



Fraunhofer Institute for Large Structures in Production
Engineering IGP

Annual Activity Report 2025

The Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft, headquartered in Germany, is a leading organization for applied research. Since its founding as a nonprofit in 1949, Fraunhofer has held a unique position in the German research and innovation ecosystem. The research organization with more than 30,000 employees currently operates 74 institutes and independent research units throughout Germany. Fraunhofer plays a major role in innovation by focusing on cutting-edge technologies and transferring research results to industry to strengthen Germany as a business location and benefit society.

Its primary customer base comprises large and medium-sized companies, which utilize Fraunhofer's expertise to boost their competitiveness with new technologies. For years, Fraunhofer has been one of the most active patent applicants in Germany and Europe. Its international patent portfolio is the basis for technology transfer through research projects, spin-offs and licensing. Moreover, Fraunhofer addresses societal goals in key technology sectors through interdisciplinary and international partnerships in specific markets. Examples include solutions for microelectronics, artificial intelligence and quantum computing, healthcare, the circular economy, new materials, energy, critical infrastructure security, and defense.

Fraunhofer is a sought-after and established partner in publicly funded projects with industry partner involvement. It is also instrumental in strengthening Germany as a hub for innovation and business, ensuring its future viability. Its activities create jobs in Germany, boost the impact of investment on industry, give companies a competitive edge and foster public acceptance of advanced technologies. International partnerships with excellent research organizations and companies around the world directly connect the Fraunhofer-Gesellschaft with the most influential research communities and economic areas.

Fraunhofer's total annual budget amounts to 3.6 billion euros. Contract research, Fraunhofer's mainstay, generates 3.2 billion of this budget. Unlike other public research organizations, institutional funding from federal and state governments accounts for no more than one-third of its contract research budget, thus providing merely the base. Fraunhofer raises at least two-thirds of its contract research budget competitively from private-sector contracts and public project funding. Unlike organizations that are largely institutionally funded, the resulting strong incentive to develop business fosters entrepreneurial spirit, ensuring that Fraunhofer continuously develops solutions for current and future economic and societal needs. In 2025, industrial revenue accounted for 966 million euros.

Since highly motivated employees are the most important factor behind Fraunhofer's success, the research organization provides opportunities for independent, creative and goal-driven work. Fraunhofer facilitates career development in the research community and in industry with targeted programs for professional and personal development.

The Fraunhofer-Gesellschaft is a recognized nonprofit named after the scholar Joseph von Fraunhofer (1787–1826), who lived and worked in Munich. Joseph von Fraunhofer's inquisitiveness and business acumen enabled him to rise from a glass grinder to a scientific pioneer who, as an inventor and entrepreneur, turned ideas into marketable products and commercialized them. His innovativeness and market focus, as well as the belief that research and practical application go hand in hand, pervade the work of the Fraunhofer-Gesellschaft, which remains committed to his legacy.

Opening Remarks



Dear Readers,

I look forward to revisiting the 2025 highlights at Fraunhofer IGP with you. Budget constraints driven by the German federal elections as well as broader European and global economic instability have altered our market landscape. These dynamic market shifts demanded a more agile approach to addressing key challenges. Amidst these external pressures, it is critical to remember how much we have actually accomplished. Despite the turmoil, we were once again able to celebrate several milestones and implement exciting projects with our partners.

One of the first highlights of the year was the “Turn Old into New” school competition, a cross-campus educational initiative organized by the institutes of the Fraunhofer Group for Production. The goal of the project is to inspire students to take an interest in technology and sustainability by having them compete with creative upcycling and recycling projects. In the final round on June 11, 2025, in Magdeburg, Fraunhofer IGP’s “Active Eco-Heroes” team successfully prevailed against another team from a partner institute. Winning first place proved that choosing the right topics can truly inspire the next generation of researchers.

We collaborated with the Department of Production Management and Logistics at the University of Rostock to launch a new, innovative research field this year: “Humanoid Robotics for Industrial Applications.” In fields such as mechanical and plant engineering or the maritime sector, humanoid robotics broadens the range of opportunity.

In August 2025, we had the opportunity to participate with the University of Rostock in the Science@Sail science fair as part of the Hanse Sail maritime festival. Our colleague Viktoria Nikolova provided fascinating insights on the topic “Underwater Bonding—What’s Possible Today and What’s Next”. She was also a guest on the science program “Wellenlänge Wissenschaft” (Wavelength Science) on Radio LOHRO.

Another major highlight was hosting the “Conference on Mechanical Engineering and Digitalization in Smart Farming” in September 2025. By showcasing the latest breakthroughs in AI, smart technologies, and robotics, the conference charted the course for the future of agricultural technology.

We hope this annual activity report gives you an overview of our activities and projects. We thrive on lively, meaningful exchanges with you and our partners in research, industry, and politics so that we can continue to address the right issues in the future.

Yours faithfully,

Prof. Wilko Flügge
Institute Director of Fraunhofer IGP



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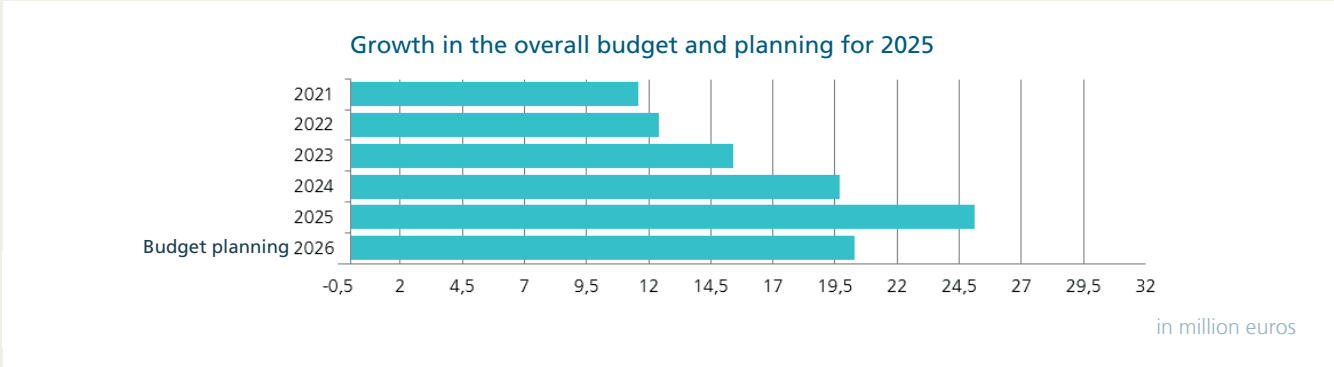
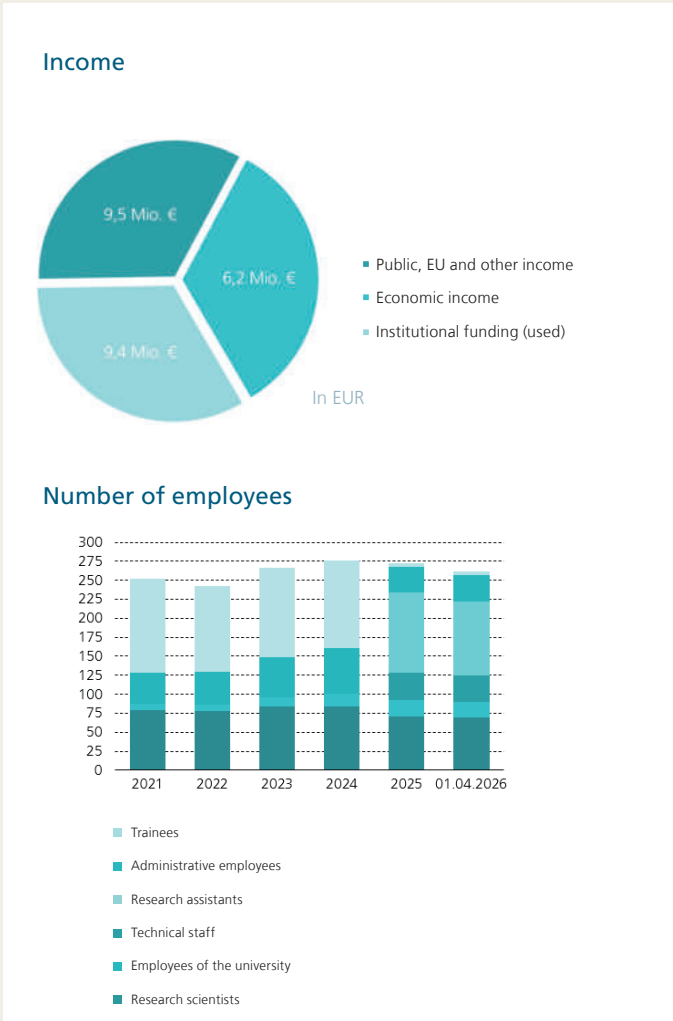
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Institute Overview

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Organizational Chart

Last updated: April 2026

Institute Director Prof. Wilko Flügge		Deputy Director Prof. Knuth-Michael Henkel		Assistants to the Institute Management Sabine Wegener Virginie Rogge	
Pre-competitive Research at the University of Rostock	Manufacturing Technologies Dr. Andreas Gericke	Production Systems Prof. Jan Sender	New Materials and Processes Dr. Michael Irmer	Strategic Tasks	Administration Lisa Knaack
Joining Technology Prof. Knuth-Michael Henkel	Joining and Forming by Plastic Deformation Dr. Felix Holleitner	Industrial Robotics Nikita Vetter	Polymer Laboratory Dr. Michael Irmer	Energy Converters Dr. Björn Henke	Human Resourc- es
Production Engineering Prof. Wilko Flügge	Mechanical Joining Technology Dr. Maik Dörre	Measuring of Large Structures Prof. Michael Geist	Adhesive Bonding Technologies Dr. Linda Fröck	Quality Management	Communica- tions
Production Organization Prof. Jan Sender	Thermal Coating Systems Dr. Michél Hauer	Production Planning and Control Dr. Konrad Jagusch	Fiber Composite Technology Dr. Stefan Schmidt	Special Tasks Special functions, building manage- ment, teaching	Purchasing
3D Measurement, Analysis and Monitoring Prof. Michael Geist	Thermal Joining Engineering Dr. Oliver Brätz	Factory and Work Organization Dr. Konrad Jagusch	Corrosion Protection Valeska Cherewko		Controlling/ Order Manage- ment
		Automation and Production Systems Steffen Dryba			Travel/ Accounting
Workshop/Sample Fabrication Martin Brandes	IT Services Marcus Baier	Test Laboratory Holger Brauns	Testing, Monitoring and Certification Body According to State Building Regulations (LBO) Prof. Ralf Glienke		

Offshore Coatings

Examination of TSA coatings as part of a field test at the Baltic Eagle offshore wind farm



Sample holders with mounted samples in transport racks aboard the RS-Sentinel

Objective of the examinations for the Baltic Eagle wind farm

The Baltic Eagle offshore wind farm is a joint venture between Iberdrola, a global leader in clean energy, and Masdar (also known as the Abu Dhabi Future Energy Company), the pioneer in clean energy in the United Arab Emirates. The wind farm highlights the need for a corrosion protection system that must prove its long-term performance under the harsh conditions of the Baltic Sea. Thermal spray aluminum (TSA) protects the monopiles in the submerged area with coating thicknesses of 350 μm in the permanently submerged zone and 400 μm in the upper sediment and transition zones. But how reliable is this system over many years in real-world use? This question was pivotal to the BSH approval process for the wind farm, because robust evidence of long-term behavior under the specific conditions of the Baltic Sea was not available at the time of planning. Therefore, a targeted monitoring campaign was required. The focus is on examining exposed, TSA-coated test specimens from the wind farm by comparing their condition after a defined exposure period to their initial state. Comprehensive laboratory testing will quantify the efficacy and durability of the protective system. At the same time, this monitoring campaign provides an opportunity to identify potential vulnerabilities before initial indications develop into serious risks to the structure. This is not merely a matter of evaluating a single corrosion protection system, but rather a fundamental question for the future of offshore protection concepts in the Baltic Sea.

