, Head of Administration, began her career at the institute as an engineer and is pleased about the increasing number of female scientific staff: "When I started at Fraunhofer IGP in 2012, I was the first female research assistant at the Rostock site. Since then, the number of female scientists has steadily grown and young women taking their first steps on the career ladder have become experts who are in no way inferior to their male colleagues". The Fraunhofer Society specifically supports the promotion of female scientists with programmes such as "Talents" and "speed up". Fraunhofer IGP will remain actively involved in the future in order to inspire both boys and girls to pursue a career in science.

Maximilian Schlicht has been working for Fraunhofer IGP since 2019. He started as a scientific research assistant in 2017 and wrote both his student research project and his Master's thesis at the Institute. Image: Fraunhofer IGP Rostock

MAXIMILIAN SCHLICHT – OUR SIMULATOR SPECIALIST FOR ANY SITUATION: THE ROAD FROM STUDENT WORK PLACEMENT TO SCIENTIST

Maximilian Schlicht has been working as a scientific research assistant at the Fraunhofer IGP since 1 January 2019. In 2017, he started as a student assistant in the Joining and Forming by Plastic Deformation department. Max is a specialist in joining process simulation, which he does with heart and soul.

"We are currently in the process of simulating various joining processes. This shows how well simulation, which is a rather abstract construct, really does reflect reality", Max explains, simplifying a very complex part of his work. Max, originally from Schwerin, began his mechanical engineering studies at the University of Rostock in 2013. As a student, he made thinking about his professional future a project. „Back then, a friend of mine was already committed to mechanical engineering. I found it very interesting and I prepared my portfolio and my presentation accordingly. My friend is now studying chemistry but I've stuck with mechanical engineering, which so far has proven to be the ideal path for me", he explains, smiling as he does so.

A part-time job that also helps professional advancement

When he was looking for a part-time job, he became aware of Fraunhofer IGP thanks to a fellow student. "She told me about her part-time job in the field of adhesive bonding technology. That was perfect. I wanted a student job where I could gain work experience during my studies. I applied to my current group – at that time still mechanical joining technology. And it worked out well".
Subsequently, Max also wrote his student research project and his Master's thesis at Fraunhofer IGP. The topic of the thesis: "Numerical simulation of the installation process of solid punch rivets with varying geometry and material concepts" He wrote with a few weeks less time than originally planned. This was because he needed enough time to apply for a research assistant position advertised, which was to be filled from 1 January 2019. „I defended my Master's thesis at the end of November 2018, and then I had to write my application fast". He got the job.

What's going on in the area around joint seams?

Max has not yet decided the topic for his PhD, but it will definitely be in the direction of simulation. At the moment, Max is working on the „Friction-based crack initiation" project, which is presented on page 18 of this report. „The advantage of a simulation – if you trust it – is that you gain knowledge that you cannot measure in any other way. In the current project, for example, it is difficult to see what is going on in the area around the joint seams. This is where we try to help ourselves using simulation, so we can see what happens between the metal sheets when they are joined.

Fraunhofer as a link between university and industry

Max has not regretted his move from university directly to Fraunhofer after his studies. During his studies, Max lived together with a physicist and a chemist: three nerds sharing a small student flat! Both ex-flatmates and very good friends are now also taking their PhDs. "But they have far less time than we do. It's much more comfortable here. I have talked a lot about it with friends who went straight into industry. I think that Fraunhofer is definitely a good springboard. The Fraunhofer Society sees itself as the transition between university and industry. You can make a variety of different contacts in industry and even if you don't complete your PhD in the end, in my opinion, Fraunhofer is a very good reference on your CV. I am gaining so much experience in project work".

Dr Michael Irmer, Team Leader Corrosion Protection, makes offshore wind turbines more efficient. Image: Fraunhofer IGP Rostock

DR MICHAEL IRMER HAS BEEN AT FRAUNHOFER IGP SINCE 2007 – HE HAS SEEN THE GROWTH OF OUR INSTITUTE!

Born in Rostock, Dr Michael Irmer began his Fraunhofer career as a student assistant. At that time, the institute was still an Application Centre (AGP). Today, Dr Irmer is head of the Corrosion Protection team in the New Materials and Processes department.

