



**Fraunhofer Institute for Large Structures in Production
Engineering IGP**

Annual report 2020

The Fraunhofer-Gesellschaft

With its headquarters in Germany, the Fraunhofer-Gesellschaft is the world's leading organization for applied research. With its focus on developing key technologies that are vital for the future and enabling the commercial exploitation of its results by business and industry, Fraunhofer plays a central role in the innovation process. It is a pioneer and catalyst for groundbreaking developments and scientific excellence. The Fraunhofer-Gesellschaft promotes science and business with inspiring ideas and sustainable scientific and technological solutions and helps shape our society and our future.

Together with contract partners from industry and the public sector, interdisciplinary research teams at the Fraunhofer-Gesellschaft transform original ideas into innovations, coordinate and implement system-relevant, key research policy projects, and strengthen the German and European economy with ethical value creation. International collaborations with excellent research partners and companies around the world ensure direct exchange with the most influential scientific and economic areas.

Founded in 1949, the Fraunhofer-Gesellschaft currently operates 75 institutes and research units. Around 29,000 employees, the majority of whom are qualified scientists and engineers, work on an annual research budget of 2.8 billion euros. Of this sum, 2.4 billion euros are generated through contract research. Fraunhofer generates around two thirds of this with orders from industry and publicly funded research projects. The German federal and

state governments contribute around one third as base funding so that the institutes can develop solutions to problems today that will become vitally important for the economy and society within a few years.

The effect of applied research goes far beyond the direct benefit for the client: Fraunhofer Institutes boost the performance and efficiency of industry, promote the acceptance of new technologies within society, and help train the future generation of scientists and engineers the economy so urgently needs.

Our highly motivated staff, working at the cutting edge of research, are the key factor in our success as a scientific organization. Fraunhofer therefore offers the opportunity for independent, creative and at the same time goal-oriented work and therefore for professional and personal development, which qualifies for demanding positions in the institutes, at universities, in business, and in society. Students have excellent career prospects in industry on account of the practical vocational training they enjoy and the early experience they acquire of dealing with contract partners.

The Fraunhofer-Gesellschaft, which is recognized as a non-profit organization, was named after the Munich scholar Joseph von Fraunhofer (1787–1826). He was equally successful as a researcher, inventor, and entrepreneur.

Figures last updated: January 2021

Annual report 2020

**Fraunhofer Institute for Large Structures in
Production Engineering IGP**

Welcome



Dear readers,

2020 challenged us in a way that none of us could have expected. Suddenly, and then for more than twelve months, our office-dominated way of working was turned on its head. The coronavirus forced us all to explore new paths and — in many ways — to reinvent ourselves. With suddenly working from the home office and having one digital conference after another, it became clear that collaboration was being entirely redefined. Life at home also changed. Children and the home office is a balancing act that many of my colleagues — and certainly also yours — had to master.

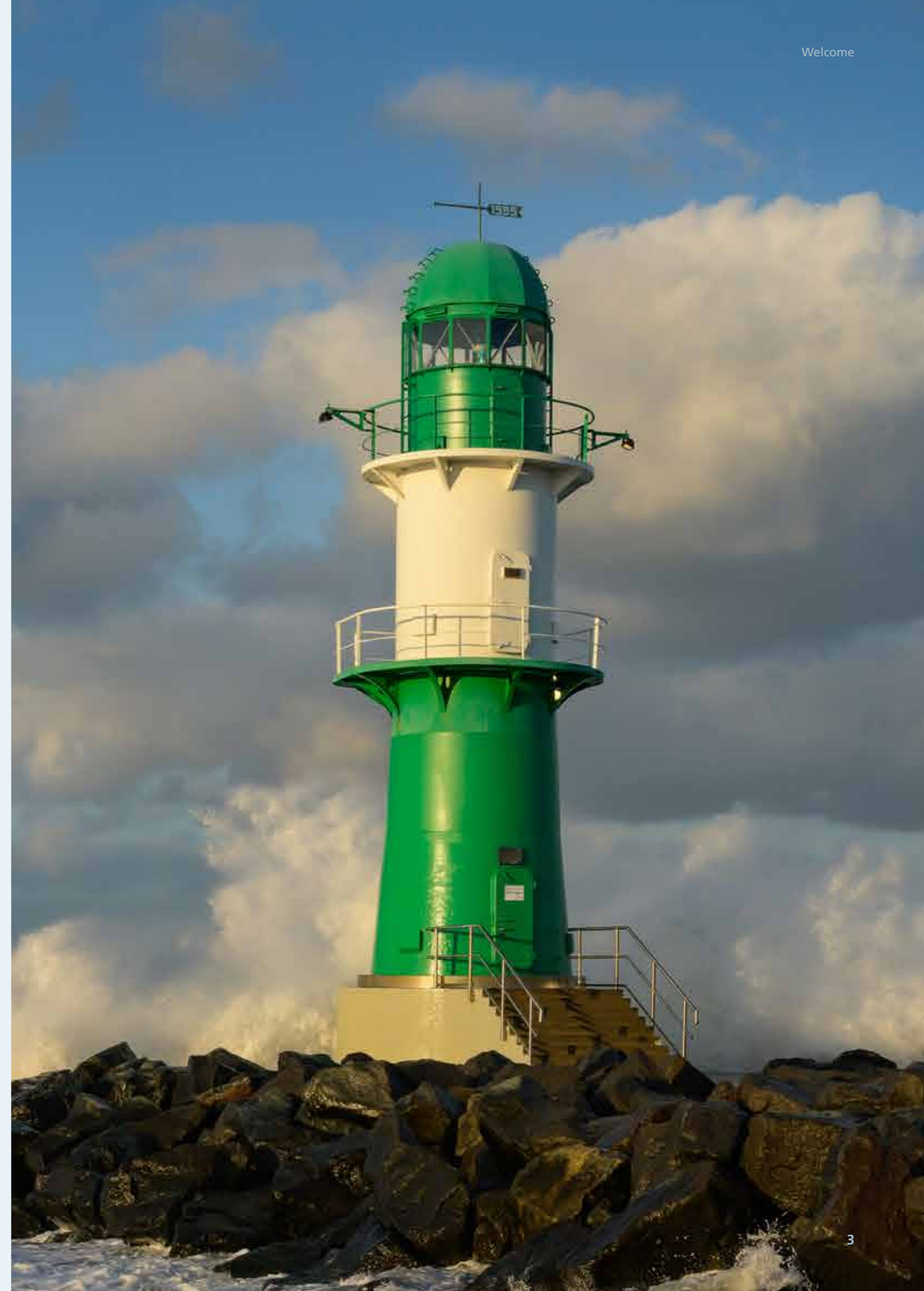
The past year also presented our research partners with major challenges. Some of these issues have been overcome, and for others no viable solution has yet been identified. Throughout all of this, Fraunhofer IGP remained a reliable partner. Especially for the small and medium-sized companies in our home state of Mecklenburg-West Pomerania, we want to be a solid rock in these turbulent times. A crisis is always an opportunity. We take the newly gained flexibility from the coronavirus period as a positive realization. We want to support you with the innovation and technology transfer to not only hold your own with the competition, but to instead be one of those leading the way forward. In these challenging times, you can look to us as a lighthouse of sorts.

The fresh, new design of the Fraunhofer-Gesellschaft gives you an overview of the activities from a year where we all learned a lot. Enjoy reading!

Best regards,

A handwritten signature in black ink, appearing to read 'Wilko Flügge'.

Prof. Wilko Flügge
Head of Fraunhofer IGP



Contents

Fraunhofer Institute for Large Structures in Production Engineering	6
2020: The facility becomes a Fraunhofer Institute	6
An overview of the Institute	8
Organizational chart	9
An interview with Institute director Prof. Wilko Flügge: An unusual first year as a Fraunhofer Institute	10
Fraunhofer IGP Prize 2020 Webasto for Thermo & Comfort SE	14
Annual Review	16
Hydrogen research for Mecklenburg-West Pomerania	18
Areas of expertise	20
Production technology	22
New processes and materials	34
Production organization and Logistic	48
Career — The way to us!	60
Scientists at Fraunhofer IGP: Cynthia Hoppe	62
Scientists at Fraunhofer IGP: Valeska Cherevko	64
Service	66
Associations, alliances, and committee work	66
Publications	68
Contact	74
Publishing notes	75
Photo credits.....	76



2020: The facility becomes a Fraunhofer Institute

Fraunhofer IGP finds solutions for special challenges in production

IGP
The first Fraunhofer Institute with its headquarters in Mecklenburg Western Pomerania

What does the innovative production of large structures look like in the future? The Fraunhofer Institute for Large Structures in Production Engineering IGP in Rostock has been researching this since the beginning of 2020. The new 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 construction as well as mechanical and plant engineering. The formerly independent facility was transferred to a Fraunhofer Institute at the beginning of 2020, making it the first institute of the Fraunhofer-Gesellschaft with its headquarters in Mecklenburg-West Pomerania.

Ever larger and more complex constructions have to withstand extreme mechanical and climatic loads. To address these challenges, the Fraunhofer Institute for Manufacturing

Engineering and Automation IPA founded a project group in Rostock back in 1992. This gave rise to the independent Fraunhofer Research Institution for Large Structures in Production Engineering IGP, which has officially been an institute of the Fraunhofer-Gesellschaft since the beginning of the year. The scientists specialize primarily in finding resource-saving alternatives that relieve the burden on the environment and on workers. The aim of the research is to develop comprehensive solutions that enable more cost-effective and quality-oriented production.

Strong research partner in the northeast

"Resource-saving solutions for special challenges in production are an essential building block for central industrial sectors in Germany and Europe," said Prof. Reimund Neugebauer, President of the Fraunhofer-Gesellschaft, when the institute was established. "With the opening of Fraunhofer IGP, Germany is adopting

a leading position in the development of efficient large-scale structures in production — a decisive contribution to making industrial value chains sustainably future-proof in international competition."

The number of employees at the institute has risen steadily since 2017. The building is currently being expanded in a fourth construction phase to include a factory area with laboratories and offices. "For many years, we have been a reliable and strong research partner for industry in Mecklenburg-West Pomerania and beyond. In the past two years, we have been able to expand our collaborations further. In the future, we will continue to promote our competencies actively in the area of large structures," says Institute Director Prof. Wilko Flügge.

In the large extension of Fraunhofer IGP, which will be completed in 2021, the future topic of "Shipyard 4.0" is a focus. Among other things, the institute has specialized in research on manufacturing technology and processes

as well as underwater materials. As a member of the Smart Ocean Technologies research group, Fraunhofer IGP will also be represented in the Digital Ocean Lab.

The planned event will be rescheduled for 2022

Fraunhofer IGP wanted to celebrate the founding of the Institute and the topping-out ceremony for the fourth construction phase on April 29, 2020. Among those invited were the Minister of Economy of Mecklenburg-West Pomerania Harry Glawe, Fraunhofer President Prof. Reimund Neugebauer and the Rector of the University of Rostock, Prof. Wolfgang Schareck. "Doing so with around 200 visitors and our 200 employees was not possible in view of the coronavirus pandemic. We are planning to make up for the celebrations at the beginning of 2022 with the inauguration of the new building," says Prof. Wilko Flügge by way of outlook.



The 4th construction phase of Fraunhofer IGP is funded by:



From AGP to IGP

- 1992: Founding of the project group
- 2000: Founding of Fraunhofer AGP
- 2017: Fraunhofer facility
- 2020: Fraunhofer Institute for Large Structures in Production Engineering IGP

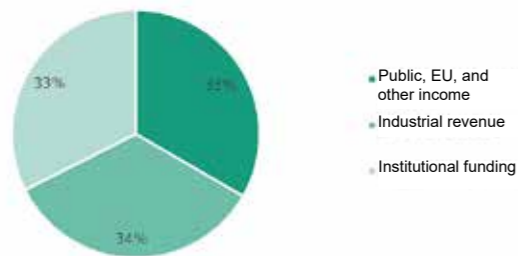
1992 Foundation of the Rostock project group of the Fraunhofer IPA in Stuttgart	2000 Foundation of the application center for Large Structures in the Rostock Production Engineering of Fraunhofer IPA — AGP for short	2017 Founding of the Fraunhofer Research Institution for Large Structures in Production Engineering IGP	2020 Founding of the Fraunhofer Institute for Large Structures in Production Engineering IGP
1994 Project group moved into the Warnemünde technical center	1998 Move to the Rostock Innovation and start-up center (RIGZ)	2004 1 st Construction phase: Technical center in Rostock Südstadt	2009 2 nd Construction phase
		2013 3 rd Construction phase	2018 4 th Construction phase

Fraunhofer IGP **WE ARE A FRAUNHOFER INSTITUTE**

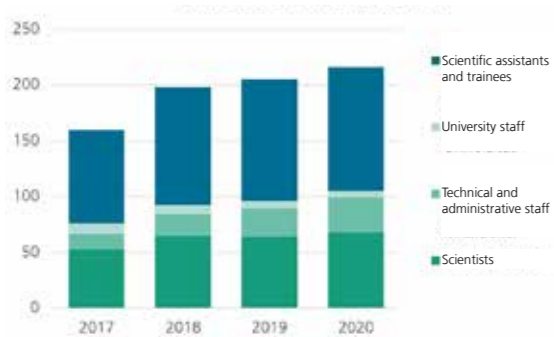
An overview of the Institute

Facts and figures

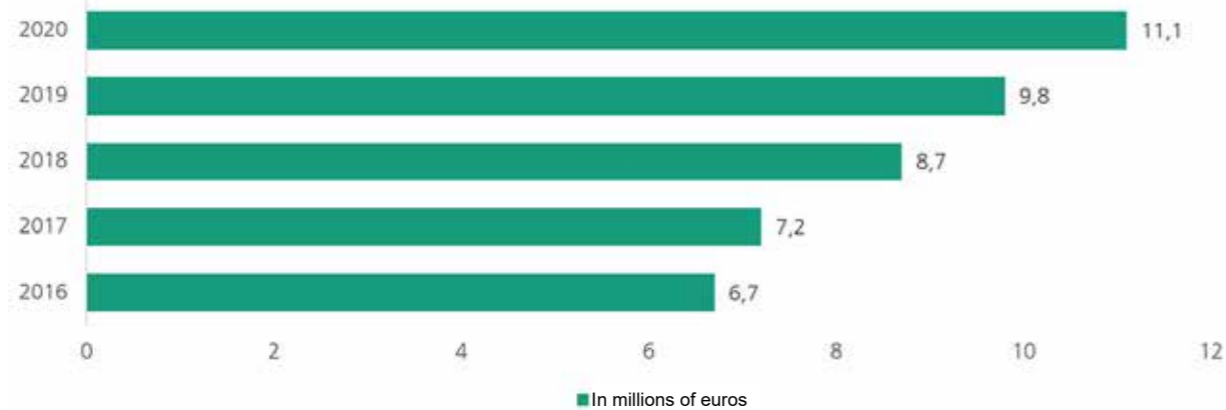
Earnings



Employee figures



Total budget



Employee figures

In 2020, the total number of employees at Fraunhofer IGP rose to 205. The majority of our scientists have a degree in engineering or a degree in industrial engineering or a Master of Science. The Fraunhofer workforce was supported by 109 research assistants in 2019. In addition, as in the previous year, three trainees supported the team. In cooperation with the Chairs of production technology and joining technology, seven employees work closely with Fraunhofer IGP in research and teaching.