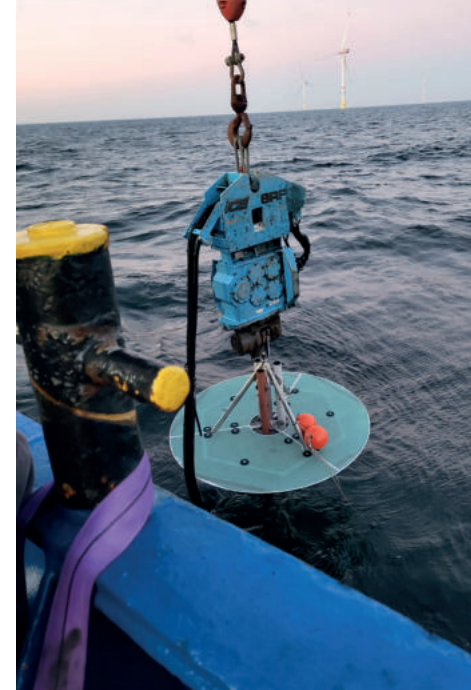
Background

TSA is increasingly recognized as a key technology for corrosion protection of offshore monopiles. In most cases, nearly pure aluminum (Al 99.5) is melted using the arc or flame spraying process and applied at high speed to the prepared steel surface. This produces a strongly adherent metallic layer, whose rough, porous structure is typically sealed as well. This layered configuration is exactly what makes the system so powerful. In addition to protecting the steel by acting as a physical barrier against aggressive, chloride-containing seawater, TSA actively intervenes in the corrosion process. This is because aluminum is electrochemically less noble than steel and acts as a sacrificial anode if the surface gets damaged. If the coating is damaged in a localized area, the exposed steel remains protected while the aluminum dissolves. In this way, TSA combines two protection principles into a single system: a passive barrier effect and active cathodic protection. The major advantage is that additional sacrificial anodes or actively operated external current systems are typically no longer necessary. This combined effect is what makes TSA so attractive. Its effectiveness has already been proven many times in high-chloride offshore environments such as the North Sea. It also paves the way for a long-lasting corrosion protection system with very low maintenance requirements for the Baltic Sea. This makes TSA technically compelling and economically significant, because every averted repair drives down total lifecycle costs of the foundation structures.

Implementation

To assess the corrosion protection system under both controlled laboratory conditions and actual offshore operations, Fraunhofer IGP devised a test concept that involves placing coated steel pipe samples directly on the seafloor of the Baltic Eagle offshore wind farm. For this novel testing methodology, a total of 20 coated steel pipes were mounted on four custom-made holders (designed specifically for long-term exposure on the seabed) and installed at two locations within the wind farm. The installation sites are located near two wind turbines whose environmental conditions are considered representative of the site. This ensures that the samples are subjected to stress exactly where the protective system must prove its long-term performance in real-world conditions. A fifth sample holder was retrieved immediately after successful installation. This approach clearly distinguishes any potential effects of the installation process itself from the actual long-term effects.

The planning and design phase for the offshore deployment was very intensive. It involved hiring a diving company, obtaining regulatory permits for work near wind turbines in the wind farm's restricted area, and chartering a vessel. Then, the installation operation was rehearsed in the Warnow harbor area. After successful testing, the research and diving vessel RS Sentinel was used to transport the samples to the offshore wind farm in December 2024, where they were deployed as planned. The installation was monitored using a remotely operated underwater vehicle (ROV). This marked the start of a real-world test in which current, salinity, sediment and time will reveal just how effective the corrosion protection system actually is in the Baltic Sea.



Deployment of a sample holder

Monitoring the deployment from the ROV control center aboard the RS Sentinel



Details

The test specimens consist of steel pipes made of the same material grade as those used for the monopiles. The pipes are 3 m and 0.7 m in length, with an outer diameter of approximately 10 cm and a wall thickness of 5 mm. Surface preparation is specified as Sa 2½ with a peak-to-valley height (roughness depth) of $60\text{ }\mu\text{m} < R_z < 100\text{ }\mu\text{m}$. After blasting, the tubes were wrapped in VCI film (film containing volatile corrosion inhibitors) to simulate the monopile manufacturing process as accurately as possible. The TSA coating was applied using the arc spraying process with aluminum of 99.5 percent purity. Some of the samples also received an organic two-component epoxy sealant. It is particularly important to note that the samples were coated using the same automated coating technology as that used for the wind farm’s monopiles. However, the samples were coated using a sprayer with two wires instead of two sprayers with a total of four wires. Also, the coating was applied tangentially rather than longitudinally. Several sample variants were defined to investigate different stress and damage conditions. Some of these variants featured bare and sealed TSA as well as superficial damage introduced along the length of the sample, covering 2 percent of the circumference. Other variants were coated only halfway along their length to investigate the transition zone during complete immersion in the sediment. All possible combinations of the aforementioned parameters are being investigated. The fully sealed and undamaged variant corresponds to the actual configuration of the coating on the foundation structures at the Baltic Eagle wind farm.

The four permanently installed sample holders are designed for long-term exposure over three or ten years. Each holder is equipped with three vertical pipe samples, each 3 m long, which penetrate up to 2 m into the sediment due to the system’s own weight. They are supplemented by two samples, each 0.7 m long, that do not come into contact with the sediment. The total weight of the holder, including the samples, is approximately 360 kg. The holder’s sinking is limited by the fiber-reinforced plastic base plate resting on the sediment and the frictional resistance of the vertical pipes. To facilitate retrieval, the permanently installed holders are equipped with an 8-mm steel cable and a buoy that floats 5 m above the sample holders in the water. The fifth holder was retrieved immediately after deployment. This holder was deployed on a trial basis to identify any potential problems with the installation process early on. The subsequent evaluation of the exposed samples will include visual inspections, SEM-EDX analyses of the TSA surface, 3D microscopic examinations, coating thickness comparisons, and determination of corrosion rates by evaluating coating removal in cross-sections. Specially designed templates will be used to measure the intact pipes at the same locations as the initial baseline conditions. All laboratory analyses are intended to explain the corrosion and failure mechanisms of the TSA coating under these specific operating conditions.

The fifth holder had already been examined for visual changes and possible alterations in layer thickness right after installation and immediate recovery. Two standard samples and one sealed sample were examined. After recovery, the sample sections located in the sediment zone were wrapped in VCI film aboard the RS Sentinel. The subsequent visual assessment revealed discoloration of the standard samples compared to their initial state. However, no changes were observed that could be attributed to mechanical damage resulting from installation. Such damage can occur if the steel components encounter large stones or rocks while being anchored in the sediment.

Observed color changes from silver to gray are attributed to the formation of a thicker oxide layer during the approximately five-month storage period prior to the offshore campaign. Coating thickness measurements also showed local deviations of more than $40\text{ }\mu\text{m}$. However, they are attributed to the surface roughness of the TSA coating as well as adhering contaminants and measurement uncertainties. Thus, the evaluation of the deployment procedure revealed no damage to the samples attributable to the installation process. However, the samples are also located in the uppermost sediment layer, which is characterized by silt and mud. This sediment layer generally does not contain any large stones, although such stones may be present in deeper sediment layers where the monopiles penetrate significantly deeper. The good news is that corrosion rates decrease with increasing sediment depth, even where the coating is damaged.

Current exposure period

The project is currently in an exposure and waiting phase. The four permanently installed sample holders at the wind farm are now undergoing the planned long-term exposure under real offshore conditions. The plan is to recover and analyze one holder per location after three years. The remaining holders are intended to be recovered and examined after ten years of exposure. Based on the available documentation, it is not yet possible to draw further conclusions regarding the long-term behavior of the TSA coating. During this waiting period, laboratory-based model studies are being conducted in realistic setups as part of a doctoral research project. The goal is to gain a targeted understanding of the factors influencing the corrosion protection performance of TSA in the Baltic Sea as well as to explore its limitations and potential. In the future, new projects are expected to build on these findings, rendering costly, site-specific long-term studies for regulatory approval obsolete.

Through its current work, both in the real-world long-term field deployment at the Baltic Eagle wind farm and in laboratory tests, Fraunhofer IGP is helping to advance more environmentally friendly and cost-effective electricity generation on behalf of the industry.

Baltic Eagle offshore wind farm



Contact

Corrosion Protection Technology
Contact person:
Jonas Nehlsen
Phone +49 381 49682-565
jonas.nehlsen@igp.fraunhofer.de

A green and red tractor is shown from a rear-three-quarter view, plowing a large field. The tractor is moving away from the viewer, leaving behind deep, wavy furrows in the dark brown soil. The field is vast and flat, stretching to a distant horizon where a line of trees and a few buildings are visible under a bright blue sky with scattered white clouds. The tractor has 'LEMKEN' written on its front and '8000 DT' on its side.

Research for Practical Applications

Featured Topic:

Production Engineering Transforms Agriculture

Introduction – Production Engineering Transforms Agriculture

Climate change, geopolitical tensions, and disrupted supply chains are once again putting food security back in the spotlight. These factors disproportionately impact specialty crops such as berries, vegetables and medicinal plants, as well as protein-rich crops like peas, beans, lupins, and soybeans. They are integral to sustainable human and animal nutrition in Germany, yet they face significant economic, quality-related, and ecological constraints.

From a mechanical engineering perspective, there is great potential for innovation here. Automation, robotics, sensor technology, and digital process chains from industrial manufacturing can be adapted for crop production, animal husbandry, and broader livestock operations. The goal is to reduce the burden of labor-intensive processes, use resources more efficiently and ensure consistent product quality.

At Fraunhofer IGP, established expertise in process and plant development, automation technology, and quality assurance is being leveraged to achieve this objective. To realize this goal, we developed the BWSF initiative (Biogene Wertschöpfung und Smart Farming = Biogenic Value Creation and Smart Farming). The focus is on adaptive harvesting and handling systems for delicate specialty crops, automated processes for growing field crops and data-driven assistance systems for farms.

A key development is our growing role as an independent certification body. We systematically evaluate the process stability, product quality, and economic efficiency of automated production processes in vegetable cultivation that were developed by our partners. We have also conducted parameter studies for agricultural machinery manufacturers, for example, on work processes, load profiles and deployment strategies. This lays an important foundation for robust, efficient machines.

Below are selected projects that demonstrate the integration of production engineering and agriculture to secure a resilient, high-quality domestic, and global food supply.



“We must adapt our production engineering to deliver the same reliability and efficiency in the field as it does in the factory. This is the only way to make a genuine contribution to food security.”

