



Reliable. Digital.
Circular.

Annual Report 2025



We view reliability engineering as an integrated approach that doesn't simply evaluate development, but actively supports it from the very beginning!"

2025 at a glance

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The annual report 2025 – digital and interactive
www.lbf.fraunhofer.de/annual-report

Reliable. Digital. Circular.

From Material to System!

Dear Readers,

Industrial development is under intense pressure today. Products and systems must be developed quickly, designed to be sustainable, and implemented cost-effectively, while also functioning reliably and safely. At the same time, complexity and regulatory requirements are increasing, as is the need to make technical decisions earlier and validate them efficiently. Anyone seeking to develop reliable and competitive solutions under these conditions must thoroughly examine the interactions between materials, components, and systems early in the development process.

It is precisely based on this understanding that Fraunhofer LBF has redefined its strategic focus. Through an intensive strategic process, we have further developed our research institute – both in terms of content and organization – so that we can address technological challenges in a more customer-oriented and consistent manner within their real-world contexts. The thematic framework of this realignment is: **material, component, system.** It describes our professional commitment to viewing the behavior and functions of materials, components, and systems not in isolation, but holistically and integrally.



**From the very beginning,
we place a high priority on
reliability – from materials to
components and to systems.”**

Prof. Dr. Tobias Melz,
Institute Director



This realignment is also closely linked to Fraunhofer LBF guiding principles. As an institute dedicated to the design and assurance of reliability in and of products, we aim to apply our expertise in such a way that materials, components, and systems are not only brought together during validation, but can be thoroughly conceived, designed, modeled, and evaluated throughout the development process, starting in the early development phases. In the spirit of **reliability engineering**, we aim to support the early, robust decision-making in development and to accompany our partners from design through simulation and experimental validation to validation within the system context.

R-strategies are playing an increasingly important role in modern products. For us, they mark the transition from purely function-oriented development to reliable solution design that considers circularity – in the sense of extended fatigue life through recycling and reuse – from the very beginning. Specifically, this means: We continue to develop recycled materials and additive concepts for demanding applications, evaluate and substitute critical materials, create the conditions for reuse through detachable joints, and integrate these considerations with methods of reliability assessment, digital twins, structural monitoring, and property validation. This allows fatigue life, criticality, and suitable R-paths to be systematically considered and robustly evaluated as early as the initial development phases.

We have deliberately supported this technical realignment with organizational changes. The **Research and Development (RD)** division, comprising six departments, forms the scientific and technological backbone of the institute. The division systematically develops strategically relevant competencies and new R&D services in response to market needs. With the new **Innovation, Transfer, and Cooperation (ITC)** division, we are strengthening the direct interface with customers, the market, and applications. ITC monitors needs and trends, initiates cross-functional innovation projects with companies, and supports the transfer of solutions and their practical implementation. With the newly established **Test Facility Design, Implementation and Operation**



(TIO) department, we are consolidating our technical testing infrastructure, developing customized test environments, and shaping operational experimental project work. This enables us to carry out tests, validations, and technical implementations efficiently and reliably.

In doing so, we are more closely integrating market observation, the development of scientific expertise, and experimental implementation – with the goal of enabling our institute to respond more quickly, flexibly, and effectively to our partners' needs and to better shape innovations. This annual report illustrates how this realignment is reflected in the service and research fields through which we will position Fraunhofer LBF externally in the future: **Reliability Assessment & Lifetime Prediction, Sustainability & Circularity, Dynamics & Vibration Engineering, Digital Twins & Simulation, Validation & Prototyping, and Consulting & Training.**





2025 – digital und interaktiv

Take advantage of the interactive nature of this annual report and gain an insight into our projects. You can also find more in-depth content on the online presence.

 www.lbf.fraunhofer.de/research-services

Our R&D priorities are concentrated in these fields. The projects selected for this annual report serve as examples of how we are working on solutions ranging from the development of individual components to system integration, enabling circular material and system solutions, making vibrations and noise manageable, and using simulation methods, digital twins, and AI specifically for development, evaluation, and validation. This illustrates how Fraunhofer LBF is reorganizing its scientific and technological expertise to address complex development tasks even more effectively.

What guides us in this endeavor is a clear mission: We aim to support our partners in industry, science, and the public sector in gaining insight into complex development tasks earlier, better managing risks, and implementing technological solutions more reliably. To this end, we combine research with implementation, methodological expertise with technological knowledge, and strategic vision with tangible benefits, while guiding our partners through challenging development projects.

My thanks go to all the employees of Fraunhofer LBF who drive this development forward with great dedication, deep expertise, and a palpable drive to shape the future. I also thank our partners for their trust, open dialogue, and willingness to shape change together. Especially in challenging times, it is not the quality of individual technologies alone that matters, but rather consistent and constructive collaboration, the ability to provide direction, and the capacity to shape partnerships successfully.

I cordially invite you to read this annual report as an insight into our work and as an expression of our strategic realignment. Perhaps it will offer you not only guidance on the Fraunhofer LBF of today, but also inspiration for the development of reliable, sustainable, and solutions with future viability for tomorrow.

Warm regards

Prof. Dr. Tobias Melz,
Institute Director

Follow us



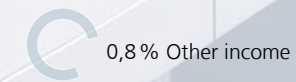
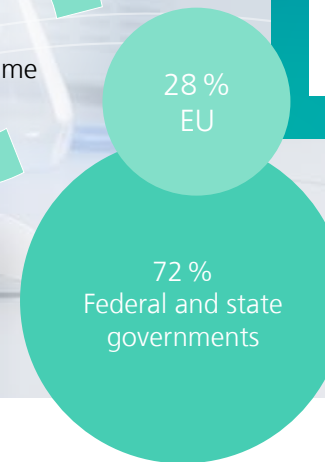
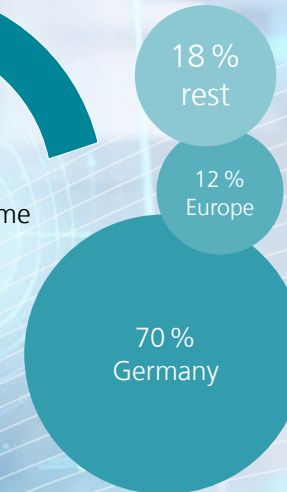
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RheinMain University

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Bosch Rexroth AG, Stuttgart
- **Heike Kind**
Robert Bosch GmbH, Stuttgart
- **Dr. Susanne Lange**
Deutsche Bahn (DB InfraGO AG),
Frankfurt am Main



Fraunhofer LBF in numbers 2025

Personal

In 2025, the institute had a total of **303 employees** on staff. In addition, 23 people were employed at the associated Chair of system reliability, smart structures, and machine acoustics (SAM) at the Technical University of Darmstadt.

Operational budget 2025 [T €]

Economic income	11.434
Public income	5.693
Other income	251
Internal programs	3.665
institutional funding (Grufi)	8.916
Total	29.959

Reliability Assessment & Lifetime Prediction

Services and Research Topics



Reliability assessments and lifetime predictions enable the early identification of risks related to component and system reliability and safety, the design of products to meet specific requirements, and the robust assurance of their functionality and durability throughout their operational life.

Holistically evaluating systems, materials, and components

Comprehensive system analyses are combined with the characterization and evaluation of metal and plastic materials and components to establish a solid basis for decision-making as early as the initial stages of product development.

Understanding aging and failure mechanisms

Mechanical, physical, and chemical properties, as well as cyclic material behavior, are analyzed to reliably predict fatigue life, reliability, and safety under realistic operating conditions.

Monitoring conditions and evaluating fatigue life during operation

Monitoring systems for continuous condition monitoring enable individual fatigue life predictions and evaluations throughout the operational period.



Services and Research Topics

- Knowledge-based optimization of system designs
- Characterizing materials and components
- Evaluating aging and failure mechanisms
- Analyzing materials and components subjected to mechanical, thermal, corrosive, and humid stresses
- Evaluating manufacturing and material influences experimentally and numerically to enhance product safety and reliability
- Implement monitoring systems for condition and fatigue life assessment

Material



Component



System



Circularity



Services offered during the development process

Understanding

Systematically analyze loads, operating conditions, and material behavior



Design

Designing components and systems for reliability



Validation

Predicting fatigue life, monitoring conditions, and validating decisions

AI-generated

Competence Center

Connecting science, industry, associations, and the public around hydrogen

From Single Cell to System Ensuring Fuel Cell Reliability through Novel Testing and Simulation Methods

Hydrogen: Power from
research – use in industry.