Earnings

The earnings for 2019 amount to a total of 9.8 million euros. The planned targets were also achieved in 2019 with an economic return of 50 percent. The Rostock Fraunhofer Institute again achieved a balanced budget in 2019 with a positive carryover. The budget as a whole is continuing to grow steadily.

Organizational chart

Last updated: June 2021



An unusual first year as a Fraunhofer Institute

Institute director Prof. Flügge looks back on 2020. It is about the successful switch to mobile working, about new topics such as Smart Farming and hydrogen, and about how the Rostock location needs to become more attractive for young researchers in the future.

In 2020, the Fraunhofer IGP became an institute and thus took off straight into the year of the coronavirus — how did that go?

Things happened in a very unusual way. We had prepared everything for the inauguration of the institute and the topping-out ceremony for our new part of the building. And suddenly everything came to a halt, and all external events were canceled. That was strange, and things felt somewhat empty. On the other hand, I was very enthusiastic about my team. We went into lockdown very quickly along with the rest of the Institute. We made that decision on a Friday at ten o'clock. That same day, all employees were in lockdown by 4 p.m. and back online on Monday morning. We had never tested the topics of home office and work in this way before and we had never needed them. And all of a sudden, it worked. I am very proud of my team because there were various hurdles in our way. This required an enormous effort especially from those who had to adjust to a new reality of working and caring for children and work. The fact that the output still had to be right and that the teams, especially the students who suddenly found themselves on lockdown in their small apartments, had to be brought along was a big challenge. So, in the end, contrary to initial expectation, the challenges were social — and not technical. The major task in 2020 was to get the team — in its existing form — through the year.

Will the planned celebrations be rescheduled?

We will definitely have the party at some point. I believe that priority should be given to team celebrations such as the summer party or Christmas parties, which should get the team back on board. On the one hand, the whole ordeal with the lockdown brought the team together, but on the other hand things have changed nonetheless. During the video conferences, you can see here and there that there is an enormous need to talk about things not related to work. I think that is the first step we will take when we are allowed to celebrate again. After that we will make sure to have the big celebration. We are looking forward to inviting all guests and maybe it is also a stroke of luck that it's not the topping-out ceremony that we are celebrating now, but rather the move-in. Now, we can proudly walk guests through the premises and there's a lot more to show than would have been the case at the topping-out ceremony.



To the video of the interview:
Scan the QR code or
click on <https://bit.ly/3spzT8n>.



“
Rapid growth is of
no use if we end up
losing know-how and
perhaps quality.”

Prof. Wilko Flügge,
Head of the Institute for
Large Structures in Production
Engineering IGP

How did the employees cope with the changed daily work routine?

They just put forth an even bigger effort than before. It's even somewhat concerning how hard they are working. Especially those who are together with their children sent me emails as early as at 4:30 a.m. and as late as at 11:00 p.m. You can also tell during video calls that the colleagues were missing the chance to go on vacation or even just to go out now and then. Work has become much, much more present for most of them because now they have taken it home with them. I think we still have to learn a little bit how to deal with that. For now, we have now gotten a handle on it, but at some point, we will need to think about how to approach the issue of work-life balance. This balance took quite a hit for many people due to the coronavirus — and certainly not because people had more free time, but because their work was always with them.

With all the challenges, which major projects could you initiate in 2020?

One thing is that we are excited to have started working in the Smart Ocean Technologies (SOT) research group. The first researchers moved to the Ocean Technology Campus in the fishing port of Rostock, right on the edge of the quay. A total of four Fraunhofer Institutes work together at this site, and this is giving rise to a new team. You can observe how the different divisions work together. The initial topics on which we will collaborate have been determined. In addition, the topic of "Energy and Hydrogen" also came to Rostock here. To a certain extent, the Hanseatic city sees itself as an energy location. Then, on the research side, there are the colleagues at the university, and in combination with our strengths, the city really does have the infrastructure necessary to make some headway in the field of hydrogen technology. The industrial site also seems to be made for this: with the port, with the possibilities of offshore technology, which then brings the electricity here, with the consumers in the port and the surrounding area, who can then use it. We are working together with the Leibnitz institutes to set up a large joint laboratory at the hydrogen research factory. This is a topic that will push us forward for some time to come. Initial steps were taken to make a research factory a reality. And given that I am somewhat from an agricultural area, the following bit is close to my heart: in December we were awarded the contract to campaign for the topic of "biogenic value creation and Smart Farming." We were able to set up a tandem effort with our colleagues in Bavaria and invest forty million euros here in Mecklenburg-West Pomerania together with Fraunhofer IGD. With the topics of soil cultivation, harvesting and the manufacture of equipment — i.e. agricultural technology per se, I see Fraunhofer IGD as being right at the forefront. Smart Farming will be an exciting topic that will accompany us for the next few years and where we can also provide the state of Mecklenburg-West Pomerania with a scientific reflection of its agricultural landscapes. The benefit will then actually be felt locally.

What are the goals for 2021?

We want to keep in close contact with our industrial partners in 2021 as well. These are partners in the maritime environment — the ones operating large structures in Mecklenburg-West Pomerania. Our partners, with whom we have worked together over the past few years, who, like everyone else, are suffering under the impact of the coronavirus. The contacts have suffered a bit, we need to keep looking after and maintaining them, we have to ensure continuity at this point. It will certainly be one of the great challenges in 2021 that we can continue working with the partners who have been with us for many years. This is not to mention developing the tender plants with Smart Farming, Ocean Technology Campus and also hydrogen to such an extent that we can build a network. We will have to move into our fourth construction phase. There will be quite a bit happening internally. We will have new premises, and we need to get the equipment up and running again. We have a renovation opportunity with the Demonstration Center 4.0, which incorporates quite a bit of the technology from the old building — in other words, to rebuild the old building. This growth will also lead to the team



getting larger. It is increasingly becoming a challenge to have one single team and not several ones. Our decided goal is to have everyone work toward a common goal, and we need to continue strengthening our team in the long term. We have employees who switch over to the industry and maintain the network there. We must ensure that high school graduates and pupils take up studies in physics, mathematics, and mechanical engineering. Everyone who studies here also stays and thus form a steady reserve for us. You have to get people to come to a holiday and agricultural region and realize that the technology we make here is inspiring. I believe this will be an ongoing challenge for us in the coming years. We have to advertise the Rostock location in order to attract employees.

Will the institute continue to grow after moving into the new building?

That is the idea. The question is whether there will be the fifth or sixth construction phase here at the site. The incredible advantage that we have of being situated directly on the campus is — to my mind — a strategically significant objective. This means that if we are considering a fifth construction phase, the link to the university must be maintained. The real question is whether we will continue to be strategically located in Rostock or whether we will perhaps put a fifth construction phase at a location like Greifswald, Wismar, Stralsund — i.e. the other university locations in Mecklenburg-West Pomerania — in order to improve the broad impact for new employees. But those thoughts are still far off. At the moment, there are quite a few topics in our line of work and no less activity. I think that in any case we should exercise caution in our growth because we also have to share the know-how internally with the new employees. Rapid growth is of no use if we end up losing know-how and perhaps quality. After all, that has been our trademark thus far, and we should definitely keep it up!

The Neubrandenburg company Webasto Thermo & Comfort SE received the Fraunhofer IGP Prize 2020

The Fraunhofer IGP Prize has been awarded annually since 2018 as a future and innovation prize in the field of production technology. It calls attention to the technological, economic, ecological, and social utility value that is gained in the close cooperation between research institutions and industrial partners. Institute director Prof. Wilko Flügge presented the award for the year 2020 to Dr. Andreas Dikow, Vice President Operations at Webasto Thermo & Comfort SE.

“The Fraunhofer IGP Prize 2020 honors IGP partners who implement joint innovations in production processes for serial operation, as is the case at the Webasto site in Neubrandenburg. The Neubrandenburg company managed to demonstrate such with the example of innovative high-voltage heating systems,” explained Prof. Wilko Flügge, Director of the Fraunhofer Institute for Production Technology IGP in Rostock, at the award ceremony in Neubrandenburg. With the technological shift in the automotive industry toward electromobility, new types of thermal systems are also necessary. Such systems are not feasible with conventional manufacturing technologies. Rather, highly innovative surface coating and joining processes have to be developed, industrialized, and made ready for serial production in a short

period of time. The Webasto site in Neubrandenburg has developed several highly innovative processes for use in the area of heating systems for electric vehicles in 400 V and 800 V on-board networks in a short period of time.

Among other things, the coating of surfaces in the micrometer layer thickness range of metallic and non-metallic materials, the bonding of metallic and non-metallic materials, the laser welding of copper connections and aluminum die-cast components, the waterproofing of substrates; laser soldering and fully automatic testing of high-voltage breakdown strengths with up to 3000 V test voltage. Technologies are used that have are forging new paths forward in the company and the industry. The industrialization of these technologies in large-scale production without direct previous knowledge and experience poses great challenges for a company and its employees.

Intelligently combined expertise

“Webasto has shown in Neubrandenburg how expertise can be built up and used effectively in a short time by means of intelligent competence development of the employees and targeted cooperation with knowledge carriers from



Dr. Dikow and his team show how new technologies can be adapted quickly and in an agile way at the German location by means of smart engineering and cooperative development activities and transferred into a series process.”

Dr. Jan Sender,
Head of Production Systems and Logistics at Fraunhofer IGP

industry-related research institutions in the region (including SLV-Rostock, Leibniz INP, Fraunhofer IGP) and engineering partners (including automation & software Günther Tausch GmbH Neubrandenburg). This intelligently combined expertise from science, engineering and industry, in conjunction with early targeted partial investments in specific plant technology, made it possible to accelerate the industrialization process, while also limiting the risk and, in the case of new findings, adapting it in a targeted manner and finally implementing it successfully,” says Dr. Jan Sender, Head of the Production Systems and Logistics department at Fraunhofer IGP. “Dr. Dikow and his team show how smart engineering and cooperative development activities can be used in Germany to adapt new technologies quickly and in an agile way and transfer them to a series process,” adds Dr. Sender.

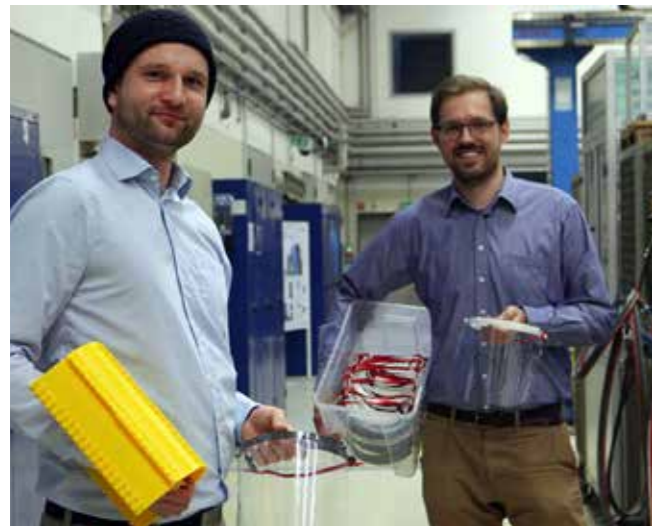
Webasto's proven ability and expertise in Neubrandenburg is of particular importance in times of technological change and therefore deserves the appropriate recognition that this reward represents. “We are delighted to receive this honor from Fraunhofer and are convinced that only the close networking of industry and research in the field of Industry 4.0 and digitization can ensure the long-term competitiveness of companies in Mecklenburg-West Pomerania,” said Dr. Andreas Dikow after the presentation.



Prof. Wilko Flügge presented the Fraunhofer IGP Prize 2020 in Neubrandenburg to Dr. Andreas Dikow, Vice President Operations at Webasto Thermo & Comfort SE (left). Photo: Fraunhofer IGP

ANNUAL REVIEW 2020

In 2020, only a few events took place at the institute. Nevertheless, we were able to receive some visitors and also contribute to the fight against the pandemic. Our construction site has made huge strides in the past year.



After work against the pandemic: Sascha Lauer and Frederik Schmatz with their auxiliary visors.

A small contribution in the fight against the pandemic: With auxiliary face visors from the 3D printer

The coronavirus pandemic also determined our everyday lives from March. The Fraunhofer IGP employees worked from home whenever possible. A few stayed at the institute. Engineer Frederik Schmatz became active again in the fight against coronavirus after work. He developed a simple but effective auxiliary face visor for medical personnel. Due to the rapidly increasing demand, these could no longer be ordered. The components for this came from the 3D printer and the lamination device. The Rostock engineer made the instructions available on the internet for "imitators." IGP engineer Sascha Lauer supported the campaign with the printers from his company 3D-Druck Rostock. They could print up to 50 visors a day. These were then distributed to practices, hospitals and nursing homes in Rostock and the surrounding area.

HY! Rostock Hydrogen Conference

At the end of September, Fraunhofer IGP hosted the first HY! Rostock Hydrogen Conference — coronavirus-compliant and as a hybrid online and attendance-based event organized by the Rostock Regiopole Region. One of the guests was the Mayor of Rostock Claus Ruhe Madsen. At the conference on September 29, experts from research and development, politics, and administration came together for the first time to discuss current developments and practical applications of hydrogen with regional actors. With the conference, an initial offer was made on the part of HY! Rostock Hydrogen Initiative to take a serious look at the hydrogen economy in the Rostock region. Around 100 participants took the opportunity to discuss things with one another.



The Mayor Claus Ruhe Madsen at the hydrogen conference at Fraunhofer IGP.

On board at... Fraunhofer IGP

With the motto: "By members for members!" the Maritime Cluster Northern Germany (MCN) extended an invitation to the format "On board at..." at Fraunhofer IGP on October 1. The members of the MCN of the Maritime Cluster Northern Germany got some insight into the work of ANOVA GmbH and Fraunhofer IGP. Prof. Knuth-Michael Henkel, Deputy Director of the Institute, presented the Institute's areas of expertise. In a small coronavirus-compliant exhibition, our scientists presented demonstrators and samples of relevance in the maritime field.