Dr. Philipp Wree,
Head of the Smart Farming
Department at the Fraunhofer
Institute for Computer
Graphics Research IGD



Figure 3: Field trial with modified cultivator points

Material Development of Flux-Cored Wires for Thermal Spraying of Wear-Resistant Coating in Agriculture

With funding from the:



Agricultural soil cultivation tools require high resistance to abrasive wear, especially since they must also withstand sudden impact loads. Since these loads vary depending on local soil conditions, it is hard to forecast tool degradation rates or establish precise replacement intervals. Potential risks include accelerated component wear, mechanical failure, and the hazard of broken parts remaining in the field, which could cause damage to subsequent agricultural implements; see Figures 1 a) and b). These undesirable consequences can currently be delayed by using hardfaced wear-resistant coatings. However, these coatings still have a limited lifespan, meaning the same consequences are ultimately unavoidable. The filler materials typically used also contain toxic and critical elements such as tungsten. Because they leak into the soil and their global prices are surging, we must find viable long-term alternatives. This shift has not only driven the rise of wear-resistant thermal spray coatings. It is also driving demand to substitute these materials where possible and design systems that allow for proactive recoating before complete component failure.

The goal of the research was therefore the first-ever targeted development of iron-based flux-cored wires with various hard-phase contents (boron carbides, niobium carbides, chromium carbides and many others) for use as a wear-resistant coating in agriculture. The modified chemical composition significantly reduces the use of scarce and toxic materials. In addition, a concept for the visual indication of a wear limit was developed to show end users the optimal time for tool replacement and recoating; see Figure 1c). As part of the research project, six prototype flux-cored wires containing varying hard phases from different manufacturers were processed into coatings, tested and continuously optimized. The focus here was on the achievable coating thicknesses and testing wear resistance according to ASTM G65 to ensure the longest possible service life of the coatings; see Figure 2. Furthermore, additional mechanical and technological characterizations (e.g., tensile adhesion and bending tests) were conducted to simulate real-world load cases as accurately as possible.

Based on the findings from the laboratory tests, arc spraying represents a cost-effective, wear-reducing and sustainable alternative for use on agricultural soil cultivation tools. The flexibility of the process also allows complex geometries to be coated in significantly less time. This advantage is particularly evident for large-area components with complex geometries; see Figure 2. Furthermore, laboratory investigations were supplemented by initial field tests at project partners' sites using plow points as an example; see Figure 3. The tests showed that some coating materials are less suitable for this application than other variants, which can be primarily attributed to varying soil conditions. Optimizing the coating parameters and material concepts is therefore advisable. Likewise, post-treatment methods such as abrasive blasting or heat treatment offer a way to improve coating quality and performance. Driven by these positive findings, plans are underway to extend the scope of our research within the TBI R&D consortium project AgriSpray in collaboration with OT GmbH & Co. KG Schwerin. Simultaneously, we are exploring opportunities with potential agricultural end users as advisory partners.

Contact

Thermal Coating Systems

Contact person:

Ahmed Eid

Phone +49 381 49682-269

ahmed.eid@igp.fraunhofer.de

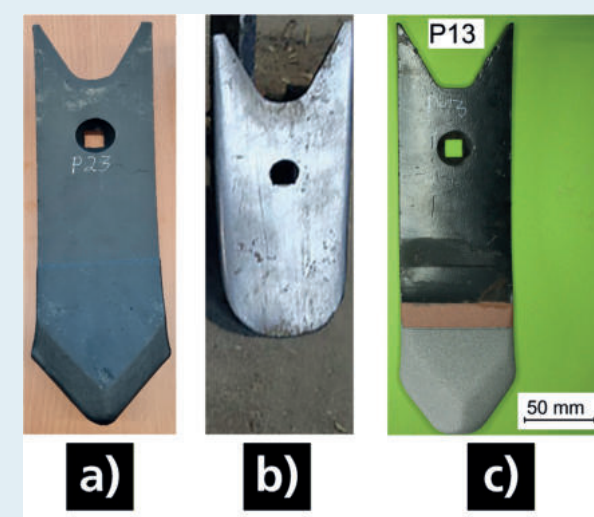


Figure 1: a), b) Comparison of cultivator points (also cultivator tines) before and after soil cultivation
c) Concept for visual wear limit indication using a cultivator point as an example. As soon as the indicator layer becomes visible, the wear-resistant top layer should be replaced. To demonstrate the concept, the indicator layer was extended beneath the wear-resistant layer

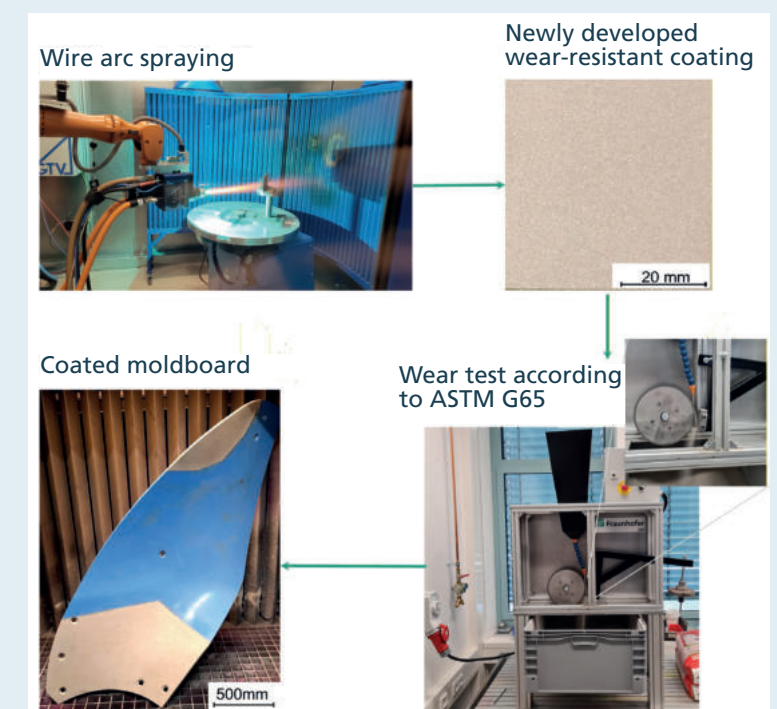


Figure 2: Process for layer development, from thermal spraying on flat specimens to the final component. Complex geometries, such as those of moldboards shown here, can be coated with minimal effort

Maintenance-Free Bolted Connections in Agriculture

In agricultural machinery manufacturing, bolted joints are preferred when the ability to disassemble the connection is a priority. Moreover, the high degree of standardization of the fasteners, the widespread availability of tools as well as the minimal training requirements for personnel enable rapid assembly and disassembly of components, for example, during maintenance or repair. This advantage is offset by the risk of the bolting assembly coming loose on its own. Cyclic and sudden stresses can loosen the bolting assembly unintentionally, which in turn can lead to significant economic losses (such as downtime during peak seasonal operations). In worst-case scenarios, it may even pose a risk to life and limb. Furthermore, the *VDI Roadmap—Agricultural Engineering and Technologies 2030* predicts a rising level of automation in agricultural machinery. With the elimination of machine operators, who previously had the ability to detect loosened bolted connections early on and take appropriate action, the reliability of bolted connecting elements is now more critical than ever.

Autonomous agricultural machine



Assistance system (left) and interior (right)

Maintenance-free connections in agriculture

However, by utilizing appropriate locking elements while factoring in service-life preload losses, bolted connections can be designed and dimensioned from the outset to be maintenance-free and resistant to loosening. At the same time, non-destructive disassembly of the components remains possible. The verification of bolted connections according to VDI Guideline 2230, Part 1, accounts for potential losses in preload due to settling effects (caused by the plastic leveling of surface roughness). It should be noted that these settling values only apply to steel-to-steel surfaces. In practice, however, coatings are often used as corrosion protection, locking elements to prevent loosening, and alternative fasteners such as lockbolt systems. Because these designs lack established settlement values, a formal verification cannot be provided. This was the primary objective of the research project "Maintenance-free connections in agriculture."

Key research areas of the project "Maintenance-free connections in agriculture"

Experimental studies were first conducted to demonstrate the effectiveness of various industry-standard locking elements. By varying several influencing factors (such as the type of coating, the clamping length of the bolted connection as well as the number and location of the separation joints), settlement values were also determined to supplement the specifications of *VDI Guideline 2230, Part 1*. Furthermore, examinations were conducted into the settlement behavior of mechanical connections using effective locking elements, such as wedge-locking washers, or alternative fastening methods, such as lockbolt systems. In the end, factors influencing the static friction coefficient in the separation joint of primed and powder-coated components were determined. Moreover, the potential of load-capacity-enhancing measures, such as friction shims and additional adhesive in the separation joint, was presented.

With funding from the:



Contact

Mechanical Joining Technology

Contact person:
Justus Mantik
Phone +49 381 49682-426
justus.mantik@igp.fraunhofer.de

Research Initiative BWSF

Contact

Agricultural Technology

Contact person:
Moritz Schröder
Phone +49 381 49682-177
moritz.schroeder@
igp.fraunhofer.de

What does BWSF stand for?

The research initiative Biogene Wertschöpfung und Smart Farming (Biogenic Value Creation and Smart Farming), or BWSF for short, is a joint effort between several Fraunhofer institutes. Teams from the following institutes are involved: Fraunhofer IGP, IGD, IIS, IVV and EMFT. The initiative focuses on application-oriented research for the Agriculture and Food industry. From seed to product, innovative technologies are being developed that contribute to a sustainable and future-proof agricultural sector.

Fraunhofer IGP is conducting research on a wide range of projects as part of the BWSF research initiative.



Project name

- Maintenance-free connecting elements in agriculture
- Thermal spraying in agriculture: Thermally sprayed coatings to increase wear resistance and provide visual wear limit indication
- Material development of flux-cored wires for thermal spraying of wear-resistant coating in agriculture
- HFMI: Preventing fatigue damage to agricultural machinery at welded joints through reliable post-processing
- PlowAnalysis: Online soil analysis for site-specific high-resolution crop management in agriculture
- Vorraiter: Preliminary study on agricultural energy planning for the regional energy transition
- H2RO: Water management using automated pipe drainage systems and irrigation from storage tanks
- Strawberry plastic tunnels: Detection of diseases in strawberries using visual computing
- NitroDetect: Determination of the C/N ratio in legume winter cover crops
- Field Trials/Mod-GT: Examinations of soil cultivation implements in field use – modular implement carrier for flexible arrangement of soil cultivation implements
- PlasmAGRAR: Plasma-based water treatment for environmentally friendly nutrient supply in agriculture
- KleTrAx: Bonding of tractor axles and other cast parts in agricultural machinery
- AgriBond: Aging of bonded components in agricultural machinery
- FarmImpact: Examination of impact stresses on bonded joints – optimization of bonded joints with regard to impact stresses
- AgrInspect: Non-destructive testing of FRP lightweight components and bonded joints in the agricultural sector
- Robust: Corrosion- and wear-resistant materials in agriculture
- Seedling Robot: Development of a system for automated planting of frigo seedlings
- Potato Sorter
- Harvest: Humanoid Robots
- Feasibility study on feed monitoring
- Field robotics: "Ampferwuzi", autonomous root-drilling device to combat invasive docks
- Low Tec Bio Char LTBC: Further development of thermally sprayed in-situ alloys for exhaust gas decomposition in agriculture

Mecklenburger Ernte Producers' Organization

In response to the rising demand for sustainable and resource-efficient agriculture, reducing chemical pesticide use has become a critical priority. Weed control poses a major challenge, particularly in vegetable farming, since it significantly affects yield, product quality and labor costs.