Hydrogen plays a key role in sustainable energy supply, as it contributes to the flexibility of energy systems, which is necessary, for example, due to seasonal influences. When there is a surplus of electricity from wind and solar power, hydrogen is produced and converted back into electricity as needed. This allows for a further reduction in the use of fossil fuels.

Networking for a Successful Hydrogen Economy

At the "GreenMat4H2" Competence Center, led by Prof. Dr. Tobias Melz, a comprehensive development portfolio for the hydrogen economy is being created – ranging from materials to components to systems. Together with the Fraunhofer IWKS, the Fraunhofer LBF supports companies in developing sustainable, reliable, and competitive products.

The focus is on materials such as plastics, metals, and CFRP, as well as PFAS substitution and recycling strategies. This is complemented by the design and validation of components and systems such as fuel cells or hydrogen tanks. End-of-life concepts are also taken into account. Companies benefit from end-to-end development across the entire value chain.

The Competence Center also strengthens the exchange between industry, science, and the public, for example through the established Hydrogen Roundtable. Events such as "Hydrogen Week" and trade fair appearances, for instance at the Hannover Messe and the Hydrogen Expo, boost public interest and initiate new projects. Additional synergies are generated through the cooperation with RheinMain University of Applied Sciences. In the BMFTR project "REQUAS," researchers inspire students early on to take an interest in hydrogen, thereby securing a qualified next generation of talent for the industry.

RENEWABLE ENERGIES, HYDROGEN AS
AN ENERGY CARRIER, RELIABILITY



Contact

Prof. Dr. Saskia Biehl
+49 6151 705-282
saskia.biehl@
lbf.fraunhofer.de

www.leistungszentrum-wasserstoff-hessen.de/en

www.lbf.fraunhofer.de/wasserstoff-en

Scalable and flexible testing – realistic simulations of multiphysical loads



Single cell



Stack, System



System

Holistic analysis of multiphysical influences on fuel cells across all levels – from materials to systems.

Reliable fuel cells through new testing and simulation methods

Comprehensive analysis of multiphysical stresses from materials to systems

The mobile use of fuel cells, particularly in commercial vehicles, leads to complex multiphysical stresses, the impact of which on reliability and fatigue life has so far been insufficiently understood. At the same time, development processes are time- and cost-intensive, while traditional laboratory and field tests often consider only individual effects and provide little systematic insight into the interaction of mechanical, thermal, and electrochemical stresses. Especially in early development phases, there is therefore a lack of a robust data foundation to make well-founded design and configuration decisions.

Cost-effective development thanks to a sound decision-making basis

Using practical and flexible testing and validation methods, the research team at Fraunhofer LBF enables a holistic analysis of these influences across all relevant levels – from materials and components to individual cells and stacks, all the way to

the entire system under realistic operating conditions. Complex operational and environmental stresses can be replicated in the laboratory in a controlled and time-efficient manner, allowing for the early evaluation of reliability, fatigue life, and new materials and designs.

In addition, structural mechanical models and a digital twin are used to virtually simulate mechanical stresses, vibration behavior, and structural dynamic effects and validate them with experimental data.

Manufacturers and system integrators thus benefit from faster and more cost-efficient development, as well as a sound basis for decision-making regarding robust, durable, and sustainable fuel cell systems.

FUEL CELL TESTING, DIGITAL TWIN,
HOLISTIC RELIABILITY ASSESSMENT



Kontakt

Prof. Dr. Matthias Enders
+49 6151 705-267
matthias.philipp.enders@
lbf.fraunhofer.de

www.multipem-brennstoffzelle.de/en

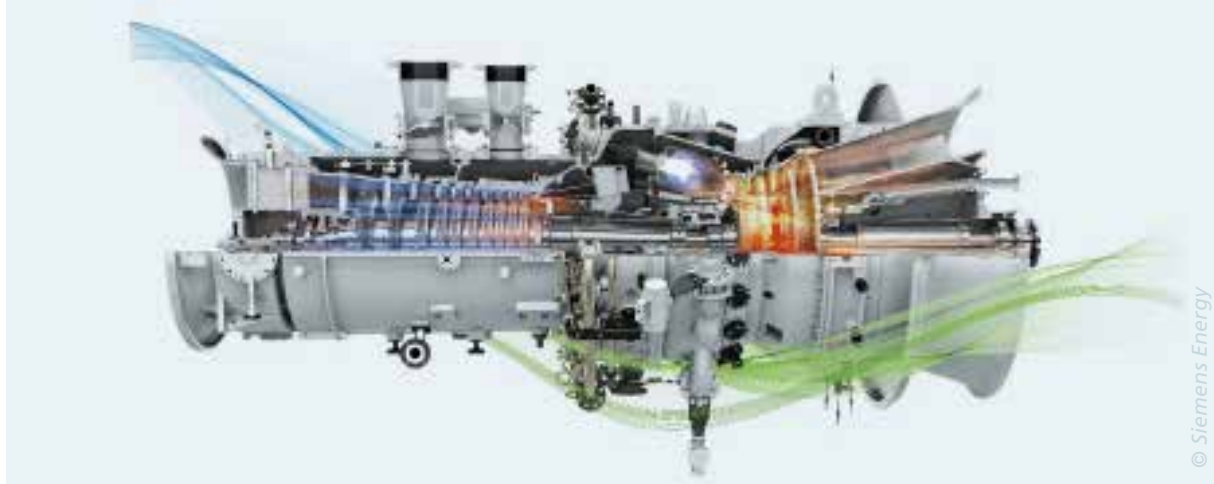


Illustration of a gas turbine for power generation.

Core technologies for the construction of hydrogen gas turbines

Investigation of the influence of hydrogen on materials and welded or brazed joints

Supported by:



on the basis of a decision by the German Bundestag

Grant number: 03EE5179D

In the "H2BED" project, led by Siemens Energy, the Fraunhofer LBF is developing core technologies for evaluating materials and joints for 100 percent hydrogen gas turbines. The focus is on materials, welded joints, and brazed joints, whose behavior under hydrogen is being investigated. The Fraunhofer experts are developing methods to assess strength and fatigue life under real-world conditions. The goal is to establish a sound basis for the safe design of fuel-carrying components.

Together with the project partners, material properties are determined in air and under hydrogen. In this process, temperature, hydrogen concentration, joining process, and notch effect are analyzed. Cyclic material characterization is performed using a test facility developed in-house in Darmstadt, which enables unique tests under real-world conditions – fatigue tests under pressurized hydrogen (up to 50 bar)

on full-scale specimens. A second facility for pressures up to 100 bar is currently under construction.

Basis for reliable preliminary design and efficient dimensioning

The comprehensive results are supplemented by hydrogen content measurements, compared with quasi-static data, and systematically evaluated to identify correlations and dependencies in strength and fatigue behavior. The goal is to identify correlations and provide a method for the preliminary sizing of hydrogen-carrying components. Customers receive a scientifically sound basis for the safe preliminary sizing and efficient design of their hydrogen-carrying components.

HYDROGEN, JOINTS, MATERIAL CHARACTERIZATION

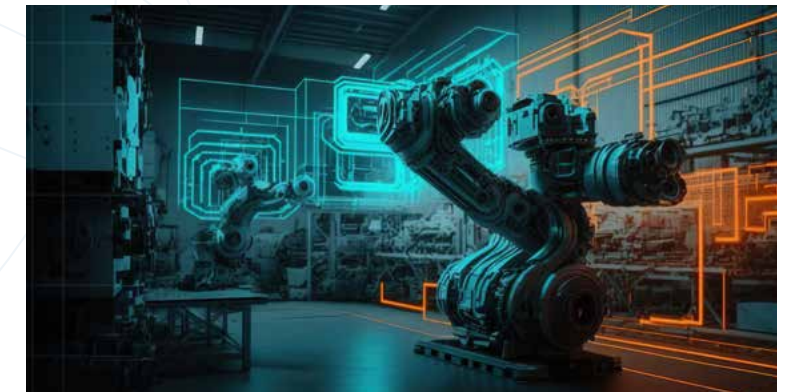
Uncertainty-aware diagnosis for operational condition monitoring

Integration of vibration-based monitoring with reliability analysis

Experts from Fraunhofer LBF are investigating the reliability of diagnoses in multisensory, machine learning-based condition monitoring systems. The goal is to quantify uncertainties in diagnosis and thereby improve decision-making processes in machine and plant operations.