Among other things, welding samples from the maritime sector were presented in a small exhibition.



Start of construction: 2019



Construction progress: 2020

The 4th construction phase of Fraunhofer IGP is funded by:



Almost complete: 2021

Joint hydrogen research for Mecklenburg-West Pomerania

In 2020, the topic of alternative energy generation was strongly brought into focus and has not lost its necessity since then, so that Fraunhofer IGP also formulated a guiding paper on H₂ research

Fraunhofer IGP is a competent partner of industry in Mecklenburg-West Pomerania and a significant driver of innovation, especially for small and medium-sized companies. In close collaboration with partners from industry, the Rostock Leibniz Institute for Catalysis (Likat) and the Leibniz Institute for Plasma Research and Technology (INP) from Greifswald, Fraunhofer IGP is working on establishing Mecklenburg-West Pomerania as a competitive technology location in the H₂ area. The aim is to make both the generation of H₂ and industrial applications sustainable and competitive. Companies throughout the state that want to operate on the market with H₂ technologies in the future need economical and reliable solutions to tie these technologies into existing infrastructures. In so doing, Fraunhofer IGP draws on its expertise from the fields of manufacturing technology, new materials and processes, as well as production systems and logistics. In relation to the relevant H₂ fields of action, the IGP, together with the Likat and the INP, offers the following competencies in the field of hydrogen generation:

Industrial manufacture of components for hydrogen generation:

- Automated production of components for electrolyzers (e.g. PEM stacks, high-temperature steam electrolyzers) and tank systems
- Innovative tank concepts (e.g. for cryogenic LNG/LH₂ liquids, production of membrane tanks)

- Investigation and evaluation of tank systems (impermeability, corrosion, resistance, etc)
- Competitive manufacturing of tank systems (e.g. welding technologies, adhesive technology, fiber composite processing)

Conceptual work:

- Modeling of transport and logistics concepts and connection to existing infrastructures
- Dimensioning and scaling of storage solutions
- Planning tools for offshore wind farms with integrated H₂ generation

Industrial applications:

- Conception and development of "Green Factory" solutions for the integration of hydrogen as an energy carrier in industrial applications
- Development of mobile production systems with hydrogen operation
- Supply of steel works for hydrogen reduction storage solutions

Mobility applications:

- Solutions for maritime mobility applications based on hydrogen ("Green Cruising")

Contact

M.Sc. Benjamin Illgen
H₂ Research Factory
Tel. +49 381 49682 - 230
benjamin.illgen@
igp.fraunhofer.de

An aerial photograph of a modern, multi-story building with a flat roof. The roof is covered with a grid of solar panels. There are several air conditioning units and other rooftop equipment. The building has large windows and a mix of white and red exterior panels. The surrounding area includes trees, a parking lot, and other buildings.

Areas of expertise

Production technology	22
Joining and forming technology	22
Mechanical connection technology	26
Thermal joining technology	28
New processes and materials	34
Adhesive technology	36
Fiber composite technology	40
Coating, weathering and corrosion protection	44
Production systems and logistics	48
Company and production organization	48
Automation technology	52
Measurement of large structures	56



Joining and forming technology

A conversation with Group manager Pascal Froitzheim

Contact

M.Sc. Pascal Froitzheim
Group manager
Joining and forming
technology
Tel. +49 381 49682-228
pascal.froitzheim@
igp.fraunhofer.de

What competencies does the Joining and forming technology group have?

We mainly deal with issues relating to forming technologies in the production of large structures. For joining, the focus is particularly on aircraft construction. In other words, how can these forming joining processes be integrated into production. We perform an investigation of the integration, but also of the quality assurance as well as a fatigue and damage investigation. When it comes to forming, on the other hand, our focus

is on the maritime industry, which means that when it comes to heavy plate forming, we are in the process of automating these processes together with our customers. There we develop suitable forecast and control models, which we integrate into the systems together with the project partners. Above all, we implement the other questions in experiments, but we also do so in simulations. In practice, that means experimentally on our dynamic testing machines and numerically with the FEM simulation and our powerful calculation cluster. This enables us to carry

out sensitivity analyses as well as optimization processes and — in combination with artificial intelligence — to make them directly available to the user.

What experience did you and your team have of the coronavirus year 2020?

As a group, we were able to adapt to the new situation relatively well. Thanks to the use of digital conference media, we had the opportunity to discuss work-related matters directly with one another as well as to have the online equivalent of hallway conversations. With the physical contacts on the testing machines in particular, we were able gradually to make up for these bottlenecks after the tests had been synchronized. In general, my colleagues really appreciated the newly gained level of freedom. This means that the colleagues were able to organize their working hours freely and still achieved very good results, even without being physically present. Especially the colleagues with children had, I think, like all other young families, difficulties balancing the reality of looking after children and performing research work. I think we handled this situation relatively well together and got through it quite well.

What successes was your group able to enjoy in 2020?

We were able to submit two AIF research projects successfully this year. One was the FRP fatigue project, which examined the fatigue behavior of fiber-reinforced plastics. The other was blind rivet CFRP, where the aim was to establish the blind riveting process for joining CFRP components. We were able to hand over both of them successfully and were able to achieve significant additional profit there, also for applied research.

Which trends in joining and shaping are currently emerging?

Now we have to see that again in two parts, one for joining by forming and one for shaping. When it comes to joining using forming technology, the joining processes are actually established, but it is more and more a question of expanding the limits of use. This means being able to use joining processes also in structures that are becoming even larger and accordingly ensuring process reliability. We are currently working very closely with a supplier from the aviation industry with the aim of establishing efficient joining processes there too. With these new types of joining technologies, the main thing is to save time and therefore conserve resources and get the most out of the joining process. In the case of metal forming, on the other hand, these shaping processes in the maritime industry are currently all carried out manually. The research developments are moving towards the automation of these applications, where we use our real-time control and forecast models to make our contribution to ensuring that these automated facilities can actually function.

What else is new?

So, we also made new investments this year, especially in a test setup. This here is a modular clamping table with sensor equipment that we can use to implement and test application-related problems here in the laboratory. An attempt is currently being made to investigate different clamping technologies and their influence on the joining process.

To the video of the interview
with Pascal Froitzheim:
Scan the QR code or click on:
<https://bit.ly/3gcxrNU>



Projects — Joining and forming technology

Aluminum punch rivets II

When joining aluminum alloys, which are widespread as ideal lightweight construction materials due to their low specific density, strong efforts are being made to achieve material-like connections. In this way, in addition to better recyclability, the risk of corrosion and internal thermal stresses between the joining members can also be effectively reduced. In the punching joining processes established in structural assembly, rivet elements made of steel are usually processed. In a previous project, however, a new high-strength aluminum alloy was successfully identified as a suitable rivet material. Following on from this, the development of the aluminum punch rivet will be continued with the aim of joining practice-relevant total sheet thicknesses in the range of three to five millimeters of high-strength aluminum alloys.



Al-VSN connection with a total sheet thickness of 3.1 mm (sheets: EN AW-6111 PX, self-piercing rivet: AA 7068 T651)



Additional information at:
<https://bit.ly/3xPU6pb>



Measurement of sheet metal forming with the help of developed process monitoring.

Simplified substitute model for process control when rounding large sheet metal thicknesses — forming optimization

The industrial rounding of heavy plates in small batches is currently controlled entirely manually. As a result, the efficiency and economy of the process depend largely on the experience of the system operator. In order to optimize the process, an objective control approach based on a simple geometric model and an artificial neural network (ANN) was therefore developed within the research project. Here, the forming behavior of the sheet metal is predicted by the ANN and visualized with the help of the geometric model. To readjust the ANN prognosis, the real deformation of the sheet metal is recorded by measurement and fed back to the ANN. The concept provides a basis for controlling the roll rounding, which permits sustainable improvement of the economic efficiency of the process, especially for SMEs.



Additional information at:
<https://bit.ly/3CWXxy3>

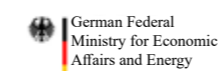
Services — Joining and forming technology

Services

- Application-specific development and optimization of forming joining processes for lightweight materials
- Process integration of forming technology joining through joining point sampling, innovative setting tool concepts, and ergonomic workplace design
- Establishing quality assurance procedures — e.g. through setting process monitoring or non-destructive testing procedures
- Material and connection testing under mechanical stress (static, cyclical, fracture mechanics)
- Forming of heavy plates and development of simplified forecast models for control-related integration
- Development of self-learning systems for joining and shaping processes (AI)
- Process simulation during joining and forming using numerical FEM (ANSYS, LS-Dyna, etc)
- Analysis methods for sensitivity and damage analysis in joining and forming technology (material and metallography)

The project Aluminum Full-Punch Riveting II is funded by:

Funded by:

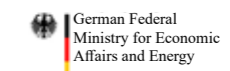


based on a resolution of the German Bundestag



The project Simplified substitute model for process control in roll rounding of large sheet thicknesses is funded by:

Funded by:



based on a resolution of the German Bundestag



Mechanical connection technology

A conversation with Group manager Maik Dörre

What competencies does the Mechanical connection technology group have?

The Mechanical connection technology group mainly deals with the derivation of design rules from experimental and numerical investigations. The focus here is on the cross-industry regulation of screw and rivet connections. Since we strive to offer our customers a coherent overall solution, the field of activity extends from consulting and training, the selection of connecting elements, through numerical and experimental investigations to the monitoring of approvals according to the German state building regulations (LBO).

What experience did you and your team have of the coronavirus year 2020?

The pandemic presented us with a special challenge that we were able to meet successfully, but it also showed us new working methods. In order to meet the requirements of our customers nonetheless, all group members worked with great personal commitment to maintain the quality as usual and to ensure that deadlines were met.

Was your group successful in 2020?

I am particularly pleased that my two colleagues Christian Denkert and Andreas Ebert were able to complete their doctorates with distinction in 2020. We were also able to successfully complete various public projects in 2020. An example of such is the research project "Frictionally engaged elongated hole

connections." Here, design approaches were developed in order to be able to use screw connections with elongated holes safely. Another research project was finalized with the "load-bearing behavior of threaded inserts." The main focus was on reducing the sheet metal thickness in aluminum constructions by the use of thread inserts. We were also able to make significant progress with the work of the leaflet. Here, as a pre-standardization work, dimensioning rules for functional element screw connections, blind rivet connections but also for lockbolt connections are derived and recorded.

What are current trends in mechanical connection technology?

Lightweight construction is a trend that has been going on for years and will continue to pose challenges in joining technology in the future. Since sheet thicknesses are getting smaller and smaller due to higher-strength materials, ever smaller clamping lengths are available for connections. For this reason, the joining technology needs to become more and more efficient. We have shown a way to counter this trend with the prestressed hybrid connection, whereby the screw connection interacts with the structural bonding. A second trend is the European Green Deal. This ensures that rail vehicle construction is experiencing a real renaissance. In addition, there is increasing need for more powerful onshore and offshore wind turbines for energy generation. Joining technology plays a key role in both industries.

What else is new?

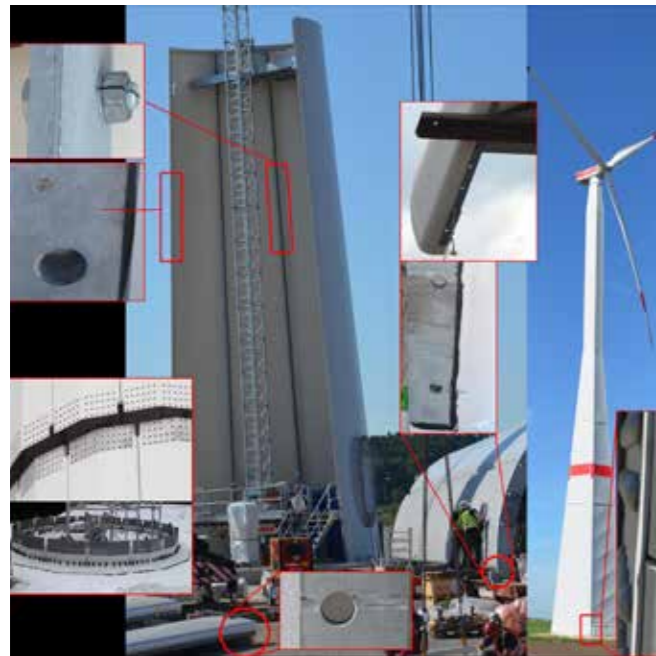
There will be innovations in our equipment in the future. For example, we will get the largest screw test bench in the world, which will enable us to examine screws with a nominal diameter of M80 and a torque of 60,000 Nm with regard to their torque-preload behavior. Furthermore, a 2 MN resonance pulsator has been procured with which we are able to test sheet metal thicknesses up to $t = 60$ mm and screws up to M64.



Contact

Maik Dörre
Group manager
Mechanical connection
technology
Tel. +49 381 49682-239
maik.doerre@igp.fraunhofer.de

Projects — Mechanical connection technology



Current applications of non-slip connections as well as occurring imperfections

Influence of manufacturing and assembly-related imperfections on the load-bearing behavior of screwed, non-slip connections in steel construction

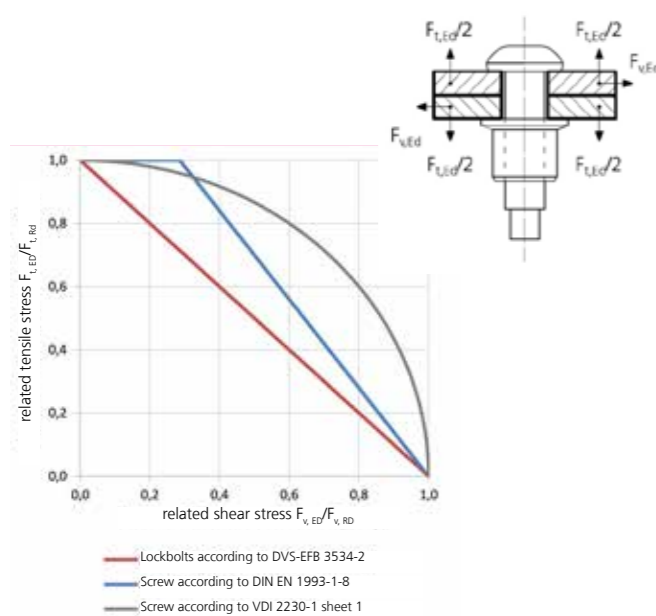
Screwed, non-slip connections are traditionally used in steel and plant construction whenever slippage and deformation in the screwed connections have to be minimized. The current test procedure of DIN EN 1090 2, Annex G is limited to the basic load-bearing behavior under laboratory conditions. On the part of the industry, there are recurring questions regarding the extent to which production, assembly and operational influences have to be taken into account in the execution of non-slip connections, since these impair the profitability of this type of connection. The aim of the research project is to record the influence of manufacturing and assembly-related imperfections as well as operational influences on the load-bearing behavior of non-slip screw connections in steel construction, in order on the one hand to ensure the load-bearing capacity and thereby the load-bearing safety of non-slip connections over their service life and on the other hand to be able to avoid unnecessary repairs and costs. Information: <https://bit.ly/37QKyj6>



Load-bearing behavior combined with stressed connections with lockbolt systems

A scientific proof concept is to be determined for the use of lockbolt systems under combined shear and tensile stress. For this purpose, the linear interaction hypothesis, which has been very conservatively applied so far, is tested with the help of experimental and numerical investigations. The analysis of the load-bearing behavior depending on the embodiment of the lockbolt system, the nominal diameter, the material pairing, the strength class and the preload are in the foreground. Based on the investigations, the determined fracture interactions for combined shear and tensile loading are interpreted and the interaction verification for lockbolt connections is revised, if necessary, to enable a more economical design.