Since 2025, as part of an R&D project, two prototype robotic systems from a Dutch startup have been deployed at the first member farms of the producers' organization. These two self-driving field robots use modern image recognition, artificial intelligence and precise laser technology to control emerging weeds autonomously and completely without herbicides. Through targeted use of laser beams, the weeds are damaged with pinpoint accuracy without harming the crops. This way, the systems make an important contribution to reducing the use of pesticides, protecting the environment and further developing sustainable production methods on member farms.

“As a producers’ organization, we are responsible for our members’ investments. To this end, we have a fund in the double-digit millions at our disposal. As an organization, we use this fund to carry out 80 to 120 projects each year. For our complex R&D investments, we prioritize partners who deliver proven reliability and expertise. We began our collaboration with IGP in 2025. It became clear to us very quickly that this would not be the only or final project. We are excited to team up again on another project in 2026, and we look forward to continuing our reliable and professional collaboration.”

Jörg Elvers,
Managing Director of the
Mecklenburger Ernte GmbH
Producers' Organization



Field robots in the test environment

To ensure an objective and scientifically sound evaluation, Fraunhofer IGP was brought on board as an independent partner in the project. Fraunhofer IGP is also supporting the producers' organization with scientific expertise as part of the project. Staff from the Automation and Production Systems division oversaw the deployment of the two field robots and organized systematic field tests in Schleswig-Holstein, North Rhine-Westphalia and Spain. Based on the documented results, we analyzed their performance, assessed their effectiveness, and developed a potential approach for optimization.

Mecklenburger Ernte GmbH is a producers' organization recognized by the European Union and the only one of its kind in the fruit and vegetable sector in Mecklenburg-Western Pomerania. The company coordinates the marketing of fruits and vegetables from its current 27 shareholders, who are based in several German states as well as in Spain. The focus is on sustainable production that meets quality, market and environmental standards.

Contact

**Automation and
Production Systems**
Contact person:
Kai Potthoff
Phone +49 381 49682-585
kai.potthoff@igp.fraunhofer.de

First Fruitful Use – Humanoid Robots in Strawberry Farming

In 2025, Fraunhofer IGP carried out an exciting, albeit time-limited, project in collaboration with Karls Erdbeerhof. Over a period of about six months, the staff worked with a G1-type humanoid robot from Unitree Robotics. This made us one of the first research institutions in Germany to conduct practical testing of the latest generation of humanoid robotics in a smart farming setting. With support from the BWSF, we evaluated the integration of humanoid robotics in strawberry farming. The collaboration with Karls Erdbeerhof made it possible to conduct the study under real-world conditions, while Fraunhofer IGD was involved throughout the project. The goal was to investigate the use of humanoid robotics for pest detection.

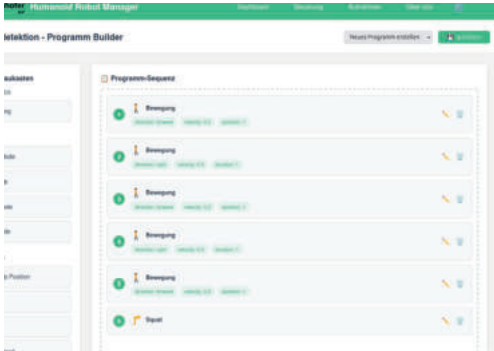
As the technological foundation, we developed the Fraunhofer Humanoid Robot Manager. This allowed us to build targeted expertise in programming humanoid systems while simultaneously creating a central platform for our research work. Within this platform, we developed a module for pest detection, supplemented by an autonomous navigation concept within the rows of strawberry plants. Moreover, a solution was developed that allows the camera mounted on the robot to be precisely aligned using the robot's arm movements. Navigation was based on an image recognition model trained with approximately 150 images, which had already been successfully tested in an initial prototype phase. Several real-world tests in December 2025 showed promising overall results for the use of humanoid robotics in this application scenario.

However, it also exposed some key challenges. For use in smart farming, humanoid robots must be reliably protected against dust, moisture, and dirt, a level of protection that was only partially achieved with the system we used. Soft ground (such as gravelly soil) led to robot instability through sinking, mirroring the effect of molehills. In this scenario, the ground's low load-bearing capacity was more problematic than its topography. The inference of the model could not yet be optimized within the project, so the computation time is currently too long for productive use. Power supply also poses a major challenge. With a battery life of roughly three hours, future deployments will require autonomous charging solutions. Furthermore, the efficiency of such systems depends heavily on the quality of the models and algorithms, as well as on an understanding of the operating environment. Additional challenges include reliable communication with external servers within the table-top growing systems, ensuring safety standards for both humans and machines, coordinating multiple robotic systems and integrating suitable tools for humanoid platforms, just to name a few.

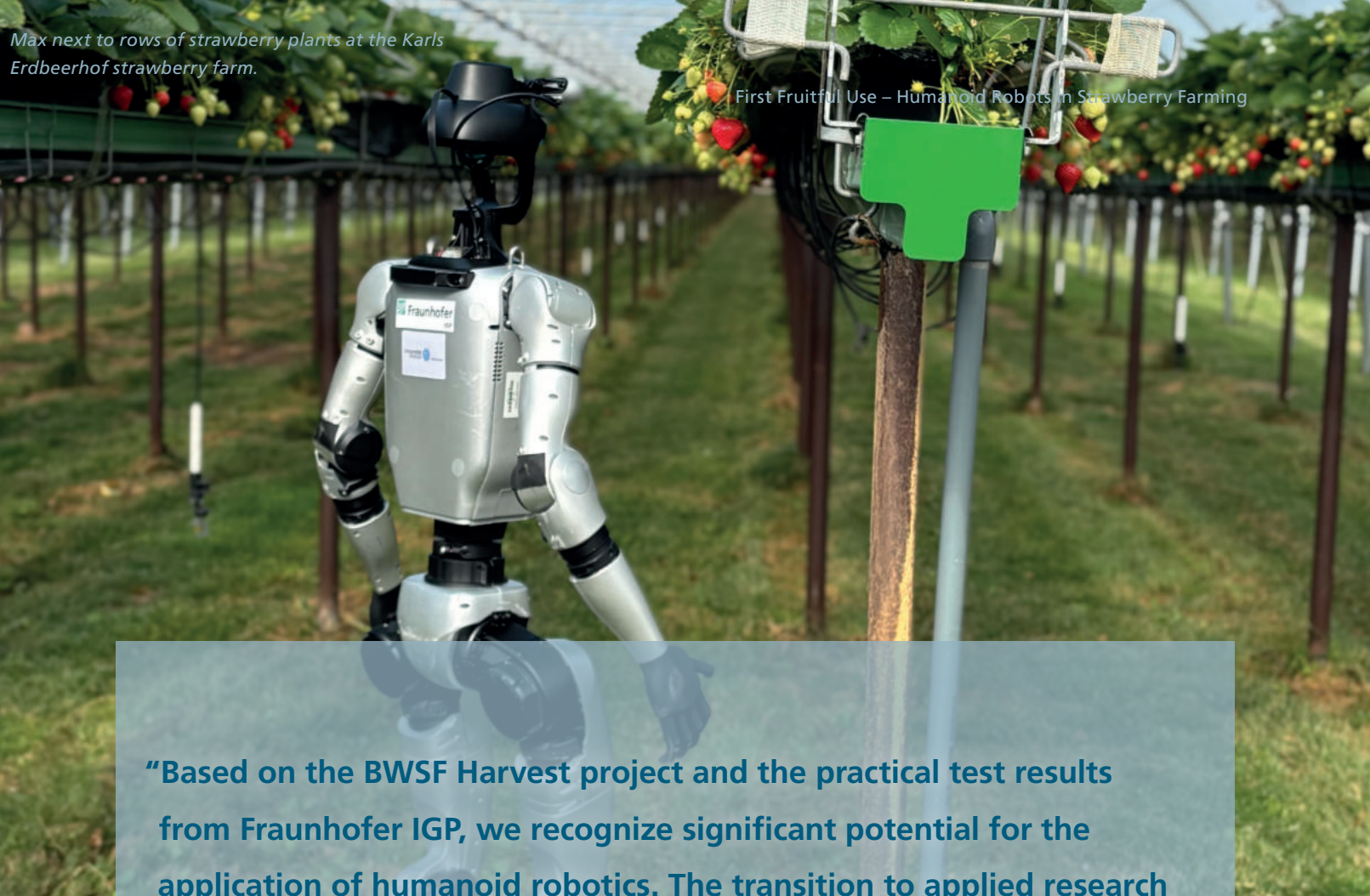
Contact

Industrial Robotics

Contact person:
Nikita Vetter
Phone +49 1748040648
nikita.werner.vetter@
igp.fraunhofer.de



Max next to rows of strawberry plants at the Karls Erdbeerhof strawberry farm.



“Based on the BWSF Harvest project and the practical test results from Fraunhofer IGP, we recognize significant potential for the application of humanoid robotics. The transition to applied research can be considered complete. We see considerable market potential, particularly in the smart farming sector. Intensive dialogue with industry stakeholders and companies also reveals a clear need for such solutions. However, additional research and development work is still required for widespread adoption.”

Thomas Hamann,
Head of Table-Top Cultivation
at Karls Erdbeerhof

Also, considering current price trends, it remains to be seen whether specialized solutions might be more practical in the future.

Despite these hurdles, it is clear that humanoid robots already possess a solid technological foundation. Breakthroughs have been observed, particularly in terms of stability and flexibility of movement. Only minor problems arose in our tests within the rows of strawberry plants. One unexpected issue was plant material getting caught in the internal mechanics, which was resolved by putting socks on the robot's legs.

It is particularly noteworthy that all tests were conducted under real-world conditions in strawberry cultivation rather than under idealized laboratory conditions. The tests took place under unpredictable weather conditions and on uneven, diverse terrain, thus providing a challenging yet practical testing ground for the application of humanoid robotics. Based on this project, we are convinced that humanoid robotics has significant potential for application in strawberry farming and smart farming in general. In addition to large companies, we also see great potential for SMEs, precisely because of the flexibility of such systems.

With funding from the:



Outlook – Technology as the Key to Food Security

The work to date shows that we can make a concrete contribution to food security with our mechanical engineering concept. Automated harvesting processes, intelligent machinery, automated livestock management processes, and digitally supported cultivation methods are already improving profitability and predictability on farms growing specialty and protein crops.

In the coming years, we will continue to pursue this path consistently. One focus is on further automating particularly labor-intensive tasks, from gentle berry harvesting to highly specialized methods in vegetable cultivation and reproducible processes in poultry production. At the same time, we are working on integrated data utilization to derive reliable metrics as well as decision-making tools for industry partners and manufacturers from sensor and process data.

Systematic field trials are a crucial component of this endeavor. At the Thünen Innovation Farm in Tellow, Germany, we will conduct comparative tests in the future to measure traction requirements, diesel consumption and load profiles of various machines and methods. This data will serve to optimize cultivation and harvesting strategies. It will also be used for additional design configuration and development of agricultural machinery.