The focus is on linking vibration-data-based monitoring with a systematic assessment of the reliability of all processing steps. As a result, diagnostic statements from the AI-based system are always accompanied by metrics indicating their respective reliability. This transparency strengthens confidence in automated diagnoses and improves decision-making in machine and plant operations.

The methodology was validated using vibration data from a small wind turbine. This involved over 6 hours of measurement data from 28 sensor channels, covering both normal operation and six specifically induced fault conditions. For the analysis, Bayesian convolutional neural networks are applied to individual sensor channels. The uncertainties in the results are broken down into epistemic and aleatory components. The sensor data is fused using Bayesian model averaging. This allows uncertainty metrics to be systematically aggregated and diagnoses to be output with a neutral result class to avoid incorrect decisions.



A sound basis for decision-making in maintenance and operation

The method for AI-based monitoring is independent of the specific use case and can be applied to other machines or systems. The results show a 10 percent improvement in diagnostic quality through the fusion of multiple information sources. Decisions regarding maintenance and operation can be made more reliably on this basis and remain traceable despite the use of AI. Additionally, optimization needs regarding the AI models could be identified, along with usable datasets for this purpose.

AI-based monitoring reliably improves diagnostic accuracy.

AI DIAGNOSTICS, MONITORING, BAYESIAN NEURAL NETWORKS

Contact

Dr. Steffen Schönborn
+49 6151 705-448
steffen.schoenborn@lbf.fraunhofer.de

www.lbf.fraunhofer.de/h2bed-en

Contact

Andreas Friedmann
+49 6151 705-493
andreas.friedmann@lbf.fraunhofer.de

www.lbf.fraunhofer.de/moira-en

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Evaluation and design of aluminum bronze cast components

Aluminum bronze alloys for turbines and ship propellers

*Component design concept
for the reliable and
failure-free operation of
maritime components.*



The Fraunhofer LBF develops customized methods for the evaluation and design of aluminum bronze cast components for turbines and ship propellers. The alloys are used in hydroelectric and tidal power plants as well as in marine engineering. The production of large components presents challenges for foundries, such as the occurrence of defects, as well as specific requirements regarding material and corrosion behavior.

In the "Bross" project, Fraunhofer LBF systematically investigates the influence of local microstructural conditions resulting from different molding materials, moisture levels, and chemical compositions during the casting process. The experts analyze the quasi-static and cyclic stress resistance of thick-walled aluminum bronzes – including under mechanical and corrosive

stress from seawater. Metallographic and fractographic examinations identify key material parameters and reveal which mechanisms influence failure under corrosion and stress.

Greater operational reliability for maritime applications

The findings are integrated into a practical design concept. This enables companies to perform targeted local design of their ship propellers and ensure reliability over the entire fatigue life. The results show that different batches exhibit comparable allowable peak stress amplitudes and that fatigue resistance under seawater corrosion can be reliably assessed.

Companies benefit from improved reliability, longer fatigue life, and lower failure risks for maritime components.

CORROSION RESISTANCE, FATIGUE
STRENGTH, MARITIME TECHNOLOGY

Contact

Dr. Steffen Schönborn
+49 6151 705-448
steffen.schoenborn@
lbf.fraunhofer.de

[www.lbf.fraunhofer.de/
bross-en](http://www.lbf.fraunhofer.de/bross-en)

Safety assessment for AI-driven autonomous maritime systems

Bayesian networks and FMEA for analyzing AI misclassifications

In the "SIMAS" project, Fraunhofer LBF, together with TKMS and its TKMS ATLAS ELEKTRONIK segment, DNV, and FEV Etamax, is setting new standards for the safety of AI-controlled, autonomous maritime systems. The newly developed methodology specifically addresses the challenges posed by the dynamically growing market for highly automated watercraft – particularly where traditional safety standards reach their limits.

Safety analyses in early development phases

The Fraunhofer experts combine proven safety analyses (FMEA) with probabilistic modeling using Bayesian networks. AI performance data, particularly confusion matrices from object classification, are directly integrated into the probability tables of Bayesian networks. This makes it possible to track how misclassifications propagate through the system architecture and influence overall safety. The methodology also accounts for external factors such as weather conditions, sea state, or optical disturbances and assigns misclassifications to severity categories according to MIL-STD-882E.

This approach provides developers with powerful tools for precise what-if analyses and targeted design optimization – even in early development phases. Vulnerabilities



*High-performance tools shorten the
approval cycles of maritime systems.*

are identified early on, and improvements are made measurable. Industry customers benefit from shorter certification cycles, reduced development risk, and a solid basis for argumentation with regulatory authorities.

The new Fraunhofer methodology enables a transparent and quantitative safety assessment – efficient and scalable, even as system complexity increases. It can also be easily applied to other AI components, opening up a wide range of applications far beyond the maritime industry.

AUTONOMOUS SHIPPING, AI SAFETY,
RISK ANALYSIS

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Contact

Simon Kupjetz
+49 6151 705-298
simon.matthias.kupjetz@
lbf.fraunhofer.de

[www.lbf.fraunhofer.de/
simas-en](http://www.lbf.fraunhofer.de/simas-en)

Sustainability & Circularity

Services and Research Topics



Sustainable and circular material and system solutions combine resource conservation, regulatory compliance, and performance – from material development through to application.

Upgrading recycled materials and developing circular formulations

The addition of additives and qualification of recycled materials, along with formulation and additive development, lay the foundation for high-performance, processable, and circular plastics.

Substituting critical materials and verifying material systems

REACH-compliant substitutions, as well as molecular and micro-structural characterizations, support sound material decisions and their transferability to parts and components.

Enabling circularity at the material and component level

Component-oriented assessments, monomaterial concepts, and structural monitoring concepts enable selection and create the prerequisites for choosing a sustainability strategy while maintaining functionality and safety.



Services and Research Topics

- Adding and upgrading recycled materials
- Developing formulations for recyclable plastics and elastomers
- Substituting critical materials in compliance with REACH
- Characterizing material compositions at the molecular and microstructural levels
- Evaluating effects on properties, structural durability, and fatigue life
- Enabling R-strategies

Material



Component



System



Circularity



Services offered during the development process

Understanding

Early assessment of material compositions, criticality, and opportunities for circularity



Design

Developing circular material and component concepts



Validation

Reliably demonstrating impacts on function, fatigue life, and reuse

New approaches to the sustainable design of dynamically loaded components

Material modeling and simulation-based optimization of bio-based thermoplastic components

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In the "COOPERATE" project, a methodology was developed that allows even bio-based plastics with properties differing from those of conventional polyamides to be precisely characterized and converted into simulable material models.



New design with robust performance.

The combination of experimental material analyses, advanced material models, and process-oriented simulation forms the core of the project. Fraunhofer LBF and its partners were thus able to develop a sustainable and robust suspension link made of bio-based thermoplastic.

The bio-based polyamides used exhibit different behavior than petrochemical references both during the manufacturing process and in the finished component, particularly with regard to moisture absorption, nonlinearity, fiber orientation,

and strength. To account for these differences in component design, anisotropic and viscoelastic models were developed, expanded, and validated at Fraunhofer LBF through extensive tensile and fatigue testing. This allowed process and material influences to be realistically modeled and optimization potentials to be specifically identified.

Realistically simulated – performance specifically improved

Based on these models, the geometry and load paths of the suspension link were adapted to achieve a level of structural durability comparable to that of the conventional component – without significantly increasing material usage. Experimental validations showed that the new design delivers robust performance even under dynamic loads. In the parallel life cycle assessment, the bio-based material also demonstrated a reduced carbon footprint compared to PA6.

The methodology developed opens up new avenues for companies to selectively choose sustainable materials and, through simulation-based design, further develop them into high-performance components early in the development process.

BIO-BASED MATERIAL SUBSTITUTION, REQUIREMENT-ORIENTED COMPONENT OPTIMIZATION, SUSTAINABLE DESIGN AND LIFE CYCLE ASSESSMENT

High-quality-looking plastic components made from recycled materials

Wear-resistant, visually textured tool coatings

Flawless plastic parts in visible areas place the highest demands on production and quality assurance. Even the smallest optical defects lead to scrap. Functional visible parts in the automotive interior, such as air vents, control levers, armrests, holders, door handles, or trim panels, are particularly affected. Manufacturers face significant pressure regarding quality and costs in this area.