Additional information at: <https://bit.ly/3k4Aljw>



Interrelationship between the various sets of rules.

Services — Mechanical connection technology

Services

- Advice on current trends and developments in joining technology (screws, rivets, lockbolts, blind fasteners, functional carriers/elements)
- Creation of expert opinions and test concepts for connections in lightweight metal and steel construction (ZiE, abZ/abG, ETA)
- Determination of static friction coefficients according to DIN EN 1090-2 Annex G and TL/TP-KOR steel structures
- Numerical simulation (FEM) with parameterized modeling
- Investigation of the fatigue strength of materials and connecting elements according to DIN 50100 and DIN 969
- Wöhler tests to determine FAT classes in accordance with DIN EN 1993-1-9 or the FKM guideline
- Development of design algorithms and test methods for non-regulated joining processes
- Derivation of maintenance concepts from the pre-tensioning force-time behavior (mechanical maintenance-free)
- Carrying out torque/preload force tests in accordance with DIN EN ISO 16047
- Seminars on the calculation of screw connections according to DIN EN 1993-1-8 and -9 (Eurocode 3) and VDI 2230 (sheet 1)
- Certification and external monitoring of manufacturers of building products as a recognized body according to the State building regulations of the German Federal States

The project **Influence of manufacturing and assembly-related imperfections on the load-bearing behavior of screwed, non-slip connections in steel construction** is funded by:



The project **Load-bearing behavior combined stressed connections with lockbolt systems** is funded by:



Thermal joining technology

A conversation with Group manager Dr. Andreas Gericke

In May 2020, "Welding technology" became "Thermal joining technology." Why?

The renaming of the group from "Welding technology" to "Thermal joining technology" was a logical consequence of what we actually do. We have dealt a lot with questions of welding technology in recent years — we still do that. At the same time, we have also been involved in thermal spraying and soldering, especially arc soldering, for ten years. It was important for us that we present our work to the outside world in this way, that we are also visible to customers and that some of the employees who work exclusively in these areas also appreciate the fact that we not only do welding technology, but also offer the entire spectrum of thermal joining technology.

What successes did your group achieve in 2020?

In 2020, we made a lot of progress in the field of arc brazing in steel construction. We have successfully completed two publicly funded projects and have achieved very interesting results that go so far that the application should also be anchored in regulations, which has not yet been the case. We were also able to obtain customer approval in this area, which means that we were actually able to establish a new joining process for steel construction and are still in the process of talking to other customers about applications. Another exciting area in which we have made progress is underwater technology. For ten years, we have been dealing with and in particular — and this is not entirely thermal joining technology — underwater screws.

Here we also had a topic that was handled successfully. This has led to there being a draft leaflet and, for the first time, basic rules having been created in steel construction for the use of screws and for tightening screws under water.

Which trends are currently emerging in thermal joining technology?

The big trends in thermal joining technology or welding technology that have been emerging for years are, on the one hand, additive manufacturing and on the other hand digitization, including Industry 4.0 and artificial intelligence. We work in both areas. On the one hand, we are additively manufacturing ship propellers from copper materials with different designs and for different applications. And on the other hand, in the field of artificial intelligence, we are in the process of developing a prediction model for welding that predicts process instabilities and welding errors. We are making good progress with this. Other trends or activities that we see especially here definitely include soldering applications in steel construction, the area of underwater technology and lightweight construction, resource efficiency in joining technology as well as materials for cryogenic applications and functional layers. In particular, the area of underwater technology is becoming more and more important because it is closely linked to global warming, climate change, coastal protection, and the renewal of port facilities.

What else is new?

We have strengthened our Thermal joining technology group in terms of personnel, especially in the field of materials technology, we have recruited reinforcements in the field of non-ferrous metals, especially aluminum. This is an application or a group of materials that is also becoming increasingly important in structural engineering and shipbuilding. We have also improved in terms of our testing capabilities. We have new test beds for the wear testing of materials, welds, and base materials in accordance with the ASTM standard and we also have a mobile, quasi-non-destructive hardness test so that we can also use it on site for monitoring, for example

on the construction site. We also have done a little bit regarding equipment in our welding laboratory. We have brought some new welding machines in order to be state-of-the-art for our customers. In addition, we have also invested in a few applications relating to the handling and robotics of welding machines in our workshop area and brought them up to date so that we can keep up and map what is also happening in the economy.

To the video of the interview with Dr. Andreas Gericke: Scan the QR code or click on <https://bit.ly/3m9W5SR>



Contact

Dr. Andreas Gericke
Group manager
Thermal joining technology
Tel. +49 381 49682-37
andreas.gericke@
igp.fraunhofer.de

Projects — Thermal joining technology

Studies on the fatigue strength of wet-welded offshore steels

The constant expansion of offshore wind farms and other offshore constructions also increases the need for repair and maintenance concepts. A characterization of the fatigue strength of wet-welded construction details is of enormous necessity in order to be able to provide fatigue evidence for cyclically stressed underwater repair welds in the future. Both OWT operators and commissioned engineering offices need knowledge of the possible results



Internal overpressure chamber

and consequences of a technical welding repair below the waterline. A direct classification of the data obtained in this research project in the notch case classes of Eurocode 3 therefore enables a remaining service life calculation in the event of repairs. Information: <https://bit.ly/3sn2YRO>



Intelligent processing of arc signals to avoid process irregularities during MIG/MAG welding



Block production in shipbuilding with long weld seams

In steel construction, joining long joints using MSG welding is a labor-intensive and time-consuming production step. Mobile welding trolleys are often used here, with the aim of increasing productivity with reproducibly high seam quality. In practice, however, weld seam defects and process instabilities often occur for various reasons, e.g. varying seam preparation. The aim is therefore to develop an algorithm and control system that detects and prevents process instabilities in mechanized MIG/MAG welding before they arise. For this purpose, a forecast model is to be developed, which serves as a reference variable for downstream control.

Additional information: <https://bit.ly/3xQ0jBm>

Additive manufacturing of maritime components — MarKomp

The development of new manufacturing technologies opens up new perspectives for the manufacture of components for maritime systems. The additive manufacturing technologies (abbreviated: AM) have developed rapidly not only because of their ability to produce near-net-shape components with complex geometry, but also offer various advantages over conventional processes in the area of individual component production. As part of the ongoing research project, in addition to the development of a robot-assisted processing



Finished ship propeller.

cell and the production-ready design of ship propellers, an adapted hybrid process chain is to be developed so that large-format components can be additively manufactured while ensuring high manufacturing accuracy and freedom from defects. The process for deposition welding of multi-component bronzes is developed with extensive material investigations and is optimized through the development of quality assurance for additively manufactured components.

Additional information at: <https://bit.ly/3mhjcuS>



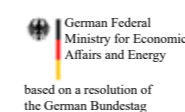
Services — Thermal joining technology

Services

- Application-oriented development and optimization of thermal joining, separating, and coating processes
- Determination of mechanical-technological and fracture-mechanical material, connection and component properties
- Analysis of welding processes using combined optical, electrical and thermal measurement methods
- Development and qualification of economic methods to improve the fatigue strength of welded structures
- Development and qualification of welding and soldering additives as well as thermally sprayed layers
- Chemical analyses (spark emission spectrometry, carrier gas extraction to determine O, N, H contents in various metals, energy dispersive X-ray spectroscopy EDX)
- Structure analysis and characterization of Fe, Cu, Al, Ni base materials using light and scanning electron microscopy (SEM)
- Determination of welding-related distortion and residual stresses and development of countermeasures
- Automation of welding processes and development of monitoring systems
- External and construction supervision with mobile measurement and analysis technology
- Design and dimensioning of welded and soldered connections
- Welding technology, metallurgy, and construction advice
- Development, testing, inspection of underwater connection technologies

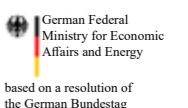
The project Investigations into the fatigue strength of wet-welded offshore steels is funded by:

Funded by:



The project MarKomp is funded by:

Funded by:





New processes and materials

A conversation with Head of Department Dr. Nikolai Glück

Contact

Dr. Nikolai Glück
 Head of
 New Processes and Materials
 Tel. +49 381 49682-228
 nikolai.glueck@
 igp.fraunhofer.de

What competencies does the New processes and materials department have?

In our company, New materials and processes currently includes the area of adhesive technology, non-metallic materials, i.e. in particular fiber composite materials, but also plastics and the areas of weathering, coating, and corrosion protection. Thanks to our comprehensive problem-solving approach, we are relatively broadly positioned in all three areas. That means it starts in the area

of automated manufacturing processes: Laminating, gluing, but also coating, and even the qualification of processes as well as materials and constructions within the framework of our accredited test laboratory.

What are current trends in new materials and processes?

A core branch of the IGP is shipbuilding and shipbuilding has traditionally been characterized by steel construction. Fiber composite materials and adhesive technology

played no role at all for a long time. In recent years, however, we have noticed the trend that engineering offices and shipyards are increasingly concerned with the subject of lightweight construction. As IGP, together with our department for automation technology, which has built up many years of expertise in the field of “automated production in shipbuilding”, and what we throw into the balance — namely expertise in the field of new materials and adhesive technology — we can serve customers in an optimum way. We are sure to see a whole range of exciting projects in the next few years. Another exciting topic is definitely the underwater structures of offshore wind turbines. Corrosion protection in particular plays a decisive role here. We are already involved in developing and qualifying new systems and will certainly start a whole series of exciting projects together with other Fraunhofer Institutes here at the Rostock location, also within the framework of the Ocean Technology Campus.

What else is new?

As far as new equipment is concerned, some delivery dates have unfortunately been delayed due to the pandemic, but in the middle of 2021 we built a new system for measuring electrochemical potentials in the area of corrosion protection and it will take us to a whole new level regarding the evaluation of corrosion protection systems and aging processes. In addition, at the end of the year we will get a new machine for the area of fatigue testing of fiber composites and adhesive connections, which we will then operate in our accredited test laboratory.

2021 will be exciting. As part of the fourth construction phase here at the IGP, we will expand the area of weather testing again by a laboratory room, so that we can expand our capacities there and also create a little space for new testing areas. And secondly, the fiber composite laboratory will move out of the adhesive laboratory and have its own area, including a large dust cabin, so that we can then try out manufacturing processes in-house on a larger scale — i.e. adapted to our customers.

Your group for adhesive technology, fiber composite technology and corrosion protection became the new Processes and materials department in 2020, why?

Due to the high relevance of our topic for current, social problems, such as climate change and the topic of resource efficiency, we have experienced strong growth in recent years. There are currently seventeen full-time employees in our division, and it was time to distribute the technical management over several people so that we can continue to serve our customers in an optimum way and work even more deeply in the individual fields.

To the video of the interview with Dr. Nikolai Glück: Scan the QR code or click on <https://bit.ly/3m9XeK9>



Adhesive technology

A conversation with Team leader Linda Fröck

You have been the Adhesive technology Team leader since 2020, how has your day-to-day work changed since then and how is your team structured?

For me, of course, there have been some changes. There are now significantly more organizational tasks. Employee management is also a new focus to which the team and I have to familiarize ourselves. But I really enjoy the new tasks and I am therefore looking forward to finding out more in the future. The Adhesive technology team currently consists of four young employees and myself. Christopher Wald is currently mainly responsible for the area of non-destructive testing technology and the simulation of bonds. Johannes Gatzke and Tom Kibellus work in the field of underwater and offshore bonding. Matthias Lang has also been part of our team since February 2021. Initially, he will primarily deal with projects in the wind energy sector. I am currently working on the aging of bonds in the maritime sector. Together, we also take care of industrial problems that need to be dealt with at short notice and the experimental investigation of adhesive joints in the accredited test laboratory.

Where do you see the advantage that your old group is now a separate department and the group has been split up into three teams?

For us as a team, there is an opportunity to work more closely together. Since each team is now smaller than the entire group before, meetings and arrangements can be made more flexibly. Since there are still regular

meetings with our department head and the other team leaders, the exchange between the teams is still guaranteed. Another positive element, in my view, is that the delimitation of the individual teams is more clearly regulated, which makes project management easier, but of course does not prevent collaboration.

What have you already implemented in the first year of your teamwork?

In the first year of our working together as a team, we were able to create a functioning cooperation. Together we thought about how we want to communicate as a team, how we want to hold team meetings and project-related meetings. Due to the situation last year, flexible models from video conferences to joint meetings outdoors have emerged. We would like to continue to do this even after the coronavirus situation comes to an end. In addition, four research projects could start last year (underwater bonding process, LEVADI, adhesive layer aging and ARGOS) and further project applications were submitted.

What trends are currently emerging in the field of adhesive technology?

In the area of adhesive technology, it is evident that the simulation of bonded joints and processes is becoming more and more important. Such simulation tasks have already been successfully processed by our team. In addition, there are currently ideas for larger research projects to increase and advance knowledge in this area further. Another trend is the use of adhesive technology in many new areas of application, such as shipbuilding. Through the management of the group



“Bonding in shipbuilding” we are very close to the maritime industry and can design research projects according to the wishes of the participants. A third trend is definitely the automation of the bonding process. This field is particularly interesting for us, because it gives us as Fraunhofer IGP the opportunity to work together on a project with employees from adhesive bonding technology and automation technology and therefore also create new points of connection in-house.