Offshore wind turbines were not his first passion. „Actually, I wanted to work in the automotive industry. I did an internship at Daimler in Berlin in 2009/2010. I could have written my diploma dissertation there, but my chances of being taken on were poor at the time", explains Dr Irmer. Prior to this, he had been employed as a research assistant at Fraunhofer AGP since September 2007. He studied industrial engineering at the University of Rostock, and in addition to his job as a night porter in a hotel, he worked in the Application Centre for Mechanical Joining Technology. „At that time, only the technical centre and its offices was located in the hall", he recalls. Instead of writing his diploma dissertation at Daimler, Michael contacted his old employer and ended up writing his dissertation at the AGP in Rostock. His topic: „Development of a concept for the strategic orientation of a research institution in Mecklenburg-Western Pomerania in the field of wind energy". The transfer from Daimler worked out equally well here.

A switch to Adhesive Bonding Technology

On 1 January 2011, Michael joined the staff of Fraunhofer AGP. He switched from Mechanical Joining Technology to Adhesive Bonding Technology. At the time, Group Head, Dr Nikolai Glück, had the POLAR research project on his desk and asked: "Wouldn't you like to deal with the subject of corrosion?" With a smile, Michael tells us today: „I had no idea about that. I think there was only one lecture in the entire course of studies that dealt with corrosion. But I gladly accepted the challenge. Nikolai put the application documents on my desk, promised me his support and then it was all systems go!" Michael has continued to work within the areas of corrosion and offshore wind energy to this day. In 2019, he successfully completed his PhD on: "The impact of mechanical stress on the longer-term effectiveness of corrosion protection in multi-layer organic coating systems using the example of offshore wind turbines". Corrosion has a major impact on the economic efficiency of offshore wind turbines.

Corrosion protection will remain an important subject in the future

Corrosion has a major influence on the economic efficiency of offshore wind turbines. "Corrosion is always associated with high costs. I am a huge fan of offshore wind energy. It simply has to become even cheaper. One starting point for this is to avoid corrosion damage and to make repairs as cost-effective as possible. The future belongs to energy generation with offshore wind turbines. With the results of my work, they can become even more competitive", explains Michael.

Plenty of room for development and a great team!

Michael, who is originally from Rostock, has never regretted that he did not end up in the automotive industry. „From friends who work in this field, I know that people work in a narrow specialist area. At Fraunhofer, you can develop far more freely and choose the fields in which you work. The Fraunhofer Society enables me to identify my strengths and to develop them. This gives me the chance to expand my skills on an ongoing basis and to continue my training in a targeted manner".
Michael heads a very young team and is looking forward to future tasks at the Fraunhofer IGP: "We're a great team. We're highly motivated and up for any challenge! We definitely want to grow in the future".

ASSOCIATION, ALLIANCE AND COMMITTEE ACTIVITIES

Fraunhofer Production Group

The Fraunhofer Production Group is a research and development partner for the manufacturing industry. More than 2,200 employees from eight institutes and three Fraunhofer facilities contribute their knowledge and experience. Using the latest findings from production and engineering sciences as well as Information Technology, the Fraunhofer Production Group offers a range of services that covers the entire product life cycle or value creation chain. Research and industry are closely linked here on an interdisciplinary basis.

www.produktion.fraunhofer.de

Fraunhofer Traffic and Transportation Alliance

Since March 2003, a number of Fraunhofer institutes and facilities have been pooling their transport-related expertise in the Fraunhofer Traffic and Transportation Alliance. The members of the Alliance have set themselves the goal of developing suitable technical and conceptual solutions for public sector and industrial clients through transport-relevant research and to translating these solutions into applications. Close, topic-related cooperation in the transport sector enables the development of holistic system and network solutions for clients as well as new areas of application through the transfer of technical expertise. This selection and bundling of the most diverse competencies ensures that Fraunhofer can offer solutions tailored to customer needs. www.verkehr.fraunhofer.de

Committee activities

Research Association for Shipbuilding and Marine Technology e.V.
Prof. Dr-Ing. W. Flügge – Member Technical Advisory Board
Prof. Dr-Ing. habil. K.-M. Henkel – Member of the technical-scientific committee

German Welding and Allied Processes Association e.V. (DVS)
Prof. Dr -Ing. habil. K.-M. Henkel – Chairman of the Association for Mecklenburg-Western Pomerania; Chariman of the Committee of the Regional Associations; Deputy President DVSdent

Research Association for Steel Application e.V. (FOSTA)
Prof. Dr -Ing. W. Flügge – Member of the Technical Board of Trustees

Maritime Alliance Baltic Sea Region e.V.
Dr -Ing. J. Sender – Chairman

Cooperation Network RIC MAZA MV e. V.
Dr -Ing. J. Sender – Member of the Board

Technology & Innovation Group for Economy/Science of Mecklenburg-Western Pomerania
Prof. Dr.-Ing. M.-C. Wanner – Member