At the same time, sustainability requirements are increasing. The demand is for less scrap, lower energy consumption, and a higher proportion of recycled polymers. However, recycled materials often exhibit fluctuating quality. Contaminants and inhomogeneities complicate processing and impair the visual appearance of the components. Foreign particles such as small stones or metal shavings also increase tool wear. This severely limits the use of recycled materials, particularly for visible parts.

Robust mold surfaces for high-quality visible plastic parts

This is where the "ROBUST" project of the Fraunhofer institutes IST, IWM, and LBF comes in. The goal is to develop a wear-resistant surface structure for molding tools. It enables the reliable production of visually high-quality components and masks surface defects caused by impurities.



The combination of targeted texturing and a suitable coating increases wear resistance, improves moldability, and extends mold life. At the same time, the relationships between surface structure, visual appearance, and defect visibility are systematically investigated.

The result: less scrap, more robust processes, and better conditions for the use of recycled materials.

PLASTIC RECYCLING, WEAR PROTECTION FOR RECYCLED MATERIALS, OPTICAL DEFECT CONCEALMENT, SURFACE TEXTURE

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Wear-resistant, optically structured tool coatings for high-quality-looking plastic parts made from recycled materials.

Contact

Georg Stoll
+49 6151 705-8528
georg.stoll@
lbf.fraunhofer.de

Dr. Felix Dillenberger
+49 6151 705-8753
felix.dillenberger@
lbf.fraunhofer.de

www.lbf.fraunhofer.de/cooperate-en

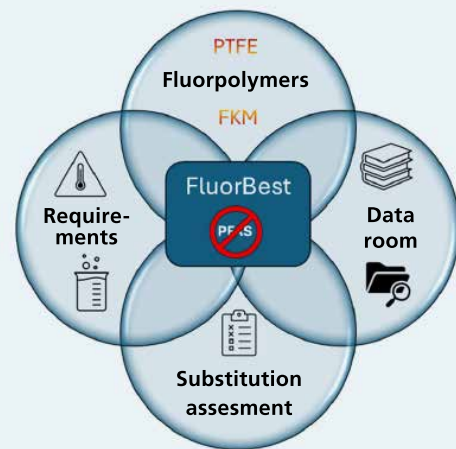
Contact

Dr. Hans Kothe
+49 6151 705-8749
hans-ludwig.kothe@
lbf.fraunhofer.de

www.lbf.fraunhofer.de/robust-en

Substitution of fluoropolymers in technical applications

Development of an AI-based evaluation method for substitution assessment



Positioning of the new FluorBest project.

Contact

Dr. Frank Schönberger
+49 6151 705-8705
frank.schoenberger@
lbf.fraunhofer.de

Dr. Annika Schlander
+49 6151 705-8781
annika.maj-britt.schlander@
lbf.fraunhofer.de

Per- and polyfluorinated alkyl compounds, known as PFAS and also referred to as “forever chemicals,” are increasingly at the center of regulatory and societal discussions. This group also includes fluoropolymers, which are indispensable today in applications such as seals and medical technology. There is a growing need to evaluate the use of fluoropolymers in a differentiated manner and to examine potential substitutes.

Systematic identification of substitution potentials for fluoropolymers through research and industry collaboration

However, assessing substitutability is complex and resource-intensive, and for many applications, no alternatives currently

exist. This is where the FLUORBEST project comes in: It is developing a systematic, AI-supported methodology to assess the substitutability of fluoropolymers in specific industrial applications. A central element is a traffic-light system that provides an indicative assessment of alternatives and their Technology Readiness Levels (TRL). A semantically structured database enables the analysis and consolidation of information from various sources, such as publications and data sheets. This allows potential substitutes to be evaluated and application areas requiring further research to be identified.

FLUORBEST supports industry – such as seal manufacturers and users – in making informed decisions about replacement options for fluoropolymers while simultaneously highlighting existing gaps in the state of the art and science, which opens up new avenues for research.

FLUOROPOLYMERS, SUBSTITUTION EVALUATION, TRAFFIC-LIGHT SYSTEM

With funding from the:



by decision of the
German Bundestag

Grant number: 03XPM019A

www.fluorbest.de



Durable and environmentally friendly: geotextiles made from modified recycled materials.

Upcycling of recycled plastics for use in geotextiles

Additives enable the use of recycled materials in new applications

In the CCPE-project “GREEN” project, Fraunhofer LBF is collaborating with partners to develop solutions for sustainable geotextiles made from recycled plastics. Geotextiles are key materials in construction, water management, and infrastructure projects. They stabilize soil, protect against erosion, and contribute to waterproofing. Until now, they have consisted almost exclusively of virgin plastics, as recycled materials usually do not meet the high requirements.

Fraunhofer researchers demonstrate that recyclates can be upcycled into geotextiles through tailored additive formulations. Various streams of recycled PP, PET, and HDPE were processed into nonwovens and membranes. With the addition of additives, the rheological properties were improved to the point where the materials offer good processability and high mechanical stability. Long-term tests under thermal and hydrolytic conditions demonstrate the long-term durability of the modified recycled materials.

Ecotoxicological Safety

Environmental compatibility is a key concern. Geotextiles come into direct contact with soil and water. The Fraunhofer LBF, together with its cooperation partners, has conducted comprehensive tests on ecotoxicological safety. The tested recyclates do not release any harmful substances such as heavy metals or PFAS and show no toxic effects on aquatic organisms.

Customers benefit from ecological and economic advantages and reduced use of virgin plastics. By combining technical performance with ecotoxicological safety, the developed solutions make an important contribution to the transition toward a circular plastics economy and to meeting the growing demands for sustainable products.

ADDITIVES, RECYCLATES,
GEOTEXTILES

Contact

Dr. Jannik Hallstein
+49 6151 705-8661
jannik.hallstein@
lbf.fraunhofer.de

Dr. Elke Metzsch-Zilligen
+49 6151 705-8609
elke.metzsch-zilligen@
lbf.fraunhofer.de

www.lbf.fraunhofer.de/green-en

“GROVE Additives” – new, customized, and bio-based stabilizers for recycled plastics and contact-sensitive applications

Wide-ranging stabilizer research from Fraunhofer LBF in preparation for a spin-off

Supported by:



on the basis of a decision
by the German Bundestag
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Customized stabilizer additives enhance the performance of recycled materials and contact-sensitive products.

Recycling is key to a climate-friendly industry – but recycled plastics are not always competitive. In the “GROVE Additives” project, researchers from Fraunhofer LBF are developing customized stabilizer additives that significantly enhance the performance of recycled plastics as well as contact-sensitive applications such as medical devices.

Based on state-of-the-art material technologies from Fraunhofer LBF, conventional components are combined with bio-based ones, enabling a new generation of sustainable plastic solutions. The new bio-based additives meet regulatory requirements and offer top performance.

Modular additive system: safe and harmless

“GROVE Additives” offers the first modular additive system that simultaneously addresses all relevant damage mechanisms in recycled materials. The patented, bio-based technology is unique on the market and enables truly 100 percent bio-based plastics. Through the targeted selection of ingredients and individual adaptability to different material streams, GROVE Additives are more effective and safer than all existing alternatives.

As part of a successfully secured EXIST Transfer of Research grant, the project team is now working on establishing a spin-off to bring the technology to market.

Recyclers, compounders, and master-batchers, as well as their end customers, benefit from this development. They can produce high-performance and cost-effective recycled plastics to replace virgin material. The Darmstadt researchers are laying the groundwork to make sustainable additive solutions widely available – to increase the recycling rate and foster a circular economy that combines economic efficiency with environmental responsibility.

STABILIZERS, BIO-BASED, PHENOLS

Contact

Dr. Katrin Markus
+49 6151 705-8731
katrin.markus@
lbf.fraunhofer.de

Dr. Christian Schütz
+49 6151 705-8805
christian.schuetz@
lbf.fraunhofer.de

[www.lbf.fraunhofer.de/
grove-en](http://www.lbf.fraunhofer.de/grove-en)



OrganoFoam foams for seat and back cushions.

Sustainable and comfortable seating

Polyurethane flexible foams made from renewable raw materials

In the joint research project “OrganoFoam,” researchers at Fraunhofer LBF developed bio-based foams for upholstered furniture and mattresses. The novel polyurethane flexible foams were produced in the laboratory as block stock. Blocks weighing up to 8 kg remained stable and retained their shape after mechanical “crushing.” It can be manufactured and used just like conventional standard foams – without compromising on resilience or fatigue life. The fine-pored, open-cell structure meets the requirements for seating and reclining furniture. Measurements show that the new foam achieves the performance characteristics of fossil-based foams. The new bio-based variant also yellows significantly more slowly and can be further protected against UV radiation through the addition of additives.