Our goal is to work with our partners to expand the BWSF Alliance into a prominent competence center for biogenic value creation and smart farming. In doing so, we will create the necessary conditions to rapidly translate research findings into marketable solutions and to sustainably reinforce the agri-food sector in Germany and beyond.



“If we want to make food security resilient for the future, production engineering, agricultural technology, and food technology must work together even more closely – from farm to table.”

Dr. Andrea Büttner,
Executive Director of the
Fraunhofer Institute for
Process Engineering and
Packaging IVV

Translating Science Into Action:

An interview with Dr. Till Backhaus

Dr. Till Backhaus – Minister of Climate Protection, Agriculture, Rural Areas, and the Environment for Mecklenburg-Western Pomerania, Germany



Dr. Till Backhaus, Minister of Climate Protection, Agriculture, Rural Areas, and the Environment for Mecklenburg-Western Pomerania, Germany

What are the key priorities of the Ministry of Climate Protection, Agriculture, Rural Areas and the Environment when it comes to production technology to support the Agriculture and Food industry in Mecklenburg-Western Pomerania?

“The EU’s Common Agricultural Policy has been a critical stabilizing force for the agricultural sector for decades. Since the 1990s, billions of euros have flowed into agriculture and rural areas in Mecklenburg-Western Pomerania through European funding programs. This continuous investment has driven farm modernization, infrastructure development as well as greater competitiveness of our Agriculture and Food industry.

Unfortunately, it is becoming clear that the EU’s financial leeway will be more limited in the future. In the current debates over the next EU budget, the Common Agricultural Policy is under considerable pressure to cut costs and undergo reform. For an agricultural state like Mecklenburg-Western Pomerania, this means that farms will have to rely more heavily on innovation and efficiency in the future to remain competitive.

That is why we are focusing on digitalization, automation and resource-efficient production technology. Precision agriculture, smart sensor technology, low-emission livestock housing technology, and energy-efficient processes make it easier to use agricultural inputs more effectively, reduce costs, and simultaneously achieve environmental and climate goals.

An important partner in this effort is the Thünen Institute’s innovation center in Groß Lüsewitz, where modern precision agriculture methods are tested under real-world conditions, from digital crop production to sensor-based decision-making support. These types of living laboratories are crucial for fast-tracking the integration of new technologies into farming practices.”

Is the small number of agricultural machinery companies in Mecklenburg-Western Pomerania a weakness?

“The structure of the agricultural machinery industry has evolved over time. Major manufacturers have traditionally established their facilities in southern and western Germany, often in close proximity to mechanical engineering clusters.

With that in mind, it’s not surprising that Mecklenburg-Western Pomerania has historically been home to only a few large agricultural machinery companies. However, I don’t see this as a strategic disadvantage.

Our agriculture operates on large, contiguous tracts of land and is exceptionally open to innovation. This structure makes Mecklenburg-Western Pomerania an ideal location for practical application and testing of new technologies.

Our state offers excellent conditions for pilot projects, living laboratories, and demo farms, especially for companies and research institutions. Anyone who wants to develop modern agricultural technology needs real-world farm structures and committed partners in the field—and Mecklenburg-Western Pomerania offers precisely these conditions.”

Which research topics are particularly important for Mecklenburg-Western Pomerania as a center for agricultural technology?

“Livestock farming is currently under considerable structural pressure. At the same time, it remains a key component of a sustainable agricultural circular economy.

In Mecklenburg-Western Pomerania, there are currently about 440,000 head of cattle, including approximately 145,000 dairy cows. The livestock density is relatively low. Mecklenburg-Western Pomerania has only about 0.3 livestock units per hectare of agricultural land, making it one of the regions with particularly extensive livestock farming.

This is precisely why there is an opportunity to expand livestock farming and balance animal welfare, economic efficiency, and environmental requirements.

Key research topics therefore include digital animal stable technology, automation, low-emission animal husbandry systems, intelligent nutrient management, and data-driven decision-making support for farms. Modern technologies can help reduce the workload, lower emissions and simultaneously ensure the economic stability of farms.”

What role do you see Fraunhofer IGP playing in the future of food security?

“Russia’s attack on Ukraine has clearly shown us how vulnerable global supply systems can be. Agriculture and food production are therefore essential to our society.

A high-performing agriculture and food industry is a crucial component of national supply security. At the same time, agriculture faces major challenges due to climate change, geopolitical uncertainties, and rising production costs.

This is where applied research can play an important role. The Fraunhofer Institute for Large Structures in Production Engineering IGP can help streamline manufacturing workflows and fast-track innovation from concept to practice.

Key research fields include the development of efficient production systems, the digitalization of agricultural processes, adaptation to climate change, and the establishment of new climate-resilient crops. This way, the institute can make a significant contribution to ensuring the long-term resilience of our agricultural systems and, consequently, our food supply.”

The Year 2025 in Review



Fraunhofer IGP Awards the 2025 Innovation and Technology Prize to the Peene-Werft Shipyard

This year, Fraunhofer IGP is awarding its in-house Innovation and Technology Prize to the team led by Harald Jaekel, managing director of the Peene-Werft shipyard. At the Wolgast site of Rheinmetall's Naval Systems division, the development of the "seeing" robot for specialized shipbuilding has reached a new level. Prof. Wilko Flügge, director of Fraunhofer IGP, presided over the ceremonial handover. "This award recognizes the long-standing collaboration between Fraunhofer IGP and the Peene-Werft shipyard," says Prof. Wilko Flügge.

Current robotic welding systems in shipbuilding tend to be cost-prohibitive and inefficient due to the use of offline robot programming. The scientific collaboration between Fraunhofer IGP and Rheinmetall's Naval Systems division focuses on the advancement of flexible, automated and intelligent welding technologies for shipbuilding. Rheinmetall's Naval Systems division is a shipyard group with four renowned shipyards in northern Germany alongside international locations, offering customized, intelligent, and cost-efficient shipbuilding solutions as well as comprehensive services. Rheinmetall Naval Systems is also a pioneer in the research and development of autonomous maritime surface systems. The goal of the collaboration is to develop innovative technologies that meet the requirements of the modern shipbuilding industry. The focus is on technical feasibility and economic efficiency.

Ceremonial presentation of the IGP Award at the Peene-Werft shipyard.

From left to right: Dr. Alexander Zych (Project Coordinator, Maritime Custom Manufacturing, Fraunhofer IGP), Prof. Wilko Flügge (Institute Director, Fraunhofer IGP), Harald Jaekel (General Management, Peene-Werft Shipyard) and Ronald Quast (Head of Shipbuilding Production, Peene-Werft Shipyard)



The "seeing" robot in action at the Peene-Werft shipyard

Research scientists at Fraunhofer IGP, in collaboration with Rheinmetall Naval Systems, developed a welding system for shipbuilding. The robot programming in this system is based on 3D sensor data from the tack-welded components and is independent of design data. The system uses novel 3D sensor technology in combination with innovative scanning strategies. "This enables seamless capture of the component geometry, regardless of the material. The benefit is that robot programs tailored to the specific component can be generated for welding, and the necessary user input is minimized," explains Alexander Zych, project coordinator for "Maritime One-Off Manufacturing."

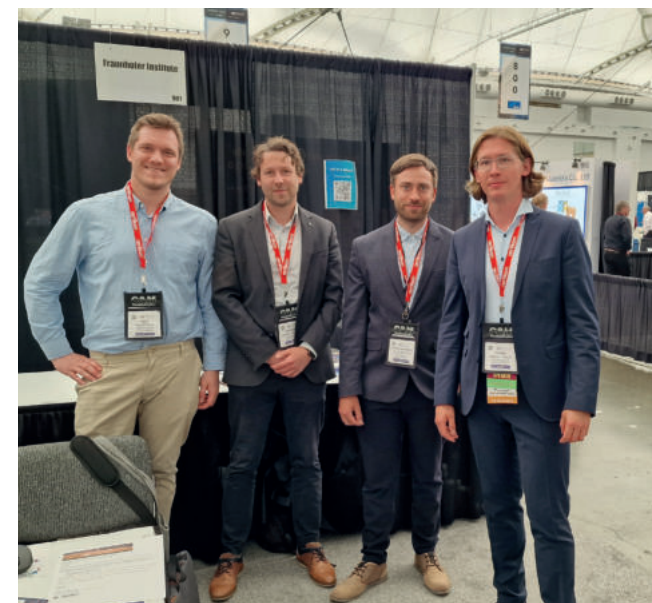
Every year since 2018, Fraunhofer IGP has selected the winner of its Innovation and Technology Award for achievements in the field of production engineering. The award is intended to highlight the technological, environmental, economic, and societal benefits resulting from close collaboration between research institutions and industry.



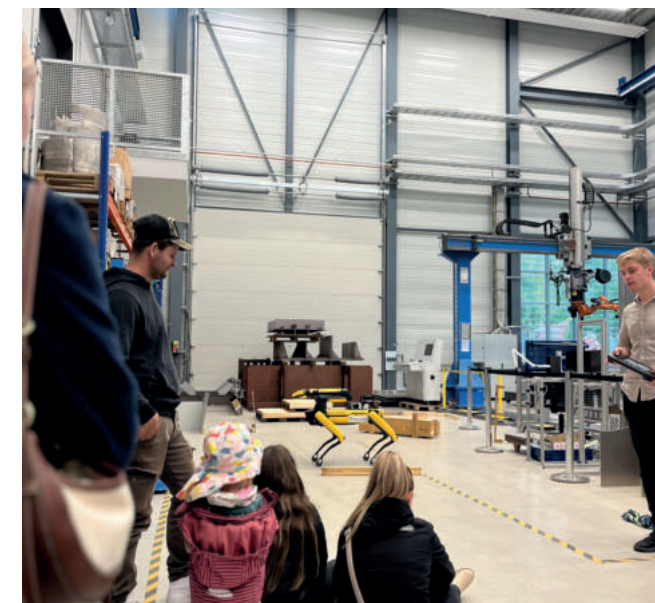
Events and Trade Show Participations



ASF special colloquium featuring a speech by Prof. Wilko Flügge



Fraunhofer IGP employees at the ITSC in May 2025 in Canada



The Long Night of the Sciences on May 15, 2025, in Rostock



Fraunhofer IGP employees on June 18, 2025, at the company run in Rostock



Fraunhofer IGP employees at the 2025 Cancer Cup



Technology Day at Fraunhofer IGP offers visitors insights into various areas of research



New research field at Fraunhofer IGP: Humanoid Robotics



For digital transformation in Mecklenburg-Vorpommern: Partner Days 2025 at Fraunhofer IGP



The joint Fraunhofer booth at Agritechnica 2025 in Hannover showcased innovative solutions for agriculture

2025 – A year full of exciting events

In 2025, Fraunhofer IGP was once again involved in a wide range of events, including the launch of a new master’s program, specialized symposia and public science events, as well as the opening of a new innovation hub. It was a truly diverse, exciting, and multifaceted year.

Fraunhofer IGP opened its doors for Robot Day and the Long Night of the Sciences to give visitors a closer look at our diverse research areas. In addition to participating in various trade shows, our employees were actively involved in team events such as the company run and the Cancer Cup.

The year also brought exciting new developments: The first Conference on Mechanical Engineering and Digitalization in Smart Farming was held at Fraunhofer IGP, and the Thünen Innovation Center in Tellow was inaugurated.