Scientific Society for Assembly Handling Technology Industrial Robots
Prof. Dr.-Ing. M.-C. Wanner – Member

Working Group XXL products
Prof. Dr.-Ing. W. Flügge – Member

German Institute for Structural Engineering
Prof. Dr -Ing. R. Glienke – - Member of the expert committee SVA Metal Construction and Composite Construction

European Research Association for Sheet Metal Processing e.V.
Dr -Ing. C. Blunk, M.Sc. M. Schwarz – Member Community Committee DVS / EFB AGMF3/V10.3 Mechanical joining - Blind rivets and lockbolts
Dr -Ing. C. Denkert – Deputy Chairman/Secretary - Community Committee DVS / EFB AGMF4/V10.4 Mechanical joining - Functional elements
Dr -Ing. C. Denkert – Member – Community Committee DVS / EFB AGMF7/V10.7 Mechanical joining – Design and Calculation
Dipl.-Ing. M. Dörre – Member – Community Committee DVS / EFB AGMF4/V10.4 Mechanical joining – Functional elements
M. Sc. R. Staschko – Member – Community Committee DVS / EFB AG MF1/V10.1 Mechanical joining – Self-pierce riveting
Prof. Dr -Ing. Ralf Glienke Deputy Chairman Community Committee DVS/ EFB AGMF3/V10.3 Mechanical joining - blind rivets and lockbolts

GfKORR - Society for Corrosion Protection e.V., Wind Energy Working Group
Dr.-Ing. M. Irmer – Mitglied
Hanse Aerospace e.V., Hamburg
Prof. Dr.-Ing. W. Flügge – Member of the Scientific Advisory Board
REFA Landesverband Mecklenburg-Vorpommern e.V.
Dr.-Ing. J. Sender – Member of the Board
Shipbuilding Association
Prof. Dr.-Ing. M.-Ch. Wanner – Head of the FA Work Organisation and Production Technology and member of the Technical and Scientific Advisory Board
DVS Committee for Technology
Dr -Ing. A. Gericke, M.Sc. O. Brätz – Member - AG V 2.5 Subsea arc and electroslag welding
Prof. Dr -Ing. habil. K.-M. Henkel, M.Sc. O. Brätz, M.Sc. B. Ripsch - Members - AG V 4 Underwater Technology
Prof. Dr -Ing. habil. K.-M. Henkel, Dr.-Ing. A. Gericke – Members – AG A 6.1 Welding in shipbuilding and Marine Technology – Welding Methods, Production Prof. Dr -Ing. habil. K.-M. Henkel, Dr -Ing. A. Gericke – Members
– AG A 6.2 Welding in shipbuilding and marine technology
– Damage to welded shipbuilding structures
Dr -Ing. N. Glück – Member – DVS Technical Committee 11 Joining of Plastics; DVS Working Group AG W 4.14 Joining of endless fibre-plastic composites
Research Association of the DVS
Prof. Dr -Ing. habil. K.-M. Henkel, Dr -Ing. A. Gericke Members – FA 03 Arc welding
Prof. Dr -Ing. habil. K.-M. Henkel, M.SC P. Andreazza, Dr.-Ing. A. Gericke – Members – FA 07 Soldering
Prof. Dr -Ing. habil. K.-M. Henkel, M.Sc. O. Brätz, M.Sc. B. Ripsch – Member – FA V4 Underwater Technology
Working Groups of the International Institute of Welding
M.Sc. O. Brätz – Memeber – IIW Commission II
Arc Welding and Filler Metals
Dr.-Ing. A. Gericke Member – IIW Commission XIII Working Group 2 Techniques for improving the fatigue strength of welded components and structures; IIW Commission XII
Arc Welding Processes and Production Systems
WIND ENERGY NETWORK e.V.
Dr-Ing. Nikolai Glück – Revisor for 2019

Expert opinion activities

German Federation of Industrial Research Associations "Otto von Guericke" e.V.
Prof. Dr -Ing. W. Flügge, Prof. Dr -Ing. habil. K.-M. Henkel, Prof. Dr -Ing. M.-Ch. Wanner – Expert Assessors
Federal Ministry for Economic Affairs and Energy
Prof. Dr -Ing. M.-Ch. Wanner – Expert Assessor for the "Innovative shipbuilding secures competitive jobs" funding initiative
German Research Foundation
Prof. Dr -Ing. W. Flügge, Prof. Dr.-Ing. M.-Ch. Wanner – Expert Assessors