Comfortable, durable, bio-based – a foam for many industries

For foam processors, furniture, and seating manufacturers, it is particularly important that “OrganoFoam” can be integrated into existing process chains without major adjustments. Tests conducted by the industrial partner show that the delivered blocks can be easily cut to size using existing

systems, bonded together to form larger surfaces, and laminated with standard upholstery fabrics. The project resulted in a demonstration sofa on which seating comfort and long-term durability are being tested under real-world conditions.

“OrganoFoam” is suitable for manufacturers seeking to strengthen their brands with credibly sustainable furniture, seating, and mattress lines. The high proportion of biogenic carbon and improved UV resistance support a positive carbon footprint and a long fatigue life.

Looking ahead, further applications are conceivable, such as in medical positioning aids, acoustic damping elements, or shock-absorbing packaging, where soft, durable, and sustainable foams are in demand.

POLYURETHANE FLEXIBLE FOAM,
RENEWABLE RESOURCES,
UPHOLSTERED FURNITURE

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Contact

Dr. Roland Klein
+49 6151 705-8611
roland.klein@
lbf.fraunhofer.de

Dr. Matthias Wittemann
+49 6151 705-8635
matthias.wittemann@
lbf.fraunhofer.de

[www.lbf.fraunhofer.de/
organofoam-en](http://www.lbf.fraunhofer.de/organofoam-en)

Making sustainable
mobility practical.

Consolidate guidelines for transport-specific life cycle assessment

A European approach to harmonise the LCA for the road transport sector



Funded by the European
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The transport sector is a major contributor to global greenhouse gas emissions. To overcome this, the environmental, economic and social impacts of technologies and mobility concepts must be assessed in a holistic way to define realistic sustainability goals and to select the most sustainable solutions. This results in a need for a harmonized assessment approach for zero-emission transport systems to ensure consistency and comparability.

The European project TranSensus LCA, coordinated by Fraunhofer LBF, established a commonly accepted and applied single approach for life cycle assessment (LCA) of zero-emission road transport systems in Europe. This was done through a consensus building approach involving overall more than 60 stakeholders from the European automotive community.

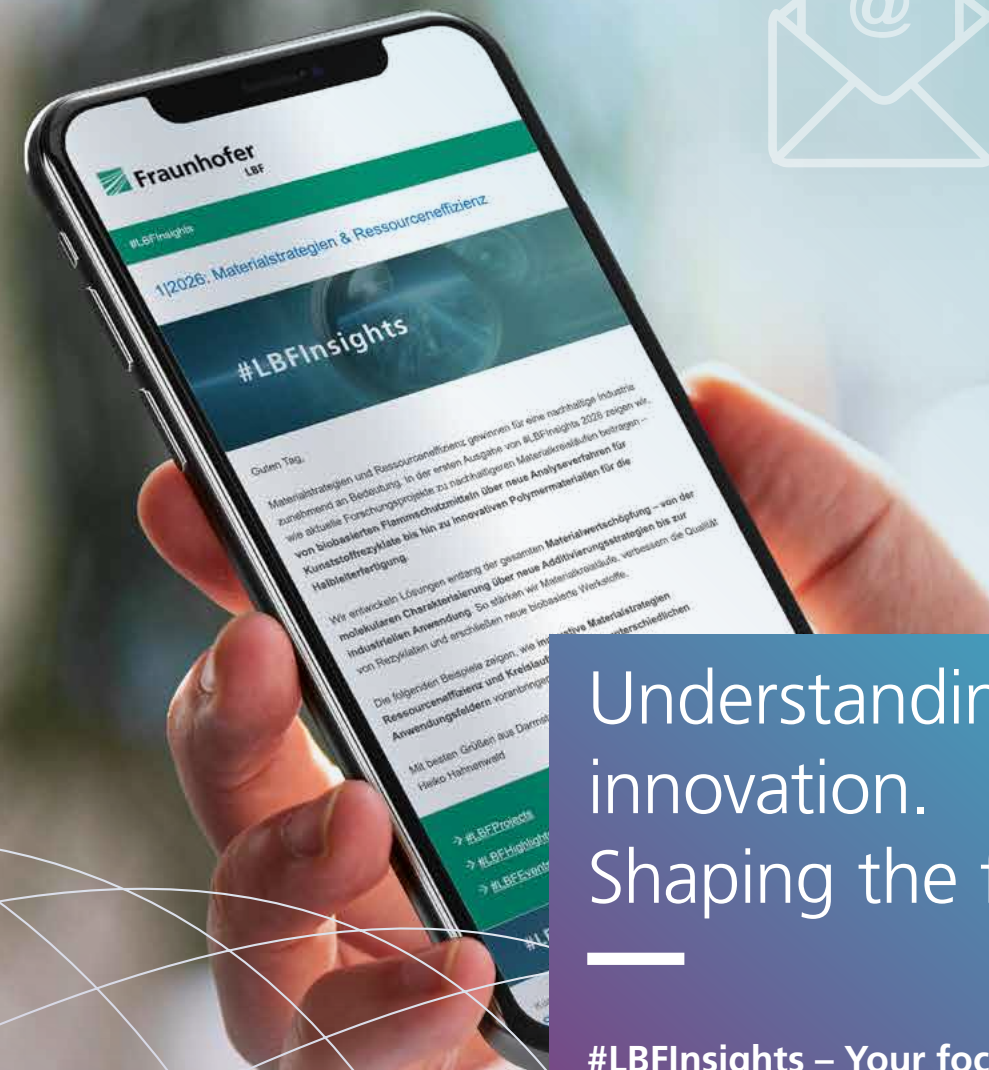
Guideline with methodological requirements for environmental and social LCA

The outcome was published as a guideline comprising 194 methodological requirements, of which 94 are mandatory, covering environmental and social LCAs for products, prospective scenarios, and fleet analyses. The guidelines are structured according the different steps in conducting an LCA specifically, i) goal and scope definition, ii) life cycle inventory, iii) life cycle impact assessment and iv) interpretation.

The document also provides guidance on reporting to ensure adherence to the TranSensus methodology. The guidelines conclude with a section on future perspectives, highlighting areas for future research that may be applied to future iterations of the methodology.

LIFE CYCLE ASSESSMENT, MOBILITY,
TRANSPORT, ECOLOGY

 www.lca4transport.eu



Understanding innovation. Shaping the future.

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The Fraunhofer LBF newsletter regularly provides insights into selected research topics related to materials, components, systems, and circularity.

**It focuses on current projects, selected findings, and events
in both research and development.**



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Dynamics & Vibration Engineering

Services and Research Topics



The effective vibration and noise control is a relevant success factor for many innovative products and systems. Precise vibration analysis and NVH optimization create a solid foundation for safety, reliability, and comfort.

Identifying dynamic effects early

Experimental and numerical system analyses under realistic operating conditions provide a solid foundation for design decisions and specifications at an early stage.

Targeted NVH optimization

Solutions for reducing vibrations and noise, as well as the optimization of assemblies and systems, improve comfort, durability, and noise performance in various applications.

Ensuring reproducible validation of vibration technology analyses

Validations in test facilities using reproducible measurement and evaluation methods support both concept validation and final product validation.



Services and Research Topics

- System requirements analysis and vibration-optimized design
- Analyzing and evaluating the vibration behavior of components and systems
- Developing and implementing vibration and noise reduction (NVH)
- Analyzing mechanical vibrations and vibroacoustic emissions
- Experimentally and numerically optimizing dynamic effects
- Improving assemblies and systems in terms of safety, noise generation, and comfort
- Perform validations using reproducible measurement and evaluation methods

Services offered in the development process

Understanding

Early analysis of vibration behavior, NVH requirements, and dynamic effects



Design

Designing vibration-optimized assemblies and systems



Validation

Validating dynamic behavior under realistic conditions

Material



Component



System



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Test environment with the cabin monument on the Multi-Axial Vibration Table (MAST) as a real system on a monument table.

Recycled materials for aircraft cabin components

New testing method for system validation of recyclable cabin monuments

Contact

Ph.D. Riccardo Bartolozzi
+49 6151 705-8264
riccardo.bartolozzi@
lbf.fraunhofer.de

Rüdiger Zinke
+49 6151 705-479
ruediger.zinke@
lbf.fraunhofer.de

The "CirKle" project addresses the global goal of "environmentally sustainable aviation" and makes a valuable contribution to the reusability of cabin monuments in accordance with the German Circular Economy Act (Kreislaufwirtschaftsgesetz, KrWG). The cabin monuments currently in use worldwide consist of phenolic resin-impregnated honeycomb panels that cannot be recycled. The global goal of "CirKle" is to manufacture a new generation of semi-finished products for cabin monuments and to directly market recycling-compatible, structurally identical monuments, particularly for the retrofit market.