A look at this selection of diverse events shows just how versatile and flexible Fraunhofer IGP is. Thanks to the dedication of our employees, funding parties, and partners, we are able to share our expertise and innovations with visitors at trade shows, conferences, and other events.



First Conference on Mechanical Engineering and Digitalization in Smart Farming at Fraunhofer IGP



Fraunhofer IGP employees at EuroCorr on September 8, 2025, in Norway



Robot-Day on November 20, 2025, at Fraunhofer IGP



PA Meetings in Rostock: Translating research into practical applications

Social Media

Insights that connect

We're online!

- Deeper insights
- Broader knowledge
- Richer dialogue

Our daily routines, our projects, our enthusiasm—online.



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We are always open to discussions and will work with you to explore the possibilities. Come work with us as an assistant—and who knows, maybe you will stay on to pursue your doctoral studies.

Or are you looking for an internship?

Depending on our availability, we offer mandatory internships in accordance with the academic regulations of the respective university, as well as voluntary internships during your studies lasting up to three months and high school internships.

We are looking for trainees!

We offer our trainees a great start to their professional careers. We offer more than just a great workplace. You will get hands-on experience and the independence to drive your own projects. With the knowledge you gain at Fraunhofer, you will have excellent opportunities after your vocational training to pursue further studies or work as a qualified specialist.

For more information, visit:
www.igp.fraunhofer.de/en/career.html

Contact

General inquiries: personal@igp.fraunhofer.de

For recent graduates, young professionals, experienced professionals

- Melanie Gragert | Phone +49 381 49682-221
melanie.gragert@igp.fraunhofer.de
- Vivien Langhof | Phone +49 381 49682-381
vivien.langhof@igp.fraunhofer.de

For students, trainees, interns

- Vivien Wischnewski | Phone +49 381 49682-336
vivien.wischnewski@igp.fraunhofer.de
- Conny Fuhrmann | Phone +49 381 49682-562
conny.fuhrmann@igp.fraunhofer.de

Careers – Join Our Team!

Is it possible to advance scientific research while simultaneously driving the economy? Yes, it is

At Fraunhofer, this balance is the key to success. The future belongs to those who forge new paths. By translating scientific insights into tangible market solutions, you will directly drive global growth, competitiveness, and job creation.

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We keep your dissertation grounded in reality and focused on practical solutions. You will be integrated into project teams from the very beginning and will be able to apply your knowledge in a practical setting. Find the perfect blend of theory and practice at Fraunhofer.

A position at Fraunhofer IGP is more than just a job.

You will benefit from close ties to commercial enterprises as well as the opportunity to interact with experts beyond our own location. We are looking for individuals who are passionate about their field and want to help shape the future. We value your expertise. State-of-the-art offices, laboratories and workshops combined with a strong team spirit create the best conditions for project success.

Are you looking for a job while you are in school?

At Fraunhofer IGP, you will have the opportunity to get a taste of the real world while you are still a student. We offer you a long-term partnership and varied tasks across different fields. Exciting assignments in dynamic teams and a friendly atmosphere await you. We understand the challenge of balancing your studies and a job. We offer flexible work hours. We can easily work out a schedule that fits your life. Projects also often provide opportunities for thesis topics.



An Interview with Viktoria Nikolova

Viktoria Nikolova is a certified materials tester and currently serves as the head of the adhesive laboratory at Fraunhofer IGP



How did you end up at Fraunhofer?

I completed my 3.5-year vocational training as a materials tester specializing in plastics technology in Bavaria in early 2019. During that time, I gained broad exposure to many different areas, but I developed a particular interest in the specialized research tasks in my former quality management lab. The key tasks in that lab included failure analyses, material testing, and material qualification in the automotive supply industry. This prompted me to specifically look for research institutes throughout Germany until I came across the Fraunhofer IGP program. I was especially drawn to the company's strategic focus and its coastal location. After submitting an unsolicited application, I received a call from my future supervisor a few months before the end of my vocational training, who told me about a suitable opportunity.

What makes working at Fraunhofer IGP particularly appealing to you?

I love the diverse day-to-day responsibilities. They match my goals perfectly and ensure I don't lose sight of the broader objectives. Through my work at the institute and the dynamic environment, I have the perfect opportunity to continuously advance my skills in various fields.

Looking back on your career so far here at Fraunhofer IGP, what challenges and highlights stand out most in your memory?

Starting my career right after my vocational training was challenging. I suddenly found myself in a new lab environment, had to answer students' questions, and was given the opportunity to take on responsibility for coordinating and helping design important experiments on short notice. Although this phase was demanding, it taught me a great deal. I particularly enjoyed working on exciting projects such as Underwater Bonding and Prestressed Hybrid Connections. In these projects, I was able to contribute to innovative processes within current research topics. After a vigorous trial and error period, I was ultimately able to participate in practical bonding tests with divers. I also worked with our research scientists to implement procedures that we had developed ourselves.

What motivated you to start your degree program?

Above all, I had a strong desire to gain a deeper conceptual understanding of our daily routines and truly understand how they work. Through my work on various research projects, I realized the immense value and excitement of analyzing these subjects from a more theoretical standpoint. I also wanted to position myself for long-term growth and expand my technical skill set.

What future moments or projects are you particularly looking forward to?

I am especially looking forward to successfully completing my degree and applying the knowledge I have gained in a targeted way to my professional work. Furthermore, I am very excited about working on current topics in the fields of adhesive bonding technology, new materials and polymer analysis. It motivates me to continue playing an active role in the development of processes and technologies and to help shape the institute's laboratory areas.



Viktoria Nikolova
Head of the adhesive laboratory at Fraunhofer IGP

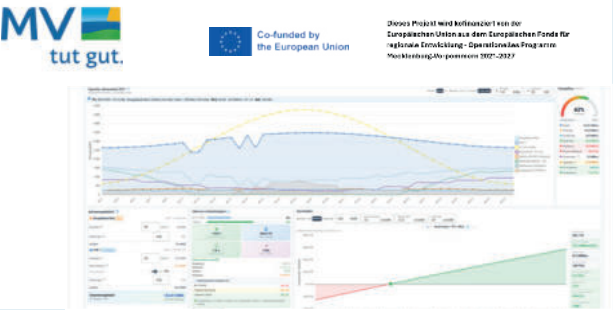
Project Overview 2025



Selected Projects 2025

EnergieControl: Development and validation of energy management and planning methodologies for energy-self-sufficient production facilities with office buildings

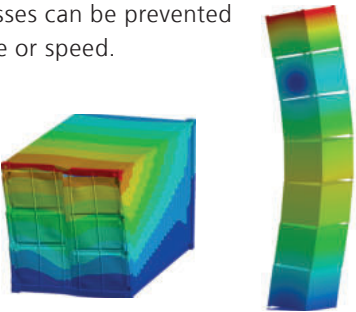
The EnergieControl project is developing a holistic concept for the planning of energy-self-sufficient factories, including office buildings. To this end, an assistance system is being designed to support customized site and project planning. We tailor the energy supply system to site conditions and rigorously manage planning risks. Moreover, we develop concepts for energy control and monitoring during ongoing operations. They are linked to renewable energy systems to control energy flows aligned with demand and maximize the use of renewable energy.



CMS: Container Monitoring System: Predictive motion modeling of container stacks

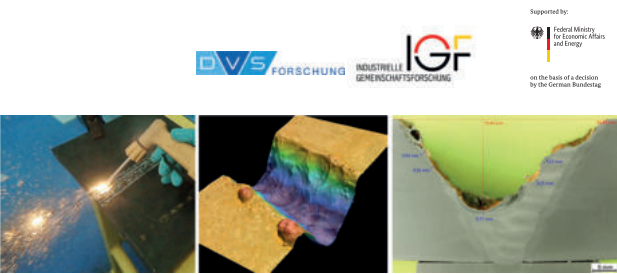
This PtJ project investigates the prediction of critical vibrations in container stacks. Sensors integrated into safety elements provide measurement data during loading and while in transit to adapt the numerical models to the actual structure. If critical conditions are detected, container losses can be prevented by adjusting the course or speed.

Supported by: Federal Ministry for Economic Affairs and Energy on the basis of a decision by the German Bundestag



UW-Fugenhobeln: Safe and efficient weld bead preparation for underwater repairs using hydrodynamic arc groove milling

We analyze hydrodynamic joint milling to optimize productivity, material behavior, and quality. To date, there are no standards in place to ensure the reliable application of this technology. The project will develop suitable process parameters, requirements, and guidelines to serve as a sound foundation for the safe application of this technology in underwater repairs.



MARIWELD: Development of resource-efficient, high-performance welding technologies for HRSS materials in maritime manufacturing

In this subproject of the MARISTEEL consortium project, highly productive welding technologies are being developed that harness the potential of innovative steels with optimized weldability for particularly high and low heat inputs. The focus is on expanded parameter windows, modified metal fillers as well as the reduction of preheating and straightening efforts. The objectives include reducing CO₂ emissions, maximizing productivity across varying sheet thicknesses, and ensuring material integrity.

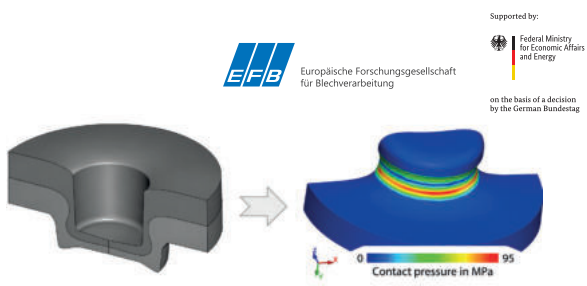
Supported by: Federal Ministry for Economic Affairs and Energy on the basis of a decision by the German Bundestag

ptj projektträger jülich



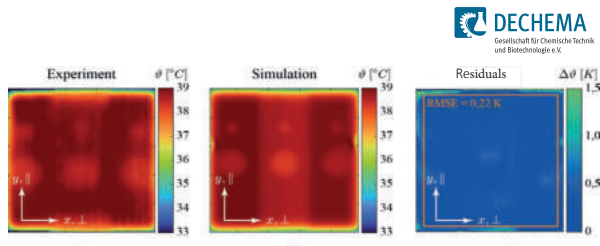
Ampere-Clinch: Resource-efficient, current-conducting connections for the energy transition

The project investigated the forming-based joining of dissimilar, electrically conductive metallic materials (such as for battery contacts or for connecting fuses) using clinching. Extensive numerical and experimental analyses of the friction-based force component in various joint configurations led to conclusions regarding the long-term stability of the electrical resistance at the clinch points.



ThermoSim: Development of simulation-based methods for more efficient non-destructive testing of large-volume multi-material adhesive joints using thermography

The goal of the ThermoSim project is the efficient integration of numerical methods into the non-destructive testing of large-volume adhesive joints using thermography and the reliable prediction of test parameters. The hypothesis is that the optimal excitation and measurement parameters for the practical thermographic detection of a wide variety of defects in a large multi-material adhesive joint can be determined by applying a two-step simulation procedure. The process must be based on a small number of experimental thermographic measurements on simple reference specimens.