Standardisation activities

German Institute for Standardisation e.V. (DIN)
Prof. Dr.-Ing. R. Glienke – Member of the Advisory Board NA 092 DIN Standards Committee for Welding and allied processes (NAS)
DIN Standards Committee for Welding and Allied Processes
Dr -Ing. N. Glück – Member - DIN Working Committee NA 092-28 AA: Bonding technology (DVS AG V 8); DIN Working Committee NA 092-00-28-01 Working Committee: Process chain bonding technology; DIN Working Committee NA 092-00-28-02 Work: Bonding of fibre reinforced plastics;

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ANNUAL REPORT 2019 – ACHIEVEMENTS AND RESULTS OF FRAUNHOFER IGP

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Editorial, layout and production: Mag. Silke Schulz
Image credits: Excluding all Fraunhofer IGP images: Gesellschaft für Wirtschafts- und Technologieförderung Rostock mbH, Rostock Business and Technology Development GmbH: Page 10 image NEVA; Digitisation Unit, International Affairs of the Ministry for Energy, Infrastructure and Digitisation of Mecklenburg-Western Pomerania: Page 11 image NØRD; IW: Page 24 top image; Adobe Stock: Title image, Pages: 15, 17, 18, 19, 20, 21, 23, 24, 26, 27, 29, 30, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 43, 45, 47; FAS: Page 21 bottom photo; dhp:i: diagram page 36; OWSplus: diagram Page 39
Print: Druckerei WEIDNER GmbH
Translation: mostly arb limited, London
Equality and gender: For reasons of improved readability, we have in some cases refrained from using both female and male language forms in our wording. However, this does not imply any discrimination against the female sex, but should be understood as gender-neutral in the sense of linguistic simplification.

Reporting period: 1 January to 31 December 2019
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Mecklenburg Vorpommern MV tut gut.
Bundesministerium für Verkehr und digitale Infrastruktur
Europäische Fonds EFRE, ESF und ELER in Mecklenburg-Vorpommern 2014-2020

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The Fraunhofer-Gesellschaft is the world's leading applied research organization. With its focus on developing key technologies that are vital for the future and enabling the commercial exploitation of this work by business and industry, Fraunhofer plays a central role in the innovation process. Based in Germany, Fraunhofer is an innovator and catalyst for groundbreaking developments and a model of scientific excellence. By generating inspirational ideas and spearheading sustainable scientific and technological solutions, Fraunhofer provides science and industry with a vital base and helps shape society now and in the future.

At the Fraunhofer-Gesellschaft, interdisciplinary research teams work together with partners from industry and government in order to transform novel ideas into innovative technologies, to coordinate and realize key research projects with a systematic relevance, and to strengthen the German and the European economy with a commitment to creating value that is based on human values. International collaboration with outstanding research partners and companies from around the world brings Fraunhofer into direct contact with the key regions that drive scientific progress and economic development.

Founded in 1949, the Fraunhofer-Gesellschaft currently operates 74 institutes and research institutions. The majority of our 28,000 staff are qualified scientists and engineers, who work with an annual research budget of 2.8 billion euros. Of this sum, 2.3 billion euros is generated through contract research. Around 70 percent of Fraunhofer's contract research revenue is derived from contracts with industry and publicly funded research projects. The remaining 30 percent comes from the German federal and state governments in the form of base funding. This enables the institutes to work on solutions to problems that are likely to become crucial for industry and society within the not-too-distant future.

Applied research also has a knock-on effect that is felt way beyond the direct benefits experienced by the customer: our institutes boost industry's performance and efficiency, promote the acceptance of new technologies within society, and help train the future generation of scientists and engineers the economy so urgently requires.

Our highly motivated staff, working at the cutting edge of research, are the key factor in our success as a scientific organization. Fraunhofer offers researchers the opportunity for independent, creative and, at the same time, targeted work. We therefore provide our employees with the chance to develop the professional and personal skills that will enable them to take up positions of responsibility at Fraunhofer, at universities, in industry and within society. Students who work on projects at Fraunhofer Institutes have excellent career prospects in industry by virtue of the practical training they enjoy and the early experience they acquire of dealing with contract partners.

The Fraunhofer-Gesellschaft is a recognized non-profit organization that takes its name from Joseph von Fraunhofer (1787–1826), the illustrious Munich researcher, inventor and entrepreneur.

Last updated: January 2020

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