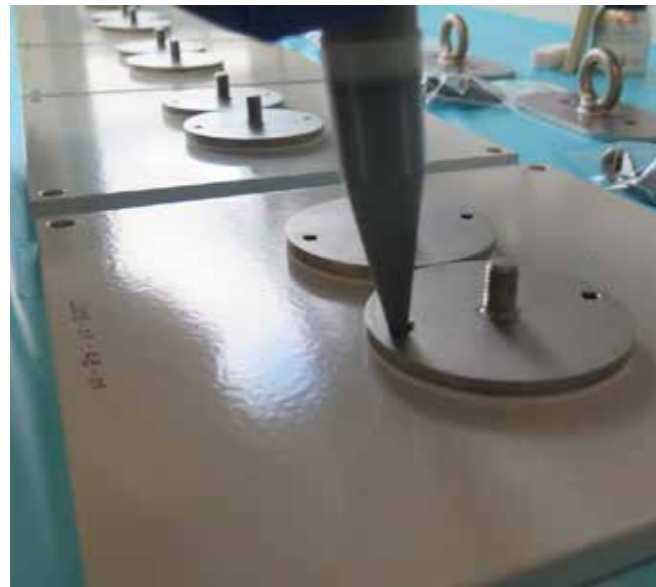
In which direction will your team develop in the future?

We will certainly align the team according to the current trends. I see great potential for our team, especially in the field of automation of the bonding process and simulation. Of course, we will also stay true to our usual fields of work, such as the wind industry or the selection and qualification of adhesives for different applications, as there are always innovations in this area and exciting projects are hidden behind the respective problems.

Contact

M.Sc. Linda Fröck
Team management
Adhesive technology
Tel. +49 381 49682-140
linda.froeck@
igp.fraunhofer.de

Projects — Adhesive technology

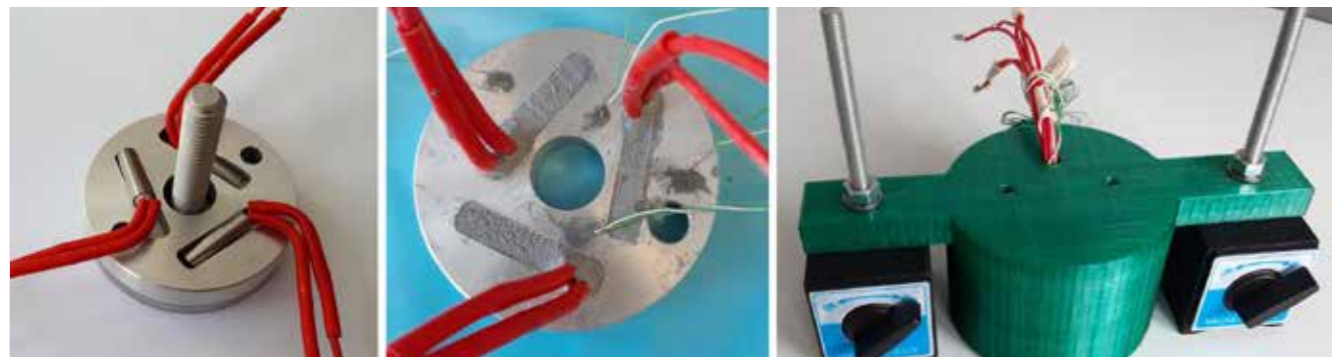


Sample production.

Development of support bonding

The increasing competition in shipbuilding increases the demands on shipyards and suppliers. There is a demand for ever shorter production times for the entire ship, as well as for the implementation of short-term changes and customer requests in the near-final construction phases. For this reason, a family of supports was developed as part of the research project (IGF 18527 BG), in addition to a non-destructive method for verifying the required minimum load-bearing capacities of the coating. After completion of the project, the shipbuilding approval was obtained from two classification societies through further investigations. The supports are currently being developed further so that hammocks can be attached to ships using two combined supports.

Additional information at:
<https://bit.ly/3g6K7FI>



Development and production of a heating system for post-curing under water bonded supports.

Investigation and optimization of the process parameters and tools for underwater bonding of mounting systems (underwater bonding process)

The operation and maintenance of hydraulic structures and vehicles often require the subsequent installation of equipment such as sensors, sonar transmitters or corrosion protection equipment under water. Metallurgical and mechanical notches are created by welding processes and mechanical joining, which is why a bonded support system was fundamentally developed in the completed IGF project

underwater bonding (19493 BR). The aim of the current project is to investigate the influence of the process parameters of the multi-stage injection process (media, times, pressures) on the quality of the connection and the development of a corresponding partially automated tool for use by divers or ROVs. This is intended to increase process reliability, verify the process limits and prepare a procedure for use by ROVs/AUVs.

Additional information at:
<https://bit.ly/3APY2rZ>



Services — Adhesive technology

Services

- Design and qualification of bonding processes and bonded joints through the selection of adhesives
- Surface pretreatment and development of adhesive processes
- Development of automation solutions for adhesive applications
- Determination of characteristic values for material and connections through static and cyclical tests as well as polymer analysis
- Analytical and numerical calculation of adhesive joints
- Adhesive process execution and component tests under simulated real conditions

The project Development of support bonding is funded by:



The project Investigation and optimization of process parameters and tools for underwater bonding of mounting systems is funded by:



Fiber composite technology

A conversation with Team leader Dr. Stefan Schmidt

What are the advantages of the new division of “Adhesive bonding technology and New materials” into three teams?

In the end, our group was relatively large. There were up to twelve of us employees and therefore the division into the three teams made sense. Each scientific employee was previously assigned to the fiber composite technology, adhesive technology and weathering, coating and corrosion protection departments to a greater or lesser extent and worked accordingly on the projects. It was important that the employees once again had a direct, professional contact through the division. Nevertheless, there is of course continued professional exchange and close cooperation between the individual teams. Especially between fiber composite technology and adhesive technology, because here there are often interfaces in the projects — e.g. when bonding rotor blades, where both technologies are common.

How did the first year as a team go?

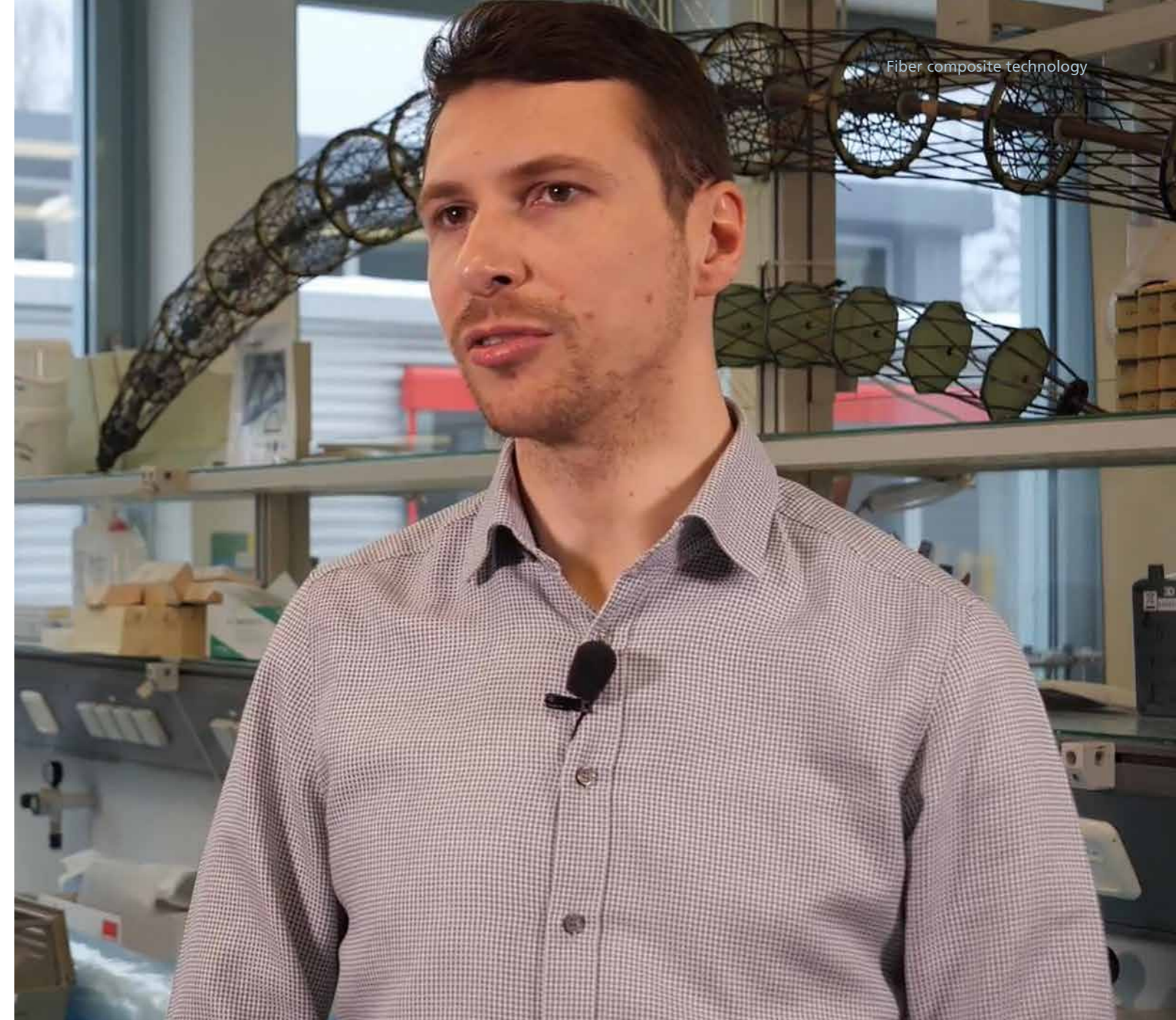
In 2020 we successfully completed the AiF project “AnorKomp.” In the project, we worked together with Clausthal University of Technology on the development of non-combustible fiber composite materials based on an inorganic matrix. The application was in the field of shipbuilding, which plays a central role for us. The inorganic systems have the particular advantage that they do not burn and can therefore be used commercially in shipbuilding without additional proof. The subject of fire protection is always a very, very difficult one because there are very strict regulations.

Another milestone in 2020: At the end of the year, an AiF project was approved which deals with key technologies for the energy transition, in particular with hydrogen technologies. We had already dealt with the subject of hydrogen in the past. In a research project that will expire in 2021, we developed a fiber composite tank with the company Emano from Teterow to be able to store hydrogen in a stationary manner. The project ties in there. We are working on a topic together with the thermal joining group. This involves the development of storage tanks for liquid hydrogen. We are working on reinforcing this tank with additional fiber composite and then achieving a higher degree of efficiency there.

In a second sub-project, we are working with Fraunhofer CML from Hamburg. There we look at how hydrogen, which is generated from electricity from offshore wind farms in the North Sea, can then be safely transported to the industry — e.g. to a steelworks. There are many different ways in which this can happen. Either by ship, pipeline, truck transport, or rail transport. We look at which process-related losses occur in the logistics chain and how these can best be optimized in order to have as few losses as possible when transporting the hydrogen.

What trends are currently emerging in the field of fiber composite technology?

The global climate crisis is currently a concern for everyone and therefore reducing CO₂ emissions is a central goal. Lightweight construction with fiber composite materials can make an important contribution to this.



Therefore, a trend can be seen especially in transportation and shipbuilding. In the future, low-emission ships will increasingly be used there, for example through lightweight construction and through the combination with electromobility.

Another trend is the sustainability of these products and the recycling of the materials used. We want to continue to work on this in the future. Hydrogen is a trending topic right now, where we also see a wide variety of applications in the field of fiber composite technology.

Which direction will your team take in the future?

Ultimately, of course, we want to continue to manufacture large composite structures. As before, the focus industries are mainly the maritime sector, i.e. shipbuilding and wind energy with rotor blade construction. That is the main direction we want to take and the industries we are targeting. We want to build on this in the future.

To the video of the interview with Dr. Stefan Schmidt: Scan the QR code or click on: <https://bit.ly/3ga7YV0>



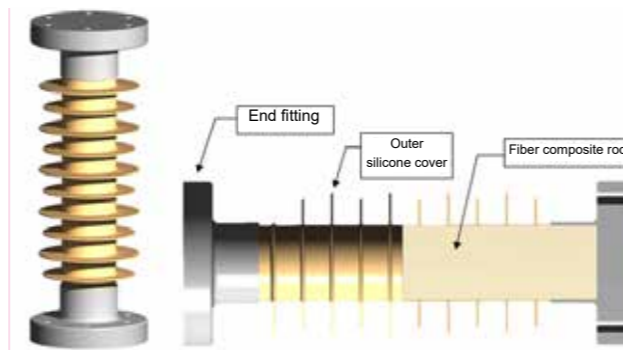
Contact

Dr. Stefan Schmidt
Team management
Fiber composite technology
Tel. +49 381 49682-223
stefan.schmidt@
igp.fraunhofer.de

Projects — Fiber composite technology

OWSplus: Vibration-resistant fiber composite insulators — Lifetime-optimized support structures for electrical equipment on floating multi-purpose platforms

Structural composite components made of glass fiber reinforced plastic are used to store electrical systems and components on energy transmission platforms. The electrically non-conductive core of composite insulators is intended to ensure safe insulation and reliable storage of, for example, converter modules. Due to the offshore use of the multi-purpose platforms, the structural components are subjected to dynamic cyclical loads resulting from external influences on the platform. Existing isolator concepts are optimized in terms of their mechanical strength in terms of materials and construction by means of numerical simulation and experimental testing. The developed design concept for



Schematic structure of composite insulator

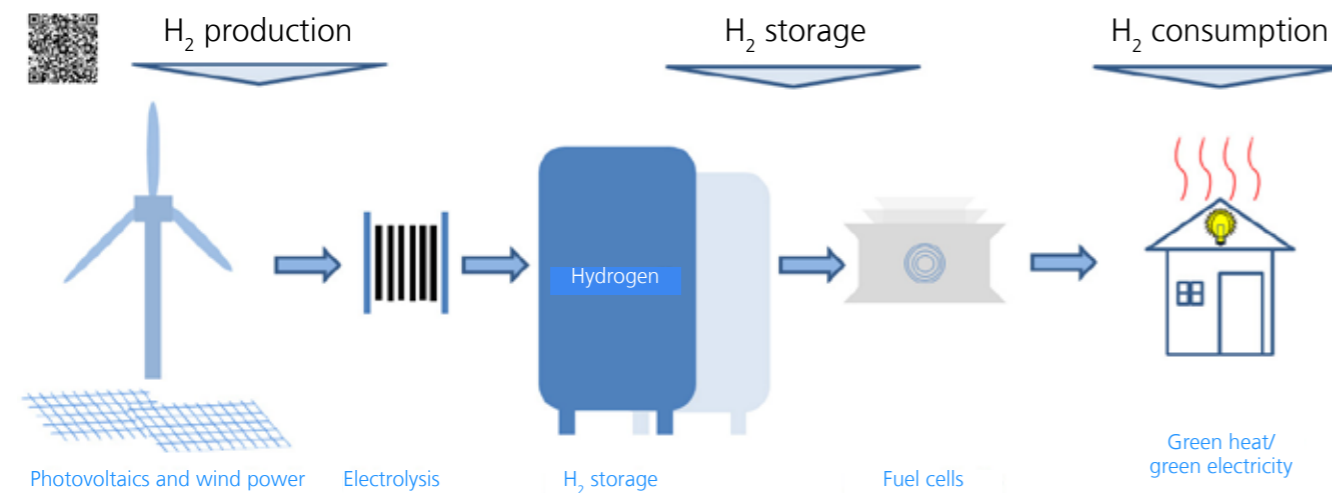
verification of the fatigue strength should be able to be transferred to comparable composite components. Information at: <https://bit.ly/3mdRXRO>



Scalable hydrogen storage systems in lightweight construction — WaSpLeicht

Overcapacities in regenerative power generation can be stored in the form of hydrogen after conversion by means of electrolysis. The gaseous pressure storage places high demands on the pressure vessels, which consist of a thermoplastic inner lining body, the liner, and a wound pressure envelope made of carbon fiber reinforced plastic. On the one hand, the

research work pursues the improvement of the composition as well as the processing of the thermoplastic liner material in reactive rotational molding with regard to its mechanical and physical properties. On the other hand, they deal with the computational design and optimization of the geometry of the individual pressure vessel components for stress reduction, especially in transition areas. Info: <https://bit.ly/3iRehPq>



Schematic sequence of hydrogen production and use.