Combination of structural dynamic testing and system simulation

Researchers at Fraunhofer LBF are engaged in test development for recyclable cabin monuments with the goal of developing a new testing method to validate the equivalence of cabin monuments

made from recyclable material to existing structures. The methodology is based on dynamic system validation using a multi-axial shaking table (MAST) and the subsequent comparison of the reference structure made of conventional material with the recycled structure using calibrated digital twins to represent the structural dynamic behavior.

The added value of this methodology lies in the fact that cabin monuments are tested with expected realistic dynamic loads and that the effects of material substitution on structural dynamic behavior can be quickly evaluated. This makes aviation more sustainable.

CABIN MONUMENTS, DYNAMIC
SYSTEM TESTING, DIGITAL TWINS

Solutions for drone technology and aerospace development

Ensuring the quality and performance of innovative aviation products

In the field of emission-neutral Urban Air Mobility (UAM), the Fraunhofer-Gesellschaft is making a significant contribution through its flagship Albacopter® project and has developed an eVTOL drone as a technology demonstrator for applications including autonomous cargo transport.

The Fraunhofer LBF contributed to the project's success with its expertise in structural and aerodynamic design and the construction of subsystems, the development of high-performance energy storage systems, and the experimental testing and validation of components. Its comprehensive system and design expertise was particularly crucial for the integration and design of various system components such as energy storage systems, emergency rescue systems, electronics, sensor systems, and propulsion units.

Systems Engineering for Innovative Drone Technologies

To design the structure, its components, and the energy storage system, Fraunhofer LBF develops methods that flexibly account for mission orientation and the associated requirements – such as aerodynamics, strength, energy and power demands from the various flight phases, as well as multiple constraints from design and manufacturing processes. This includes, in particular, the interfaces for connecting/integrating various system



components – such as energy storage and emergency rescue systems, as well as electronics and sensor systems in the fuselage – and the connection of the propulsion units to the wings via motor mounting arms.

Structural dynamic analyses
on the Albacopter® –
Ground vibration test at
Fraunhofer LBF.

The Fraunhofer LBF supports the aviation industry with extensive system and design expertise in the development of new drones and advanced drone technologies – from concept to the validation of individual components and entire systems. This allows potential weaknesses to be identified early on and optimized in a targeted manner.

STRUCTURAL DESIGN, COMPONENT INTE-
GRATION AND OPTIMIZATION, SYSTEM
RELIABILITY

Contact

Dr. Sven Herold
+49 6151 705-259
sven.herold@
lbf.fraunhofer.de

www.albacopter.fraunhofer.de/en

www.lbf.fraunhofer.de/albacopter-en

www.lbf.fraunhofer.de/cirkle-en

Innovation for quieter port management

Improving quality of life and enhancing logistics efficiency



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Kontakt

Dr. Sebastian Rieß
+49 6151 705-378
sebastian.riess@
lbf.fraunhofer.de

Field testing: Vibroacoustic metamaterials (VAMM) can efficiently reduce vibrations.

Noise is considered a form of environmental pollution and poses significant health risks. Industrial noise in inland ports, in particular, leads to conflicts of use between industry and residents. Growing cargo volumes make effective noise reduction measures increasingly important.

In the project "Noise-Optimized Logistics in the Inland Port LOLA," Fraunhofer LBF, together with its project partners, developed and implemented solutions for noise reduction in the inland port. The Fraunhofer researchers developed concepts for active, semi-active, passive, and process-based measures, ranging from innovative vibro-acoustic metamaterials (VAMM) to Active Noise Control (ANC).

Tangible benefits for port operators and residents

Fraunhofer LBF led the development and field testing of the application demonstrators in the project. Measures such as Bragg arrays for the targeted reduction of tonal noise, VAMM for vibration reduction, and Acoustic Black Holes were tested in the laboratory and at the port. Five use cases – ranging from bulk cargo to container handling – formed the basis for these practical tests. Logistical processes were analyzed and specifically optimized to minimize noise sources.

The results show: up to 6 dB less noise at critical points and more efficient logistics processes.

The synergy of research, practical experience, and digitalization makes Fraunhofer LBF a strong partner for quiet logistics processes. Customers benefit from solutions that can be flexibly adapted to different port locations and processes. A tool developed by Fraunhofer IML as part of the project visualizes the project results and illustrates the impact of the implemented measures.

VIBRATION DAMPING, NOISE
REDUCTION, VIBROACOUSTIC
METAMATERIALS



De-iced leading edge of the wing in the icing wind tunnel at Cranfield University.

Energy-efficient vibration-based de-icing for aircraft wings

VIDS Piezoelectric de-icing system for the aircraft of the future

As part of the Clean Aviation project "UP-Wing," the Fraunhofer LBF is collaborating with Airbus and other partners to develop a novel, vibration-based de-icing system for aircraft wings. The Vibration Induced De-Icing System (VIDS) does not rely on hot air, but instead uses highly dynamic actuators that set the leading edge of the wing into resonance. The vibrations generated thereby break up the ice structure and detach the ice layer from the surface.

A smart structure closed-loop approach continuously monitors the structural dynamic properties of the wing, detects ice buildup via resonance shifts, and adjusts the excitation signal in real time. This ensures that the system always operates within the most energy-efficient range. In Cranfield University's icing wind tunnel, ice layers up to 3 cm thick were successfully removed using a CFRP wing prototype – at temperatures ranging from approximately -7°C to -20°C . The tests demonstrate energy savings of around 80 percent compared to bleed air-hot air

systems and about 25 percent compared to electrothermal de-icing solutions, raising the system's technology readiness level to TRL 4.

Energy-efficient with potential for new key markets

VIDS is suitable for both metal and CFRP wings and can, in principle, be integrated into existing structures as a retrofit. This makes the system particularly attractive for future hybrid and electric aircraft, as well as for drones and regional aircraft with limited electrical power. Additionally, there is potential for application to other infrastructure at risk of icing, such as wind turbines or high-voltage power lines.

VIBRATION-BASED DE-ICING,
ELECTROMECHANICAL DE-ICING
SYSTEM, VIBRATION-BASED DE-ICING
SYSTEM (VIDS)

supported by:



Contact

Denis Becker
+49 6151 705-246
denis.becker@
lbf.fraunhofer.de

Thorsten Koch
+49 6151 705-391
thorsten.koch@
lbf.fraunhofer.de

www.lbf.fraunhofer.de/upwing-en

Digital Twins & Simulation

Services and Research Topics



Digital twins help to define requirements early in the development process, evaluate system architectures virtually, and validate design decisions with confidence.

Evaluate requirements and variants early

Virtual system models and digital process chains enable requirements and architectural decisions to be simulated and compared early on.

Integrating material and simulation knowledge

The integration of material data and microstructure-informed models improves the accuracy of simulations and supports well-founded product specifications.

Coupling simulation and experimentation

Through calibration and validation with real-world experimental data, risks are identified early and decisions are robustly validated.



Services and Research Topics

- Development and application of digital twins
- Numerical product development
- Virtual system models and digital process chains
- Coupling simulations and experiments to improve efficiency and cost-effectiveness in product development
- Material data and microstructure-informed models

Material



Component



System



Circularity



Services offered during the development process

Understand

Define requirements and system behavior using models



Design

Virtually compare and optimize system designs



Validation

Linking simulation and experimentation, validating models, and validating decisions

AI-generated

The dawn of a new era in the circular economy for electric vehicle drivetrains

Linking data from development, manufacturing, and operation with targeted end-of-life studies



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Contact

Georg Stoll
+49 6151 705-8528
georg.stoll@lbf.fraunhofer.de

The research project “Automated and Digitalized Circular Economy Solutions for Electric Axle Drive Systems, ReDriveS” is launching: The 25 partners from industry, small and medium-sized enterprises, and academia, supplemented by associated partners from research and business, represent one of the national flagship projects in the BMW’s “DNS of Sustainable Mobility – Digital, Sustainable, System-Capable” program. Automated disassembly processes, innovative recycling methods for rare-earth magnets, and the use of digital twins are intended to lay the cross-industry foundations for sustainable electromobility.