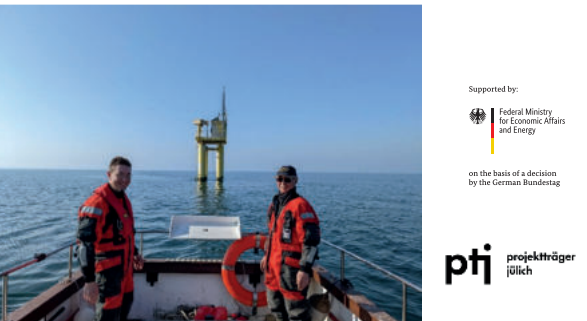
SmartBOND: Joining innovative materials in shipbuilding using an automated adhesive bonding process

The objective of the smartBOND project is to establish adhesive bonding technology in shipbuilding to facilitate the reliable and cost-effective deployment of advanced multi-material systems. An automated, flexible, and low-heat joining technology is expected to improve product quality, productivity, and working conditions. Close collaboration among experts in shipbuilding, adhesive bonding technology, automation, and digitalization is intended to streamline the transition of new technologies into industrial operations.



SEEBAR: Seawater-resistant power generation using fuel cells and a pressure-neutral, self-sufficient energy supply with redundant buffer batteries

As part of the SEEBAR project, a pressure-neutral, encapsulated high-voltage (HV) platform is to be developed that will be positioned underwater and ensure the power supply for underwater systems. It will be powered by an offshore fuel cell system that produces and stores hydrogen on site and supplies the required energy as needed.



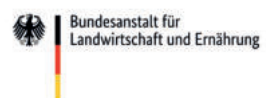
Project name	Researchers
Quality assurance across the entire lifecycle for formed joints in wrought aluminum alloys (QS-Riveting)	Dr. Felix Holleitner
Fraunhofer development modules for the full fuselage: eco-efficient technology applications (FrauGrETa)	Dr. Felix Holleitner, Jacques Biltgen, Nils Heidemann
Forming, clamping and joining with automated machine learning (smart process chain)	Dr. Lukas Kappis
Resource-saving, current-conducting connections for the energy transition (Ampere-Clinch)	Dr. Felix Holleitner
Digital twin for continuous material via markerless position determination (CoilTwin)	Jesline Johnson
Assembly behavior and load-bearing capacity of friction-fit slotted connections for mechanical engineering applications on surfaces with practical value (Load-bearing capacity of slotted connections)	Jörg Ganschow
Joining with high-strength, preloaded blind rivet nut fasteners for structures made of aluminum profiles (BN-Mutter)	Jörg Ganschow
Preloaded hybrid joints in hot-dip galvanized steel structures subjected to complex loads (vorgespHybrid)	Justus Mantik
Further development of notch classes according to EC3 for non-welded construction details using the synthetic Wöhler line and taking typical steel construction manufacturing practice into account (EC3 synthetic)	Dr. Florian Kalkowsky
Cost-effective joining through analysis of the fatigue strength of punching functional elements (StanzelementSchwi)	Alex-Leon Holm
Extension of the design rules for mechanical connections of light-gauge steel constructions according to Eurocode 3, Parts 1–3 (Mechanical Connections in Light-Gauge Steel Construction)	Dr. Florian Kalkowsky
Further development of the notch class catalog for large-diameter bolts in steel and plant construction (Notch class in large bolts)	Jonas Hinrichs, Fritz Wegener, Dr. Mathias Schwarz

Project name	Researchers
Assembly and load-bearing behavior of high-strength preloaded bolted joints for hydraulic engineering and offshore applications (Assembly and load-bearing behavior of bolted joints UW)	Alex-Leon Holm
Application of future-proof mechanical joining technology for existing infrastructure and new product developments (High-performance blind fasteners)	Dr. Mathias Schwarz
Fatigue strength of lockbolts for fatigue strength verification in mechanical engineering (SRB fatigue strength)	Alexander Holch
Development of a test procedure for experimental determination of the static friction coefficient in friction-based joints for mechanical and plant engineering (static friction coefficient in mechanical engineering)	Justus Mantik
Assessment of the fatigue life of high-cycle-loaded stainless steel bolt-nut joints for mechanical engineering (Fatigue life of stainless steel bolts)	Fritz Wegener
Assessment of the fatigue life of bolts > M39 in mechanical and plant engineering (Fatigue strength of large diameters)	Jonas Hinrichs
Safe and efficient weld preparation for underwater repairs using hydrodynamic carbon arc gouging (Underwater gouging)	Carl Christian Nehls, Dr. Oliver Brätz
Non-contact temperature monitoring for qualifying the flame straightening of aluminum in shipbuilding (SpectroStraight)	Anton Konstanz
Qualification of GJS materials and thermally sprayed corrosion protection systems for underwater use under fatigue loading (KorroGuss)	Carl Christian Nehls, Dr. Michél Hauer
Increasing the fatigue strength of wet-welded joints under water (UW-Schwingfestigkeit II)	Carl Christian Nehls
MariSteel subproject: Development of resource-saving high-performance welding technologies for HRSS materials in maritime production (MariWeld)	Christoph Reppin, Anton Konstanz
Determination of notch class-dependent limit values for internal imperfections in welded joints – Limits of internal imperfections (LIMPER)	Jakob Ahrens, Dr. Oliver Brätz
Safe arc stud welding without a ceramic ring on austenitic materials for shipbuilding applications through combined gas shielding, process modification and process monitoring (EasyStuds)	Tom Fiedler, Dr. Oliver Brätz

Project name	Researchers
Development of intelligent image processing algorithms for quality monitoring during automated MIG welding of aluminum materials for external and non-surface irregularities (AluDetect)	Henning Credet, Alexander Luther
Deformation capability of welded joints in high- and ultra-high-strength steels in steel construction (HighDeformWeld)	Dr. Oliver Brätz
KoSyShip: Corrosion-resistant system components for low-emission marine fuels (Individual project: SmartComponents – Innovative manufacturing concepts and component test bench) (KoSyShip SmartComponents)	Dr. Andreas Gericke, Dr. Björn Henke, Dr. Michél Hauer, Julia Schubert
Improved fatigue strength assessment by incorporating manufacturing constraints and optimization potential (OptiMP OptiFatMan)	Jakob Ahrens, Alexander Holch, Ahmed Eid
Digitalization of cold plastic forming through continuous quality control (DIKUQ)	Jonas Puschmann, Dr. Felix Holleitner, Dr. Christian Scharr
BIM-based lifecycle management of a building for automated virtual condition analysis (BIMLeb)	Dr. Christoph Heinze, David Ullrich
Container Monitoring System – Predictive movement modelling of container stacks (CMS)	Dr. Christoph Heinze, Arne Blosser
New methods for in-process data acquisition and digital information management (DataWeld-CurvedWeld)	Kai Potthoff, Dr. Christian Scharr
Multisensory adhesive joint inspection in shipbuilding (Joint-Inspect)	Dr. Christian Scharr
Digitalization of the measurement process for prefabrication in metal construction (DAVoM) (UnderSec)	Christopher Karberg
Seawater-resistant power generation using fuel cells and a pressure-neutral, self-sufficient energy supply with redundant buffer batteries (SEEBaER)	Christopher Karberg
Development of 3D as-built models at the Wismar site (RobWind)	Arne Blosser, Nick Kirschke
National Action Plan Fuel Cell Production – Technology Network ViR (ViR = virtual reference architecture) (H2GO ViR)	Jan Tschirner

Project name	Researchers
Digital twin of the shipbuilding process (Digital Shipbuilding Platform)	Dr. Konrad Jagusch, Dr. David Jericho
Intelligent data processing and object recognition for digital monopile twins (IntelliDat)	Laura Robl Nikita Vetter
Closed-loop digital pipeline for flexible and modular manufacturing of large components (PENELOPE)	
Development and validation of energy control and planning methodology for energy self-sufficient production halls with office buildings (EnergieControl)	Jakob Moritz Trappel, Paul Gerds, Lennart D'Laclaverie
Transfer project for systematic networking of intelligent systems and projects in the fields of agriculture, rural areas and foodstuffs (X-KIT)	André Siegrist
Development of an automated system for assessing the N supply of winter cereals for agricultural practice via scalable application windows (AutoFenster)	Kai Potthoff
Development of an AI-based method for detecting and compensating for geometric irregularities in wire arc additive manufacturing (hyMMF-Monitoring)	Dr. Sebastian Rieck, Dominik Hack, Julia Schubert, Carl Christian Nehls
Joint project: smartBOND – Joining of innovative materials in shipbuilding production using an automated bonding process; sub-project D: Development and qualification of bonding processes and smart connection to quality management (smartBOND)	Dr. Linda Fröck, Johannes Kuhlmei
Life-cycle processes and design concepts for bonded large-scale maritime structures (BigBond)	Dr. Linda Fröck, Matthias Lang
Development of simulation-based methods for more efficient non-destructive testing of large-volume multi-material adhesive joints using thermography (ThermoSim)	Johannes Kuhlmei
(Dis)assembly of optimized modular construction of thermoplastic fiber composites (DOM4Composites)	Nicco Stroetmann, Dr. Felix Holleitner, Dr. Stefan Schmidt
Increasing the long-term durability of bio-based fiber-reinforced plastic composites for use in shipbuilding (BioFKVSchiff)	Alex Liebau

The projects mentioned here were funded by:



Groups, Alliances and Committee Assignments 2025

Fraunhofer Group for Production

The Fraunhofer Group for Production is a research and development partner for the manufacturing industry. More than 2,200 employees from eight institutes and three Fraunhofer research units make their knowledge and experience available. Utilizing the latest findings from production and engineering sciences, as well as computer science, the Fraunhofer Group for Production offers a range of services that covers the entire product life cycle and the entire value chain. Research and industry are deeply integrated across multiple disciplines here. www.produktion.fraunhofer.de/en.html

Fraunhofer Transport Alliance

Since March 2003, various Fraunhofer institutes and facilities have been pooling their transport-related expertise in the Fraunhofer Transport Alliance. The alliance's goal is to research, develop, and implement practical and conceptual transport solutions for public and industrial clients and to transform them into real-world applications. By collaborating closely on targeted topics, the alliance members deliver integrated system and network solutions for the transport sector. Furthermore, sharing expertise creates pathways for new application areas. This selection and bundling of a wide range of expertise ensures that needs-based solutions can be offered to customers. www.verkehr.fraunhofer.de/en.html

Committee work (in alphabetical order)

Arbeitsgemeinschaft Großmotoren – CIMAC Deutschland des Verbandes Deutscher Maschinen- und Anlagenbau (VDMA)

Dr. B. Henke (Member)

XXL products working group – IPH – Institut für Integrierte Produktion Hannover gGmbH

S. Dryba (Member)

ASIM Specialist Group Association for Simulation of the German Association for Informatics

Prof. J. Sender (Member)

Committee on Geodesy of the Bavarian Academy of Sciences (DGK) – Department of Engineering Geodesy

Prof. M. Geist (Guest member)

DECHEMA – Gesellschaft für Chemische Technik und Biotechnologie e.V.