Services — Fiber composite technology

Services

- Application-oriented development of innovative composite manufacturing processes and lightweight construction methods
- Design, configuration, and dimensioning of fiber composite components
- Optimization of fiber composite structures with analytical and numerical calculation methods
- Development of fire-protected composite materials
- Polymer analysis studies to optimize composite manufacturing processes
- Optimization of fiber composite materials for material, force-fit, and form-fit joining processes
- Development of processes for recycling thermoset fiber composites
- Determination of mechanical-technological and fracture mechanical material and component properties (static, cyclical)
- Carrying out chemical-physical tests on unreinforced and fiber-reinforced plastics

The OWSplus project: Vibration-resistant fiber composite insulators — Lifetime-optimized support structures for electrical systems on floating multi-purpose platforms is funded by:



The project WaSpLeicht is funded by:



Coating, weathering, corrosion protection

A conversation with Team leader Dr. Michael Irmer

You have been a Team leader since January 2020. How has your day-to-day work changed?

The daily work routine has not really changed. I am still very much involved in the projects. I just got a little more responsibility, especially responsibility for my team. These are currently Daniel, Valeska, Jonas, and Christian and of course I want to give them the best possible support on their way to a doctorate. There is also a little more to do in the area of strategic project acquisition. Here, the four should work on the most suitable topics as possible, which will then also advance them scientifically and expand the expertise for our company

What are the advantages of the new division of the adhesive technology group in three teams?

The advantage of these three teams is that we have a little more drive. Especially in terms of professional depth, we have reached our limits as a large, cohesive group with seventeen staff members. It is then difficult to promote the individual currents in such a way that one can continue to grow. That is why the step was just right to divide us into teams so that each team takes on the drive for itself and can turn it into a group. The small teams offer us the opportunity to give our employees the best possible support in building up their expertise and implementing their personal goals.

Were you able to achieve a few small milestones in the first year?

We almost constantly reach milestones in our projects. As a team, we have not set ourselves any milestones; instead, we measure ourselves primarily by the project successes that we have. We are currently working on five major research projects and they are all going extremely well. We deal with sensor-integrated coatings, underwater coating, film coating on offshore wind turbines, automated edge coating and the application process on multi-material structures. Everyone has reached one milestone or the other this year as well.

What are the current trends in coating, weathering, and corrosion protection?

The current trends are certainly digitization, automation, and structural health monitoring. In the area of corrosion protection on large structures, which is typically done manually, there are always new and exciting approaches to integrating robots into the process. Another point is the increased use of sensors in order to simplify condition monitoring in the operating phase of, for example, offshore wind turbines. Here, we can also make a contribution through smart coatings that already contain the sensors.

Which direction will your team take in the future?

I think we have dealt a lot with the subject of weathering in the past. Here we have always tried to check and evaluate the limits of the coating systems. At the moment, I think that we should deal more with the application and that is where the focus will be in the next few years. We are looking at how we can get more automation in and how we can improve

processes and coating systems. The bottom line is that we then know how application processes work with different coating materials and what influence aging has on them. Everything else remains to be seen. We are also very market-driven here — if a customer comes up to us and says that he would like this or that to be developed, we would be the last ones to shut it down.

To the video of the interview with Dr. Michael Irmer scan the QR code or click on: <https://bit.ly/37PmhtF>



Contact

Dr. Michael Irmer
Team management
Coating, weathering and
corrosion protection
Tel. +49 381 49682-222
michael.irmer@
igp.fraunhofer.de

Projects — Coating, weathering, and corrosion protection

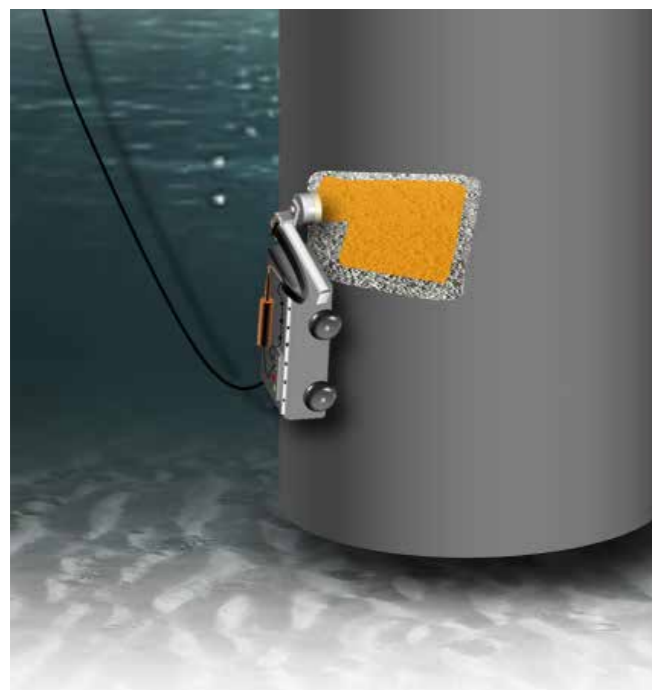


The preparation for an experiment.

OWSplus — Development of a coating technology for the automated corrosion protection of floating multi-purpose platforms

High atmospheric loads lead to special requirements for the corrosion protection of offshore wind turbines through coating systems. The manual application process and the achievement of defined layer thicknesses using spray technology is very time-consuming and costly. In addition, complex geometries, such as weld seams and edges, often lead to quality-reducing edge alignment. As a result of this effect, the requirements for corrosion protection according to the minimum layer thickness are often no longer met. To counteract the alignment of the edges, weld seams and edges are treated with a brush in an additional work step. The aim of this research project is to automate the submission process for complex geometries in order to enable high-quality and cost-reduced corrosion protection.

Additional information at: <https://bit.ly/3mdqPTh>



Model of a mechanized coating application by an underwater vehicle on a monopile.

Underwater maintenance — Coating application

As part of the Smart Ocean Technologies (SOT) research group, Fraunhofer IGP deals with problems in the maritime industry. Together with the Digital Ocean Lab in Nienhagen, the SOT forms the research-based basis for the Ocean Technology Campus being developed at the Rostock fishing port, which is funded by the Fraunhofer-Gesellschaft. The IGP contributes its expert knowledge in the field of corrosion protection as part of the underwater maintenance project and, together with the Fraunhofer Institutes IOSB, IGD and IKTS, is developing a process for the mechanized application of coating materials using an underwater vehicle. The aim is to develop a technology that partially repairs the corrosion protection in the form of spot repair applications. This not only leads to great economic advantages, but also goes hand in hand with a considerable increase in occupational safety at sea due to the elimination of diving operations.

Additional information at: <https://bit.ly/3ASPFM4>



Services — Coating, weathering, and corrosion protection

Services

Coating:

- Selection and optimization of coating systems and processes for steel construction and offshore applications
- Development and testing of automated application technology for large structures
- Development of smart coatings with function and sensor integration
- Development of ROV-supported coating technology in the underwater sector

Weathering:

- Accelerated laboratory aging in the accredited test laboratory
 - Offshore test (ISO 12944-9)
 - Salt spray/condensation test
 - UV/condensation test
 - Xenon test
- Development of test methods for combined mechanical and media loads for special applications
- Combined test methods for large components as well as joining and assembly processes in a climatic chamber (-50 °C...+60 °C)

Corrosion protection:

- Evaluation of the corrosion protection effect of coating systems as well as on complex structures and mechanically joined connections
- Determination of corrosiveness categories in the field and derivation of necessary corrosion protection measures
- Use of electrochemical measurement methods to quantify new types of coating systems in the underwater area and transfer from laboratory tests to real ambient conditions with large sample geometries

The OWSplus project — Development of a coating technology for the automated corrosion protection of floating multi-purpose platforms is funded by:



Company and production organization

A conversation with Head of Department Production systems and logistics Dr. Jan Sender

What competencies does the corporate and production organization group have?

In close cooperation with industrial partners, our team develops individual solutions for the design and control of the production of tomorrow. In the field of factory and logistics planning, we work with methods and tools from the digital factory, such as material flow simulation, 3D layout planning and robot simulation. In this way, we can support industrial partners, among other things, in securing reorganization or investment projects in production.

At the shop floor level, our focus is on the development and implementation of individual solutions for smart factories in the context of Industry 4.0. The individual solutions for the control of the production of tomorrow include IT-based production data acquisition systems which, in combination with the most modern location technology, lead to an increase in the transparency of the production process. Another focus of our work is on the area of ergonomic assistance systems. In this context, innovative production concepts based on human-robot collaboration are being developed.

What successes did your group achieve in 2020?

We have laid the foundations for two very important and forward-looking projects. On the one hand, we initiated the E2MUT alliance. This is a great success because we were able to assert ourselves against strong project consortia nationwide. With the project,

we want to relieve urban traffic, among other things, by shifting the volume of traffic to the water with the help of electromobile shipping. Another highlight is the commissioning of the planning of a hydrogen factory at the Rostock location together with our neighbors, the Leibniz Institute for Catalysis here in Rostock and the Leibniz Institute for Plasma Research and Technology in Greifswald.

We have also advanced our developments in the field of Industry 4.0 in shipbuilding. We were able to advance the digitization process in the shipyards strongly by means of various projects with German shipyards and were able to gain a foothold in this area. The customers are satisfied with us. Word gets around. We were also able to win over new customers. We were also able to expand our cooperation with strong partners from the region such as Liebherr and Nordex. And we have expanded our activities in the field of craftsmanship. This resulted in the startup Artesa. Courageous Fraunhofer employees took the plunge into self-employment here.

What trends are currently emerging in the field of production systems and logistics?

Industry 4.0 and digitization are still trending topics. Thanks to current issues such as hydrogen, customers are also becoming more aware of more sustainable production. The topic of sustainability is becoming more and more important. Energy consumption in production and logistics processes are increasingly becoming the focus of attention. This also increases the need for intelligent and sustainable solutions. Demographic change is another trend. The workforce is getting older



and the working conditions — for example in a shipyard especially in the production environment — are not such that every worker can be expected to work here up to 67 years of age. We are searching for solutions for this. How you can create more ergonomic workplace conditions in a harsh industrial environment where a person can still work beyond the age of 60. That is one of the essential questions that will occupy us in the future. Automation of processes will play an essential role in this.

What else is new?

With the move to the new building, we will get new laboratories and will be able to map human-robot collaboration and exoskeletons and the production workstation of the future. In addition, we can show the Shipyard 4.0 and develop it further. Here we can develop assistance systems for employees: from digitization and location systems to new planning software and systems. In addition, our group has currently grown so much that we are planning to restructure in the future and will group together and expand our core competencies even more.

Contact

Dr. Jan Sender
Head of
Production systems and
logistics
Tel. +49 381 49682-55
jan.sender@
igp.fraunhofer.de

Projects — Company and production organization



The maintenance of cranes is getting easier.

Crane maintenance 4.0 Annual report

The networking of service technicians and employees in order planning and control as well as the digital interaction of organizational units is currently being promoted throughout the industrial sector under the heading of Industry 4.0. The basis for this is the data acquisition via sensors or status reports from the executing employees from their workplaces. As part of a development project, an optimized maintenance management system for crane maintenance is being developed. In terms of its functions, this should serve both order management and the implementation of maintenance measures and serve to reduce the complexity of the upstream organizational process as well as the procurement of information during maintenance work, e.g. through AR support.

Additional information at:
<https://bit.ly/3yUVQ1F>



Production building at Nordex.

Simulation-based optimization of the logistics processes in the rotor blade production of wind turbines

In the field of wind energy, the length of a single rotor blade is often more than 70 meters. For this reason, component logistics is a particular challenge in the industry. Nordex Energy GmbH therefore relies on a simulation system with which these logistics processes can be digitally reproduced and evaluated based on scenarios. On this basis, a number of measures could be found and validated on the digital model, with which the logistics processes can be optimized and the throughput of the system increased. In this way, investment-neutral measures such as the reorganization of the layout as well as alternative transport concepts for a leaner material flow could be developed.

Additional information at:
<https://bit.ly/2W97Yhg>



Services — Company and production organization

Services

Factory planning and logistics — Digital factory

- Productivity and potential studies for production systems
- Digital factory design using material flow and kinematics simulation to secure investment decisions
- 3D layout planning in a virtual reality environment for new planning and reorganization projects
- Optimization of production and logistics systems based on 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 center, fault management, etc)
- Introduction of digital tracking and tracing systems based on Auto-ID technologies (RFID, location, etc) for the seamless traceability of orders

Ergonomics and work design — workers of the future

- Ergonomics assessment in the workplace (including ergonomics simulation)
- Realization 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





Automation technology

A conversation with Group manager Steffen Dryba

What experience did you and your team have of the coronavirus year 2020?

Our group is used to working digitally. Much of the work is done on a PC. We work very intensively with simulations, numerical

processes, and CAD systems. That means that for us the boundary conditions have not fundamentally changed. Nevertheless, we have inevitably made great progress in the area of digitization and cooperative work and had a very positive experience of this transformation process that we had to go

through. We believe we are prepared for the future should such situations arise again.

What successes could your group celebrate in 2020?