Digital Twin from Fraunhofer LBF

As a key partner, Fraunhofer LBF is developing a digital twin that reliably assesses

the condition of electric axle drives and the expected remaining fatigue life of their components. To this end, the researchers are linking data from development, manufacturing, and operation with targeted end-of-life investigations and translating them into robust condition and fatigue life models. Drawing on proven expertise in systems engineering, structural and system simulation, as well as damage and fatigue analysis, they combine physical and data-based modeling to create a holistic picture of degradation and reuse potential. In doing so, the institute establishes the basis for decision-making regarding the efficient disassembly, reuse, and cost-effective recycling of electric axle drives.

With its combination of automation, digitalization, and circular economy, “ReDriveS” exemplifies the transformation of the German automotive industry toward sustainable, data-driven, and resource-efficient production systems. Upon completion, the project’s results are to be transferred to industrial applications and made available as an industry solution for OEMs, suppliers, and recyclers.

AUTOMATION, DIGITALIZATION,
CIRCULAR ECONOMY



Welded maritime support structure for offshore wind power.

Precise fatigue life prediction of welded maritime support structures

Assessment of fatigue strength under multi-axial loading

Maritime load-bearing structures in offshore wind power are subjected to complex, multi-axial, and time-varying loads. Weld notch regions are particularly critical. Existing methods often inaccurately assess the effects of non-proportional loading – resulting in high safety factors and unnecessary material usage.

Significant savings potential in the manufacturing process

The Fraunhofer LBF is developing a new, practical evaluation methodology for predicting the fatigue life of welded joints. The focus: resource- and cost-efficient design without compromising safety. An extensive testing program on welded steel joints under combined bending and torsional loads, along with a comprehensive literature database, forms the foundation. The result: prediction accuracy increases by 24 to 77 percent compared to standard methods.

Artificial neural networks and explainable AI (XAI) validate the evaluation concept and provide deeper insights into the underlying relationships. Using finite element models, locally acting stresses are precisely calculated and various stress concepts are applied. This enables a geometry-independent evaluation – uniaxial reference tests are no longer necessary, and application is simplified.

The result: Lower uncertainties enable significant savings in sheet thickness and weld volume – material usage and costs decrease by up to 20 percent. The Fraunhofer LBF is thus setting new standards for safe, economical, and sustainable welded joints. This directly benefits manufacturers of offshore structures, as well as other companies focused on multi-axial cyclic stresses.

WELDED JOINTS, MULTIAXIAL
FATIGUE, LOCAL STRESS CONCEPTS

Supported by:



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Grant number: 03SX559 C

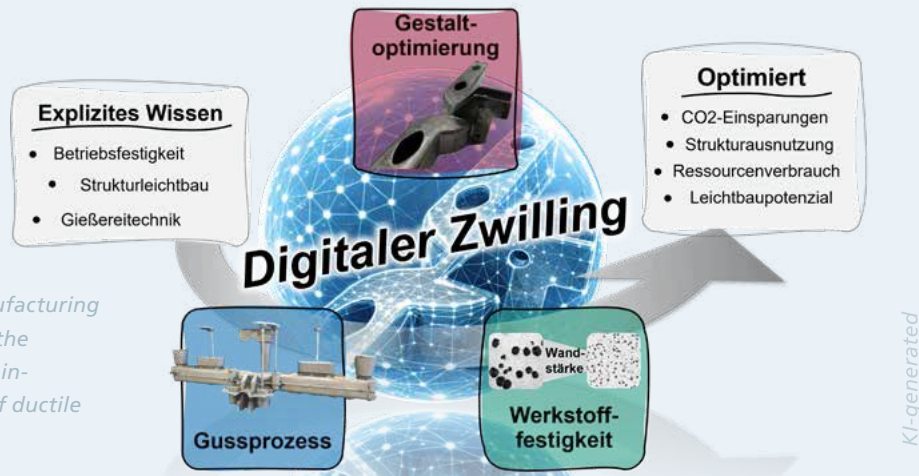
Contact

Niklas Bauer
+49 6151 705-273
niklas.michael.bauer@lbf.fraunhofer.de

Dr. Jörg Baumgartner
+49 6151 705-474
joerg.baumgartner@lbf.fraunhofer.de

www.lbf.fraunhofer.de/smatra-en

Digital twin optimizes manufacturing processes, fatigue life, and the resulting CO₂ emissions of thin-walled components made of ductile iron (GJS).



Digital twin for ultra-lightweight, reliable cast structures

Investigation of the cyclic durability of thin-walled cast components – now feasible for the first time

Supported by:



on the basis of a decision by the German Bundestag
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03LB3079B

In the “GJSlim” project, Fraunhofer LBF is collaborating with partners to develop an innovative lightweight construction concept for ductile iron (GJS). The goal is to create particularly thin-walled structures with wall thicknesses under 5 millimeters. The digital twin links the casting process, component design, and local material properties, thereby enabling wall-thickness-dependent optimization. Fraunhofer LBF contributes its expertise in simulation, experimental verification, and fatigue life assessment.

By systematically combining foundry technology, lightweight structural design, and structural durability, ultra-lightweight GJS components can be safely designed and reliably manufactured for the first time. The project team is determining under which conditions very thin-walled structures can be reliably cast. Suitable molding materials, coatings, and defined process windows ensure stable surfaces and prevent defects such as carbides.

Researchers at Fraunhofer LBF are analyzing how microstructure and solidification time influence local cyclic load-bearing capacity. The results are incorporated into a new design concept that enables precise fatigue life predictions.

High component complexity at low production costs

With the digital twin, companies can now manufacture thin-walled, functionally integrated components made of gray cast iron in a resource-efficient and low-carbon manner. This increases material utilization, reduces production costs, and minimizes the environmental footprint. Fraunhofer’s practical solutions combine safety and cost-effectiveness.

DIGITAL TWIN, WALL THICKNESS-BASED TOPOLOGY OPTIMIZATION, CO₂ SAVINGS

Unique fatigue strength database for plastics

30 Years of Expertise for Faster, Safer Design

Researchers at Fraunhofer LBF have pooled over three decades of experience in the “Fatigue Strength Database for Thermoplastics” to create a unique foundation for design, material selection, and fatigue life prediction. The database identifies relationships between material, geometry, external influences, and loading, making them immediately usable for development and validation.

The database comprises more than 11,000 tested specimens and 1,300 Wöhler curves. It covers engineering thermoplastics from various manufacturers, different additive formulations, conditioning states, varied specimen geometries, environmental influences, and mechanical loads. Standardized test documentation and evaluation ensure high comparability and direct transferability to simulation and design routines.

Data-driven insights for efficient and reliable plastic designs

Key findings: The notch effect increases significantly with rising cycle life and is influenced exclusively by the glass transition temperature. Sharper notches lead to steeper Wöhler curves and thus to a faster decline in strength. In industrial practice, this knowledge enables targeted material



selection and the derivation of lean test matrices, which reduces development times and costs while increasing reliability and time-to-market.

Fraunhofer experts are continuously expanding the database and evaluating data-driven models to predict the effects of notching and temperature. With additional material classes and application-specific load sets, design guidelines are further refined – for more robust plastic structures, lower risk of failure, and more efficient development processes – backed by the largest fatigue strength database of its kind.

Digital testing laboratory enables the efficient transfer of results into databases.

Contact

Dr. Dominik Spancken
+49 6151 705-412
dominik.spancken@lbf.fraunhofer.de

www.lbf.fraunhofer.de/datenbanken-en

Contact

Christian Pittel
+49 6151 705-647
christian.pittel@lbf.fraunhofer.de

Felix-Christian Reissner
+49 6151 705-302
felix-christian.reissner@lbf.fraunhofer.de

www.lbf.fraunhofer.de/gjslim-en

Project team of the K3I-Cycling consortium in front of Lobbe's LVP sorting plant in Iserlohn.



AI-powered plastic recycling with artificial neural twin

From mixed packaging waste to high-quality plastic recyclates with AI

With funding from the:



by decision of the German Bundestag

Grant number: 033K1201

In the "K3I-Cycling" project, Fraunhofer LBF leads the work package "Recycling and Recyclate Production." Together with 16 partners, experts are developing new methods to produce high-quality plastic recyclates from mixed lightweight packaging waste. The focus is on the practical production and evaluation of recyclates on a laboratory and pilot scale, as well as the development of additive packages – including bio-based stabilizers – to improve specific material properties. Using state-of-the-art material analysis and machine learning, polyolefin recyclates are classified according to their state of aging and impurities and grouped into quality clusters. This results in reliable material quality levels that can be incorporated into new standards and digital product passports.