Prof. W. Flügge (Member of the Executive Board, DECHEMA Functional Materials Division)

German Society for Materials Science (DGM)

Dr. A. Gericke (Member, Joint Committee "Materials Technology Steel")

Dr. A. Gericke (Member, Working group "Material fatigue")

Deutscher Robotik Verband e.V. (DRV)

N. Vetter (Member)

Deutscher Schraubenverband e.V. (DSV)

Dr. M. Dörre (Member, AK Gemeinschaftsforschung)

J. Ganschow (Member, AK Schraubmontage)

German Welding Society (DVS)

Dr. A. Gericke (Managing Director Rostock District Association)

K. Potthoff (Executive Board Member for Technology Rostock District Association)

Deutsches Institut für Bautechnik

Prof. R. Glienke (Member, Expert Committee SVA Metal Construction and Composite Construction)

DVS Technical Committee

Dr. O. Brätz (Member, WG V 2.2 Stud welding)
Dr. A. Gericke (Member, WG V 2.5 Submerged arc and electroslag welding)
Prof. K.-M. Henkel (Member, WG V 4 Underwater technology)
Dr. A. Gericke (Member, WG A 6.1 Welding in shipbuilding and marine technology, Welding processes, fabrication)
Dr. A. Gericke (Member, WG A 6.2 Welding in shipbuilding and marine technology, Damage to welded shipbuilding structures)
Dr. A. Gericke (Member, WG Q 1 Design and calculation)

European Research Association for Sheet Metal Working (EFB)

Prof. W. Flügge (Contact person)
Prof. R. Glienke (Chairman, Joint Committee EFB AGMF3/V10.3 Mechanical Joining, Blind Rivets and Lockbolts)
Dr. M. Schwarz (Deputy Chairman, Joint Committee EFB AGMF3/V10.3 Mechanical Joining, Blind Rivets and Lockbolts)
J. Ganschow (Member, Joint Committee EFB AGMF4/V10.4 Mechanical Joining, Functional Elements)
Dr. K. Nowak (Member, Joint Committee EFB AGMF8/V10.8 Mechanical joining technology testing and joining properties)

Forschungsvereinigung des DVS

Prof. K.-M. Henkel (Member, Research Council)
Dr. A. Gericke (Member, Technical Committee 03 Arc welding)
Dr. L. Fröck (Member, Technical Committee 08 Adhesive Bonding Technologies)
Dr. A. Gericke (Member, Technical Committee 09 Design and strength)
Prof. K.-M. Henkel (Member, Technical Committee V4 Underwater technology)

Forschungsvereinigung für Stahlanwendungen e.V. (FOSTA)

Prof. W. Flügge (Member of the Technical Board of Trustees)

Forschungsvereinigung Schiffbau und Meerestechnik e.V. (FSM)

Prof. W. Flügge (Member of the Technical Advisory Board)
Prof. K.-M. Henkel (Member of the technical-scientific committee)

Association of Thermal Sprayers (GTS)

Dr. M. Hauer (Member)

GfKORR - Gesellschaft für Korrosionsschutz e.V., Arbeitskreis Windenergie

Dr. M. Irmer (Member)

Hanse Aerospace e.V., Hamburg

Dr. F. Holleitner (Member)

Industrieverband Blechumformung (IBU)

Dr. A. Gericke (Member)

Internationaler Verband für den Metalleichtbau (IFBS)

Dr. F. Kalkowsky (Member)

Kompetenzkreis Industrievermessung (KKIV)

Prof. M. Geist (Member)

Competence Network OceanTechnologies@Fraunhofer

Dr. M. Irmer (Member)

Kooperationsverbund RIC MAZA MV e. V.

Prof. J. Sender (Member of the Executive Board)

Prof. W. Flügge (Advisory Board Member)

Maritimer Zukunftsbeirat Mecklenburg-Vorpommern

Prof. W. Flügge (Member)

Maritimes Consulting Center GmbH (MCC)

Dr. M. Irmer (Member)

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Dr. Konrad Jagusch (Member)

REFA Bundesverband e.V.

Prof. J. Sender (Member)

REFA Landesverband Mecklenburg-Vorpommern e.V.

Prof. J. Sender (Chair of the Executive Board)

Rostock denkt 365° e. V.

Prof. K.-M. Henkel (Member)

The German Society for Maritime Technology (STG)

Prof. J. Sender (Head of the Workplace Organization and Production Technology division, Member of the Technical Scientific Advisory Board)

Strategierat Wirtschaft – Wissenschaft

Mecklenburg-Vorpommern

Prof. W. Flügge (Head of Action Area 3 “Mechanical and Plant Engineering” of the Regional Innovation Strategy for Mecklenburg-Vorpommern (RIS))

Subsea Network

Dr. M. Irmer (Member)

UV Rostock-Mittleres Mecklenburg e.V.

Prof. W. Flügge (Member)

Verband für Schiffbau und Meerestechnik e.V. (VSM)

Prof. W. Flügge (Member)

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Dr. B. Illgen (Member)

WGAb e.v. – Academic Society for Work and Industrial Organisation

Prof. J. Sender (Member)

Wissenschaftliche Gesellschaft für Montage, Handhabung und Industrierobotik (MHI)

Prof. M.-C. Wanner (Member)

Wind Energy Network e.V.

Dr. M. Irmer (Member of the Executive Board)

Working Groups of the International Institute of Welding

Dr. O. Brätz (Member, IIW Commission II Arc Welding and Filler Metals)
Dr. A. Gericke (Member, IIW Commission XII Arc Welding Processes and Production Systems)
Dr. O. Brätz, Dr. A. Gericke (Members, IIW Commission IX Behavior of Metals Subjected to Welding)
Dr. A. Gericke (Member, IIW Commission XIII Working group 2 Techniques for improving the fatigue strength of welded components and structures)
Dr. O. Brätz (Member, IIW Commission XV Design, Analysis and Fabrication of Welded Structures)

Expert witness services

German Federation of Industrial Research Associations “Otto von Guericke” e.V.

Prof. W. Flügge, Prof. K.-M. Henkel,
Prof. M.-C. Wanner (Expert assessor)

Federal Ministry of Economics and Technology

Prof. M.-C. Wanner (Expert assessor for the funding program “Innovative shipbuilding secures competitive jobs”)

German Research Foundation (DFG)

Prof. W. Flügge, Prof. M.-Ch. Wanner (Expert assessors)

Standardization work

German Institute for Standardization e.V.

Prof. R. Glienke (Member of the Advisory Board NA 092 DIN Standards Committee on Welding and Allied Processes (NAS))
DIN Standards Committee on Welding and Related Processes
Dr. L. Fröck (Member)
DIN Working Committee NA 092-00-28 AA: Adhesive Bonding Technologies (DVS AG V 8);
DIN working group NA 092-00-28-01 AK: Adhesive Bonding Technologies Process Chain;
DIN working group NA 092-00-28-02 AK: Bonding of Fiber-Reinforced Plastics

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Contacts

Organization

Institute Director | Chair of Manufacturing Technology
Prof. Wilko Flügge
Phone +49 381 49682-20
wilko.fluegge
@igp.fraunhofer.de

Assistant Director | Chair of Joining Technology
Prof. Knuth-Michael Henkel
Phone +49 381 49682-30
knuth.henkel
@igp.fraunhofer.de

Institute Assistant
Sabine Wegener
Phone +49 381 49682-13
sabine.wegener
@igp.fraunhofer.de

Institute Assistant
Virginie Rogge
Phone +49 381 49682-11
virginie.rogge
@igp.fraunhofer.de

Head of Administration
Lisa Knaack
Phone +49 381 49682-226
lisa.knaack@igp.fraunhofer.de

IT Management
Marcus Baier
Phone +49 381 49682-57
marcus.baier
@igp.fraunhofer.de

Communications
Hanna Rickert
Phone +49 381 49682-315
hanna.rickert
@igp.fraunhofer.de

Quality Management
Marietta Flügge
Phone +49 381 49682-385
marietta.fluegge
@igp.fraunhofer.de

Competence areas

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

Mechanical Joining Technology
Dr. Maik Dörre
Phone +49 381 49682-239
maik.doerre
@igp.fraunhofer.de

Joining and Forming by Plastic Deformation
Dr. Felix Holleitner
Phone +49 381 49682-234
felix.holleitner
@igp.fraunhofer.de

Thermal Joining Engineering
Dr. Oliver Brätz
Phone +49 381 49682-231
oliver.braetz
@igp.fraunhofer.de

Thermal Coating Systems
Dr. Michél Hauer
Phone +49 381 49682-225
michel.hauer
@igp.fraunhofer.de

Energy Converters
Dr. Björn Henke
Phone +49 381 49682-338
bjoern.henke
@igp.fraunhofer.de

New Materials and Processes
Dr. Michael Irmer
Phone +49 381 49682-222
michael.irmner
@igp.fraunhofer.de

Adhesive Bonding Technologies
Dr. Linda Fröck
Phone +49 381 49682-140
linda.froeck
@igp.fraunhofer.de

Fiber Composite Technology
Dr. Stefan Schmidt
Phone +49 381 49682-223
stefan.schmidt
@igp.fraunhofer.de

Corrosion Protection Technology
Valeska Cherewko
Phone +49 381 49682-689
valeska.cherewko
@igp.fraunhofer.de

Production Systems
Prof. Jan Sender
Phone +49 381 49682-55
jan.sender
@igp.fraunhofer.de

Production Planning and Control
Dr. Konrad Jagusch
Phone +49 381 49682-51
konrad.jagusch
@igp.fraunhofer.de

Factory and Work Organization
Dr. Konrad Jagusch
Phone +49 381 49682-51
konrad.jagusch
@igp.fraunhofer.de

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

Industrial Robotics
Nikita Vetter
Phone +49 381 49682-335
nikita.werner.vetter
@igp.fraunhofer.de

Measuring of Large Structures
Prof. Michael Geist
Phone +49 381 49682-48
michael.geist
@igp.fraunhofer.de

Contacts

Supporting areas

Head of the Testing, Monitoring and Certification Body

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

Head of Test Laboratory

Holger Brauns
Phone +49 381 49682-220
holger.brauns@igp.fraunhofer.de

Workshop/Sample Fabrication

Martin Brandes
Phone +49 381 49682-145
martin.brandes@igp.fraunhofer.de

University teaching

Dr. Julia Stahl
Phone +49 381 49682-568
julia.stahl@igp.fraunhofer.de

Contacts by sector

Shipbuilding

Prof. Jan Sender
Phone +49 381 49682-55
jan.sender@igp.fraunhofer.de

Aircraft Construction

Dr. Felix Holleitner
Phone +49 381 49682-234
felix.holleitner@igp.fraunhofer.de

Lightweight Metal and Steel Construction

Dr. Maik Dörre
Phone +49 381 49682-239
maik.doerre@igp.fraunhofer.de

Mechanical Engineering

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

Wind Turbines

Dr. Michael Irmer
Phone +49 381 49682-222
michael.irmen@igp.fraunhofer.de

Rail and Vehicle Construction

Fritz Wegener
Phone +49 381 49682-386
fritz.wegener@igp.fraunhofer.de

Marine Technology

Dr. Michael Irmer
Phone +49 381 49682-222
michael.irmen@igp.fraunhofer.de

Agricultural Technology

Moritz Schröder
Phone +49 381 49682-177
moritz.schroeder@igp.fraunhofer.de

Hydrogen Application Center

Dr. Benjamin Illgen
Phone +49 381 49682-230
benjamin.illgen@igp.fraunhofer.de

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

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Fraunhofer IGP

Fraunhofer Institute for
Large Structures in Production
Engineering IGP

Albert-Einstein-Str. 30
D–18059 Rostock

Phone +49 381 49682-0
info@igp.fraunhofer.de

www.igp.fraunhofer.de/en.html