An important research focus of our institute is on the maritime industry. We are therefore pleased that two very important projects in this area have started. On the one hand, there is the project "Additive Manufacturing of Maritime Components" (MarKomp), which we are working on in conjunction with our long-term partner, MMG in Waren and the University of Rostock. The aim of this project is to map additive manufacturing processes for large maritime components such as ship propellers using robots. On the other hand, the project "Development of intelligent welding robots for applications in shipbuilding" (IntRobAS) has started. This is also a maritime project that we are working on together with our long-term partners, Peene-Werft in Wolgast and IMG in Rostock. For the next few years, we will be dealing with robot concepts for manufacturing in shipbuilding. Both projects are key projects that are being worked on in an interdisciplinary manner throughout the institute.

As part of a further project, a bolt setting and a bolt insertion robot were developed and implemented as prototypes. Applications for patents have been made for both systems and we hope to build on these developments over the next few years.

What are the current trends in automation technology?

In automation technology at the IGP, we have specific access to the topic of automation technology. We always have a connection to the production of large structures in small numbers up to one-off production, often in the maritime sector. That means that we deal with how we manage to implement automation concepts in areas that are not yet or only slightly automated. Often the aim is to use robot systems in what are actually atypical applications. In so doing, we pursue different concepts: One concept is to develop very large robot systems in order to be able to offer the largest payloads and workspaces for our customers and partners. Another is to make

small robots more flexible using application-specific kinematics and to work with them in or on the workpiece. The main trends that we are currently observing and that we will or have already taken up are human-robotics and cooperative concepts for heavy-duty robot systems. This raises security-specific questions that we want to address. Another topic is mobile robotics, with which we want to address robot applications in unstructured environments, such as a shipyard, in a much larger workspace and with significantly greater flexibility. There is also the topic of artificial intelligence. Although this is not a trending topic, it is already widely used, but in the area of production, directly in complex welding or other manufacturing processes, we can still achieve a great deal and offer added value for our partners and customers. We will therefore focus on this in the next few years.

What else is new?

We have invested in a state-of-the-art welding robot and a completely new welding system, thereby bringing our large portal up to date, with which we conduct research and development in the field of automated welding of large volume structures in shipbuilding. We also now have a new 3D camera that we use directly on the robot and the offline programming software SKM DCAM with which we can create robot programs, especially in the field of additive manufacturing, and hope to open up new possibilities.

To the video of the interview with Steffen Dryba: Scan the QR code or click on: <https://bit.ly/3gajtw1>



Contact

Steffen Dryba
Group manager
Automation technology
Tel. +49 381 49682-45
steffen.dryba@
igp.fraunhofer.de

Projects — Automation technology

Development of an automated carrier system for connecting tools on longitudinal divisions

For the construction of wind turbines in panel construction, panels should be joined to form a tower, since the conventional tower construction is no longer economical with ever increasing hub heights. For this purpose, these panels are erected conically and overlap each other by means of tab connections. At the connection points, there are holes for a connection system on the tabs as well as on the panels. To facilitate the joining of



The bolt insertion robot.

these elements, a fitter should only screw on the joining part of the connecting system from the inside of the tower and then join it. The connection systems are to be fed in automatically from the outside of the tower. For this purpose, an automation solution was developed in the form of a bolt insertion robot that autonomously travels along a connection point, detects the drill holes, and provides the fasteners to the assembler.
Info: <https://bit.ly/3xVf8Tb>



Development of intelligent welding robots for applications in shipbuilding

Special shipbuilding in Germany is characterized by small batch sizes and the use of different materials. Welding is an essential step in the construction of the hull. For this purpose, mostly rigid system concepts with welding robots are currently used or welding is still done manually. Conventional welding robot applications are characterized by a low level of flexibility. Last but not least, the predominant use of offline robot programming systems, which is often uneconomical with



Experimental setup.

small batch sizes, contributes to such. The aim of the current research project is to develop economical automation solutions for welding applications in shipbuilding by means of the use of flexible system concepts in connection with 3D sensors.

Additional information at:
<https://bit.ly/3ggv7Fp>



Automated crane systems in aircraft assembly

Digitization offers enormous potential for increasing efficiency in the field of logistics. Here, the value-adding work share of employees can be significantly improved by means of open and cooperative automation. Together with Airbus, Fraunhofer IGP has been implementing the integration of an automated crane system into the complex production process of modern aircraft over the course of several years as part of an aviation research and technology project. The Fraunhofer IGP philosophy is based on the expansion of conventional crane systems with the functionalities of industrial robots. The digitally networked

control platform enables flexible cross-system information exchange, while the innovative safety concept reliably protects people inside the workspace.

Information at: <https://bit.ly/3k7UTwC>



Services — Automation technology

Services

Handling technology

- Development and implementation of robot and special kinematics according 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
- Measurement 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 area of joining, forming, and generative processes
- Concept creation from robot cells to the safety concept
- Selection and integration of tools and sensors
- Support with the implementation

The project development of intelligent welding robots for applications in shipbuilding as well as the project development of an automated carrier system for connecting tools on longitudinal divisions is funded by:



Measurement of large structures

A conversation with Group manager Dr. Michael Geist

What experience did you and your team have of the coronavirus year 2020?

It was of course the case that this year we had to switch very heavily to home office processes, which, however, led to digital work being advanced very strongly in our company. That had a very positive effect. Among other things, our employees have learned again to create free space, especially for scientific work. The disadvantage was, of course, that interpersonal "hallway conversations" were a little neglected. At the moment, we are in the process of leveraging the advantages of both worlds. We are trying to bring interpersonal relationships a little more to the fore without losing the advantage that the home office undoubtedly offers.

Was your group successful in 2020?

We can highlight two projects in 2020. On the one hand, a project will be ended this year that dealt with monitoring of industrial buildings using drones. In industrial buildings, especially at great heights, the inspection of joints, for example, is usually associated with a lot of effort using risers. We have developed a system that deals with indoor navigation by drones that automatically fly through industrial building structures inside and inspect or appraise the building using photo documentation in order to detect damage. The project was successfully completed in December and at that time we purchased a drone as an additional carrier platform for measurement technology. It can now be used indoors, which has great advantages for many industrial productions. In our new projects

area, the combination of different sensors is becoming more and more important. We succeeded in initiating projects in the field of acoustics in 2020. This means that we are increasingly developing test systems that are composed of several sensors, so-called "multi-sensor systems." With these systems, for example, we not only check the geometric properties of a component or object, but can also determine additional component characteristics through the use of acoustic or infrared sensors.

What are the current trends in the area of measuring large structures?

The trends that are emerging here are, on the one hand, that more and more sensors are being linked to one another and that a wide variety of test tasks are being combined using multi-sensor systems and the data analyses are being merged.

There is also a trend toward such systems being used in a mobile manner. The systems have to be guided along the object dynamically or moving structures have to be recorded. For our institute with a focus on large structures, these trends are an enormous added value that we can offer our customers. The systems are much more variable and can be used independently of location. For example, a project to inspect rotor blades is currently starting. A test platform is being developed that is guided along a wind turbine blade of a plant during operation and combines several measuring systems. This makes it possible to inspect a rotor blade in one test run using different methods at the same time. This automation of test processes, this increasing mobility of the systems and the

fusion of different sensors are the trends that we are currently dealing with.

What else is new?

In 2020, not only was the coronavirus a big, moving topic, but in our group there was the fact that we got four new employees, which is about half the size of our group. For us, the particular challenge in the pandemic-related circumstances was to train new employees and introduce them to the IGP. And we succeeded in doing just that. With Dr. Christoph Heintze, we gained an expert with extensive experience

in structure-borne noise, and he is now developing this area for us. With additional projects, for example for the monitoring of large ship engines, he is building an area that enables us to use additional acoustic sensors in component testing.

To the video of the interview with Dr. Michael Geist: Scan the QR code or click on: <https://bit.ly/3iTuI2w>



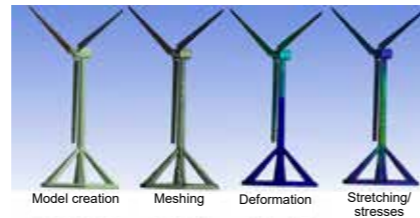
Contact

Dr. Michael Geist
Group manager
Automation technology
Tel. +49 381 49682-48
michael.geist@
igp.fraunhofer.de

Projects — Measurement of large structures

Digital technology developments for the metrological underwater structure analysis of floating wind farms

Fraunhofer IGP is pursuing the goal of a monitoring solution for deformations in large structures such as floating offshore platforms. This encloses both the areas above and below the water. At critical points in the structure, sensors are provided to monitor the structural behavior. Together with the project partner Evologics, solutions are found to implement periodic and/or continuous monitoring under water. The processing and evaluation of the recorded data is carried out by the IGP. If there are temporally synchronized sensor data with a spatial relationship under and over water to each other, these data



Example FEM.

can be evaluated together. Taking into account the causal relationships, condition assessments can be made and deviations from the planned behavior or from forecast models for future structural behavior can be taken into account.

More information at: <https://bit.ly/3snorug>



LaserBeat: Automatic error detection when testing tunnel structures without contact

In Germany, traffic tunnels with a total length of over 1400 km are used, the vast majority of them for train traffic. Regular inspections are of great importance for the long-term safe use of these infrastructure structures, which are usually designed for a service life of 100 years. Currently, the walls are tapped manually to find hidden flaws during the tunnel inspection. In the LaserBeat project,



Tunnel tube with mobile scaffolding for manual testing.

an internal Fraunhofer cooperation between the IPM and IGP institutes is pursuing an approach to automating this time-consuming process. With the use of laser systems for the production and measurement of mechanical vibrations in the tunnel wall, contactless and therefore flexible and fast scanning of large areas is possible. To detect defects, the surface vibrations received are analyzed and a search is made for local anomalies that indicate hidden defects.

Additional information at: <https://bit.ly/3me6kWK>



Inspection, monitoring, and documentation of structural steel structures — InüDosS

Buildings are long-term objects that are subject to degradation in the course of their planned use due to dynamic and static loads. To reduce the resulting damage, sustainable building management in the form of building inspections must be carried out at regular intervals, which are usually time-consuming and personnel-intensive and associated with restrictions on the use of the building. In order



Automated condition recording with the help of a drone.

to enable simple, accelerated, and regular building inspections, the InüDosS project developed an inspection system for the automated assessment of the condition of buildings. For

this purpose, automated unmanned flying objects are used to record the condition of the structures. Any damage in the image data is then detected with the help of neural networks and assessed based on its type, size, and location in the building. In this way, the building inspector is supported. Info at:

<https://bit.ly/3snorug>



Services — Measurement of large structures

Services

- Implementation and development of methods for geometric quality control as well as control of manufacturing processes through the use of modern 3D measuring methods
- Requirements-specific modeling of high-resolution point clouds (reverse engineering)
- Analysis, advice, and conceptual design of measurement and test 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 bases based on 2D and 3D measurement data as well as data modeling 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 acquisition and interpretation of 3D data as well as integration of additional information sources
- Development of complete systems for monitoring and interpreting the current status of large structures, individual components, plants, and processes (monitoring, product life-cycle management, building information modeling)

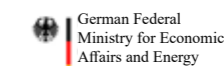
The LaserBeat project is funded by: WISA — Inter-institute pre-competitive research for the development of technologies and products by means of strategic, business-oriented in-house research projects

The project digital technology developments for the metrological underwater structure analysis of floating wind farms is funded by:



The project Inspection, monitoring and documentation of structural steel structures — InüDosS is funded by:

Funded by:



based on a resolution of the German Bundestag





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Information at www.igp.fraunhofer.de/de/karriere

Contact

- Personnel manager Melanie Gragert
Graduates, young professionals, experienced professionals
Telephone +49 381 49682-221
melanie.gragert@igp.fraunhofer.de
- Personnel manager Claudia Bäcker
Female students, apprenticeships, internships
Telephone +49 381 49682-381
claudia.baecker@igp.fraunhofer.de
- Personnel clerk Pauline Teucher
Female students, apprenticeships, internships
Telephone +49 381 49682-319
pauline.teucher@igp.fraunhofer.de

Among other things, we offer vocational training to become a materials tester. Photo: Fraunhofer IGP

Career — The way to us!

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as well as the exchange with experts: inside and outside of your own location. We are looking for people who are dedicated to their field and want to help shape the future. We rely on your expertise. Outstandingly well equipped offices, laboratories, and workshops as well as a culture characterized by team spirit create the best conditions for project success.

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Scientists at Fraunhofer IGP

Cynthia Hoppe is 26 years old and has been working at Fraunhofer IGP since 2019 as a research assistant in the Production Systems and Logistics department

What did you study?

I studied industrial engineering and did my Bachelor's and Master's degree in Rostock. Before that, I graduated from a business high school — that is why the direction of business was established relatively quickly. However, I also noticed that I was interested in technical processes, and at home I was often asked "Hey, can you take a look at this, it's broken, it doesn't work any more." Then I took it apart and, when things went well, reassembled it and it worked again. This is why I decided on the synthesis between engineering and economics.

How did you get to Rostock?

I actually came to Rostock by train with a suitcase. I looked for a furnished room and wanted to keep my move simple because I grew up five hours away from here. But why I studied in Rostock is of course the Baltic Sea. I think you can ask all newcomers and at least ninety percent answer the Baltic Sea, and of course it was the same with me.

Which major did you choose in your studies?

I chose the major in Manufacturing and Automation Technology. I would say it is definitely relevant. Simply, in order to have the technical understanding and to have already heard a few basic terms, such as Industry 4.0, digital factory. I also support projects that relate to the manufacture of large maritime structures. A lecture on "Ship manufacturing technology", for example, makes sense for this. Nevertheless, I would say that it is not a requirement in order to gain a foothold here in the department or at Fraunhofer at all, but it is definitely a little advantage.

How did you come to Fraunhofer?

During my studies, I started a part-time job as a student research assistant. I wanted to combine the theoretical knowledge that you get from university with practice. This is a sensation likely familiar to all students. You ask yourself "What is actually used in a company, what do I need from what I am currently learning here?" And that is exactly what Fraunhofer IGP has offered. Through applied research, you get to know one company or the other and learn a bit about what is going on in the region.

What makes working at Fraunhofer different?

I would say the push to do research. Of course, as a student research assistant, you have already noticed that your own ideas are welcome here and that you can act them out creatively. In addition, it is of course really exciting to work alongside companies as they implement their own ideas as well as developments of the team and to then see the company, for example, have more efficient production processes. And of course that is just a really exciting task.

How was it to start your new job in the middle of the pandemic?

I had the small privilege of having worked here as a student research assistant and had been able to get to know the team for four years. That is why I was not a stranger and my team knew me and I knew the team. Nevertheless, new employees came during the pandemic. We make sure that we still have a few personal conversations, a little small talk and yes, meet online in the evening and then play the odd game online together.

What professional plans do you have for the future?

Of course, I would like to be able to support as many companies as possible in optimizing their production structure. You realize now, especially in times of the pandemic, that it is incredibly important to be economically well positioned and competitive. That is why I would like to see many projects and many creative ideas that will then be used in the company and that we will be able to support.



In addition, it is of course really exciting to work alongside companies as they implement their own ideas as well as developments of the team and to then see the company, for example, have more efficient production processes."

Cynthia Hoppe,
Scientist in
the Production systems
and logistics department



To the video of the interview:
Scan the QR code or click on
<https://bit.ly/3geX40n>

Scientists at Fraunhofer IGP

Valeska Cherewko is a research associate in the field of coating, weathering, and corrosion protection. She is also a member of the “Smart Ocean Technologies” research group. This is based in the Rostock fishing port. Valeska has an office in the institute as well as on the Warnow with a view of the water.

What did you study?

I studied mechanical engineering here at the University of Rostock. I have always been interested in technology and wanted to know how things work and get to the bottom of them.

How did you get to Rostock?

I originally come from North Rhine-Westphalia and moved to Rostock because life is of course important to me in addition to studying. I think Rostock, with the Baltic Sea on its doorstep, is the ideal place for students. Even now I am still very happy here.

Which major did you choose in your studies?

In my Bachelor's degree, I majored in development and construction and in my Master's degree in welding technology and lightweight construction. That means, I have positioned myself broadly in my studies and even today I still come across things here and there that I learned during my studies.

How did you come to Fraunhofer?

Fellow students told me about their work at Fraunhofer. In 2015, during my fourth semester, I started working as a research assistant in fiber composite technology. I was also able to get to know and support adhesive technology and the area of corrosion protection during my student days. All of these disciplines are now working together under the “New materials and processes” department.

What makes working at Fraunhofer different?

During my almost five years as a student at Fraunhofer, I got good insight into the day-to-day business of scientists and therefore knew that industry-related research and the opportunity to do a doctorate were the right way to start my career.

What about the doctorate? Do you already have a topic in view?

I have now been a research assistant at Fraunhofer IGP for almost a year and work in the Smart Oceans Technologies research group, in which the competencies of several Fraunhofer Institutes are grouped together in an interdisciplinary manner. For me, this interdisciplinary work resulted in a project that I find very exciting. I can well imagine that my doctorate topic will open up here.

How was it to start your new job in the middle of the pandemic?

Due to my many years as a student at IGP, I was already very well connected when I started. I also knew about the skills and possibilities, especially regarding the laboratories. That is why it was easy for me to get started. Of course, I also had great colleagues who welcomed me warmly and supported me in ensuring that everything went smoothly.



As a student at Fraunhofer, I got good insight into the day-to-day business of scientists. Industry-related research and the opportunity to do a doctorate are the right starting point for me.”

Valeska Cherewko,
Scientist in the Coating, Weathering, and Corrosion Protection team and also at Fraunhofer SOT



To the video of the interview:
Scan the QR code or click on
<https://bit.ly/3CXr8r5>

Associations, alliances, and committee work

Fraunhofer Group for Production

The Fraunhofer Group for Production is a research and development partner for the manufacturing industry. More than 2200 employees from eight institutes and three Fraunhofer facilities provide their knowledge and experience. Using the latest findings from production and engineering sciences as well as computer science, the Fraunhofer Group for Production offers a range of services that encompasses the entire product life cycle and the entire value chain. Research and industry are closely and interdisciplinary networked here. www.produktion.fraunhofer.de

Fraunhofer Traffic and Transportation Alliance

Since March 2003, various Fraunhofer Institutes and facilities have been pooling their transport-related competencies 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 and industrial clients through transport-related research and to implement them. By means of close, topic-related cooperation, comprehensive system and network solutions as well as new areas of application can be developed for customers through know-how transfer in the transport sector. This selection and grouping of the most varied of competencies ensures that needs-based solutions can be offered to the customer. www.verkehr.fraunhofer.de

Committee work

Forschungsvereinigung Schiffbau und Meerestechnik e.V.
Prof. W. Flügge — Member of the Technical Advisory Board
Prof. K.-M. Henkel — Member of the Technical Scientific Committee

Deutscher Verband für Schweißen und verwandte Verfahren e.V.

Prof. K.-M. Henkel — Chairman of the State Association Mecklenburg Western Pomerania; Chairman of the Committee of the National Associations; Deputy DVS President

Forschungsvereinigung für Stahlanwendung e.V. (FOSTA)

Prof. W. Flügge —
Member of the Technical Board of Trustees

Maritime Allianz Ostseeregion e.V.

Dr. J. Sender — Chairman

Kooperationsverbund RIC MAZA MV e. V.

Dr. J. Sender — Member of the Board of Directors

Technology & Innovation Circle Economy/Science

Mecklenburg Western Pomerania

Prof. M.-C. Wanner — Member

Scientific Society for Assembly-Handling Technology-Industrial Robots

Prof. M.-C. Wanner — Member

Working Group XXL Products

Prof. W. Flügge — Member

German Institute for Structural Engineering

Prof. R. Glienke —
Member of the SVA Metal Construction and Composite Construction Expert Committee

Europäische Forschungsgesellschaft für Blechverarbeitung e.V.

M. Schwarz — Member — Community committee DVS / EFB AGMF3/V10.3 Mechanical joining — Blind rivets and lockbolts

Dr. C. Denkert — Deputy chairman / Secretary — Community committee DVS / EFB AGMF4/V10.4 Mechanical joining — functional elements

Dr. C. Denkert — Member — Community committee DVS / EFB AGMF7/V10.7 Mechanical joining — construction and calculation

M. Dörre — Member — Community committee DVS / EFB AGMF4/V10.4 Mechanical joining — functional elements

Prof. Ralf Glienke Deputy Chairman of the Community Committee DVS / EFB AGMF3/V10.3 Mechanical joining — blind rivets and lockbolts

GfKORR — Gesellschaft für Korrosionsschutz e.V., Wind energy working group

Dr. M. Irmer — Member

Hanse Aerospace e.V., Hamburg

Prof. Dr. W. Flügge — Member of the Scientific Advisory Board

REFA Landesverband Mecklenburg-Vorpommern e.V.

Dr. J. Sender — Member of the Board

Shipbuilding Society

Prof. M.-Ch. Wanner — Head of the company work organization and production technology as well as member of the technical Scientific Advisory Board

DVS Technical Committee

Dr. A. Gericke O. Brätz — Member — AG V 2.5 Submerged arc and electroslag welding

Prof. K.-M. Henkel O. Brätz B. Ripsch — Member — AG V 4 Underwater technology

Prof. K.-M. Henkel, Dr. A. Gericke — Member — AG A 6.1 Welding in shipbuilding and marine engineering — welding processes, manufacturing

Prof. K.-M. Henkel, Dr. A. Gericke — Member — AG A 6.2 Welding in shipbuilding and marine technology — damage to welded structures in shipbuilding

Dr. N. Glück — Member — DVS-Technical Committee 11 Joining of plastics; DVS-Working group AG W 4.14 Joining of endless fiber-plastic composites

Dr. N. Glück — Member — DVS-Technical Committee 11 Joining of plastics; DVS-Working group AG W 4.14 Joining of endless fiber-plastic composites

Research Association of the DVS

Prof. K.-M. Henkel, Dr. A. Gericke

Member — FA 03 Arc welding

Prof. K.-M. Henkel, M.SC P. Andrezza,

Dr. A. Gericke — Member — FA 07 Soldering

Prof. K.-M. Henkel O. Brätz,

B. Ripsch — Member — FA V4 Underwater technology

Working Groups of the International Institute of Welding

O. Brätz — Member — IIW Commission II Arc Welding and Filler Metals

Dr. 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

Dr. 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. Nikolai Glück — Reviewer for 2019

Expert reviewer activities

Working group of industrial research associations

“Otto von Guericke” e.V.

Prof. W. Flügge, Prof. K.-M. Henkel, Prof. M.-Ch. Wanner — Expert reviewer

Federal Ministry for Economics and Technology

Prof. M.-Ch. Wanner — Expert reviewer for the funding program “Innovative shipbuilding secures competitive jobs”

German Research Foundation

Prof. W. Flügge, Prof. M.-Ch. Wanner — Expert reviewer

Standardization work

Deutsches Institut für Normung e.V.

Prof. R. Glienke — Member of the advisory board NA 092 DIN-Welding and Allied Process Standards Committee (NAS)

DIN-Standards committee

Welding and allied processes

Dr. N. Glück — Member — DIN-Working Committee NA 092-00-28 AA: Adhesive technology (DVS AG V 8); DIN-Working group NA 092-00-28-01 AK: Process chain adhesive technology; DIN-Working group NA 092-00-28-02 AK: Bonding of fiber composite plastics;

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Ebert, Andreas: **A contribution to the test-based determination of the sliding resistance of prestressed steel construction connections.**

Rostock: University of Rostock, Faculty of Mechanical Engineering and Ship Technology 2020

Gericke, Andreas: **Influence of the welding parameters and polarity modulations on the material transition as well as the burn-up and burn-off behavior of alloy elements in submerged arc welding.**

Rostock: University of Rostock, Faculty of Mechanical Engineering and Ship Technology 2020

Haberecht, Tobias: **Dismantling of disused rotor blades using sensor-based, robot-guided water jet technology.**

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Hanover: Europäische Forschungsgesellschaft für Blechverarbeitung e.V. 2020

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Contact

Organization

Head of Institute | Chair of Manufacturing Technology

Prof. Wilko Flügge
Telephone +49 381 49682-20
wilko.fluegge@
igp.fraunhofer.de

Deputy Head of Institute | Chair of Joining Technology

Prof. Knuth-Michael Henkel
Telephone +49 381 49682-30
knuth.henkel@
igp.fraunhofer.de

Institute assistant

Sabine Wegener
Telephone +49 381 49682-13
sabine.wegener@
igp.fraunhofer.de

Institute assistant

Virginie Rogge
Telephone +49 381 49682-11
virginie.rogge@
igp.fraunhofer.de

Head of Administration

M.Eng. Lisa Knaack
Telephone +49 381 49682-226
lisa.knaack@
igp.fraunhofer.de

Head of IT

Marcus Baier
Telephone +49 381 49682-57
marcus.baier@
igp.fraunhofer.de

Public relations

M.A. Silke Schulz
Telephone +49 381 49682-224
silke.schulz@
igp.fraunhofer.de

Areas of competence

Mechanical connection technology

M.Sc. Maik Dörre
Telephone +49 381 49682-239
maik.doerre@
igp.fraunhofer.de

Joining and forming technology

M.Sc. Pascal Froitzheim
Telephone +49 381 49682-228
pascal.froitzheim@
igp.fraunhofer.de

Thermal joining technology

Dr. Andreas Gericke
Telephone +49 381 49682-37
andreas.gericke@
igp.fraunhofer.de

New materials and processes

Dr. Nikolai Glück
Telephone +49 381 49682-39
nikolai.glueck@
igp.fraunhofer.de

Adhesive technology

M.Sc. Linda Fröck
Telephone +49 381 49682-140
linda.froeck@
igp.fraunhofer.de

Fiber composite technology

Dr. Stefan Schmidt
Telephone +49 381 49682-223
stefan.schmidt@
igp.fraunhofer.de

Coating, weathering and corrosion protection

Dr. Michael Irmer
Telephone +49 381 49682-222
michael.irmer@
igp.fraunhofer.de

Production systems and logistics

Dr. Jan Sender
Telephone +49 381 49682-55
jan.sender@
igp.fraunhofer.de

Production planning and control

M.Sc. Konrad Jagusch
Telephone +49 381 49682-51
konrad.jagusch@
igp.fraunhofer.de

Factory and work organization

M.Sc. Florian Beuss
Telephone +49 381 49682-59
florian.beuss@
igp.fraunhofer.de

Automation technology

Steffen Dryba
Telephone +49 381 49682-45
steffen.dryba@
igp.fraunhofer.de

Measurement of large structures

Dr. Michael Geist
Telephone +49 381 49682-48
michael.geist@
igp.fraunhofer.de

Supporting areas

Head of testing, monitoring and certification body

Prof. Ralf Glienke
Telephone +49 381 49682-40
ralf.glienke@
igp.fraunhofer.de

Head of Test laboratory

M.Sc. Holger Brauns
Telephone +49 381 49682-220
holger.brauns@
igp.fraunhofer.de

Head of Technical services

Kay Müller
Telephone +49 381 49682-60
kay.mueller@
igp.fraunhofer.de

University teachers

Dr. Ulrich Kothe
Telephone +49 381 49682-50
ulrich.kothe@
igp.fraunhofer.de

Contact persons by sector

Ship construction

Dr. Jan Sender
Telephone +49 381 49682-55
jan.sender@
igp.fraunhofer.de

Aviation construction

Dr. Thomas Nehls
Telephone +49 381 49682-65
thomas.nehls@
igp.fraunhofer.de

Lightweight metal and steel construction

M.Sc. Maik Dörre
Telephone +49 381 49682-239
maik.doerre@
igp.fraunhofer.de

Mechanical engineering

Steffen Dryba
Telephone +49 381 49682-45
steffen.dryba@
igp.fraunhofer.de

Wind energy plant

Dr. Nikolai Glück
Telephone +49 381 49682-39
nikolai.glueck@
igp.fraunhofer.de

Rail and vehicle construction

Dr. Christian Denkert
Telephone +49 381 49682-64
christian.denkert@
igp.fraunhofer.de

Marine engineering

Prof. Knuth-Michael Henkel
Telephone +49 381 49682-30
knuth.henkel@
igp.fraunhofer.de

Publishing notes

**Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e. V.
Hansastraße 27 c
80686 Munich**

Publisher

Fraunhofer Institute for Large Structures in Production
Engineering IGP
Prof. Wilko Flügge
Albert-Einstein-Strasse 30
18059 Rostock
Telephone +49 381 49682-0
Fax +49 381 49682-12
info@igp.fraunhofer.de
www.igp.fraunhofer.de

Editorial team, layout and production: Silke Schulz

Print: Fraunhofer Verlag

Reporting period: January 1 to December 31, 2020

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Fraunhofer IGP

Fraunhofer Institute for
Large Structures in
Production Engineering IGP

Albert-Einstein-Str. 30
18059 Rostock

Tel. 0049 381 49682 0
Email: info@igp.fraunhofer.de

www.igp.fraunhofer.de



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