For the first time, reliable performance metrics for high-quality plastic recyclates in demanding products

Fraunhofer researchers combine their expertise in material development and system reliability with data-driven AI,

making a significant contribution to the automation and digitization of recycled material evaluation.

Packaging manufacturers, recyclers, and brand owners benefit from reliable performance metrics, enabling them to specifically use high-quality plastic recyclates for demanding applications – including food-contact packaging. The Artificial Neural Twin (ANT) shows where AI-supported measures can further increase the use of recycled materials. These include e.g. the newly introduced DangerSort system for battery detection and optimized logistics. Industry and municipalities can thus meet recycling targets cost-effectively, measurably reduce CO₂ emissions, and secure the supply of secondary raw materials – a key building block for a resilient European circular economy.

AI-ENABLED PLASTICS RECYCLING,
ARTIFICIAL NEURAL TWIN/ARTIFICIAL
NEURAL TWIN, HIGH-QUALITY
PLASTIC RECYCLATES

Find out more about our practical solutions here:

 www.lbf.fraunhofer.de/projects



At Fraunhofer LBF, we use our long term expertise in interdisciplinary research and development to create applied solutions that meet the specific challenges of our industrial partners. We push the innovation process from the initial idea through prototypes to effective technology transfer, including licensing and spin-offs."

 www.lbf.fraunhofer.de/k3i-cycling-en

Validation & Prototyping

Services and Research Topics



Efficient validation processes create a consistent, credible evidence trail for verifying functionality and reliability – from the concept phase through to experimental validation.

Utilizing hybrid surrogate testing and multiphysics analyses

Hybrid surrogate tests and experimental component and system analyses under multiphysics conditions provide early, cost-effective, and robust validation as early as the concept and design phases.

Structuring validation and verification processes

Statistical test planning, digital twins of test facilities, structured data acquisition, and end-to-end processes increase the efficiency and traceability of product validation.

Integrating and prototyping mechatronic and adaptronic systems

Integrating sensors and actuators into systems supports the robust validation of complex systems in operation and simplifies experimental verification.



Services and Research Topics

- Hybrid surrogate testing for fast and cost-effective durability validation
- Subassembly and system analyses under multiphysical conditions
- Validation and verification processes with statistical test planning
- Digital twins of test and validation facilities
- Structured and application-specific data acquisition
- Integration and prototyping of mechatronic and adaptronic systems
- End-to-end support from integration through to experimental verification

Services offered during the development process

Understanding

Translating requirements, loads, and functions into validation and analysis concepts

Design

Targeted development of prototyping, system integration, and test strategies

Validation

Demonstrating function and reliability through experimental and data-driven methods

Material



Component



System





Development of an industrial manufacturing technology for elastomer sensors

Industrial sensor integration revolutionizes elastomer components



Machine base with sensor-integrated elastomer element for process monitoring.

Industry 4.0 requires smart, integrated sensor technology. Fraunhofer LBF provides the solution: Through the "DELIGHT" project, experts have developed an industrial manufacturing technology for elastomer sensors that can be seamlessly integrated into elastomer components such as machine bearings or couplings.

The patented Delta-C® technology uses structured metal electrodes and a dielectric elastomer. Under load, the material deforms, presses into the electrode structure, and changes the capacitance – allowing forces to be measured precisely. The sensors are cost-effective, environmentally friendly, and do not require critical materials such as rare earths. Robust, versatile, and reliable, they enable machine monitoring, overload detection, and longer maintenance intervals.

Digitization of Components and Processes

The project resulted in a scalable, cost-effective manufacturing process: Structured metal electrodes made of wire mesh and metal foil are bonded and smoothed using a roll-to-roll process. An automated system applies silicone in layers, cures it, and positions the electrodes using a robot. End-of-line tests ensure the highest quality and reproducibility. The new sensor elements were successfully integrated into elastomer components and tested under practical conditions.

The Fraunhofer LBF is thus setting new standards in smart sensor integration – for innovative, future-proof mechanical engineering solutions.

ELASTOMER, SENSOR TECHNOLOGY, FUNCTIONAL INTEGRATION, DIGITALIZATION OF COMPONENTS AND PROCESSES

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Contact

Dr. William Kaal
+49 6151 705-440
william.kaal@lbf.fraunhofer.de

Thorsten Koch
+49 6151 705-391
thorsten.koch@lbf.fraunhofer.de

www.lbf.fraunhofer.de/delight-en



Highly efficient: The "evTrailer" with hybrid energy storage and maximized energy efficiency.

Hybrid storage: maximizing charging efficiency and range for semi-trucks

Mission-specific control of energy flows for greater efficiency and sustainability in heavy-duty transport

In the "evTrailer2" project, Fraunhofer LBF has developed an innovative hybrid storage system for heavy semi-trailer trucks. The system combines high-energy and high-performance cells and ensures optimal charging and recuperation phases. This significantly reduces charging times and extends the fatigue life of the batteries. The range of electric trucks increases. The result: transport and logistics companies benefit from lower operating costs and a better environmental footprint.

Hybrid storage system for maximum charging efficiency and range of semi-trailer trucks

By managing energy flows according to the mission, the distribution of storage capacity is optimally adapted to route length and driving conditions. The concept



The "evTrailer2" at the consortium's final meeting.

utilizes two drive axles: the high-energy storage system supports steady-state driving, while the high-performance storage system activates during acceleration and uphill driving. This enables power outputs of up to 600 kW. At fast-charging stations, charging power of up to 350 kW is achievable, and on overhead line routes, even up to 500 kW. Brake energy recovery amounts to up to 348 kW. With a capacity of 122 kWh (98 kWh usable) and a fatigue life of over 700,000 km, the storage system offers maximum reliability.

This new technology not only improves the efficiency of the powertrain but also protects the high-energy cells from harmful peak currents. The Fraunhofer LBF thus provides a solution with future viability for greater efficiency and sustainability in heavy-duty transport – delivering tangible competitive advantages.

HYBRID ENERGY STORAGE, CHARGING EFFICIENCY, ELECTROMOBILITY, ELECTRIC TRACTION SYSTEMS, COMMERCIAL VEHICLE TECHNOLOGY

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Contact

Dr. Sven Herold
+49 6151 705-259
sven.herold@lbf.fraunhofer.de

Heiko Atzrodt
+49 6151 705-349
heiko.atzrodt@lbf.fraunhofer.de

www.lbf.fraunhofer.de/evtrailer-en

Consulting & Training

Services and Research Topics



Scientifically grounded troubleshooting, expert consulting, and practical training help companies systematically solve technical challenges, make informed decisions, and build sustainable expertise.

Quickly addressing urgent technical challenges

When damage occurs, processes become unstable, or systems react unexpectedly, swift and reliable action is required. The Fraunhofer LBF supports companies with scientifically grounded troubleshooting to systematically analyze causes, understand interrelationships, and derive viable solutions.

Providing guidance for well-founded decisions

Consulting at Fraunhofer LBF combines scientific depth with a practical perspective on materials, components, systems, and methods. This creates a solid foundation for decision-making – from classifying technical issues to selecting suitable methods, processes, and development paths.

Building sustainable expertise

Training courses, workshops, and continuing education programs help companies build up up-to-date methodological and analytical expertise in a targeted manner. This ensures that knowledge is imparted, made applicable in practice, and anchored within the company for the long term.



Services and Topics

- Scientifically grounded troubleshooting for urgent technical issues
- Interdisciplinary root cause and damage analysis
- Neutral assessment of complex problems along the value chain
- Technical consulting on materials, components, systems, and methods
- Practical training courses, workshops, and continuing education programs
- Support in the implementation of new methods and processes

Our Services for Technology Transfer and Problem Solving

Immediate support

Identifying causes and deriving solutions



Providing guidance

Systematically classifying complex issues



Building expertise

imparting knowledge and facilitating transfer

Systematic Research!

We address technological challenges in a customer-focused manner, consistently considering their real-world contexts. Our overarching framework is: **material, component, system**. This describes our professional approach of examining the behavior and functions of materials, components, and systems not in isolation, but holistically and integrally.

Division Innovation, Transfer and Cooperation (ITC)

The **Innovation, Transfer and Cooperation (ITC)** Division strengthens Fraunhofer LBF's direct interface with customers, the market, and applications. It identifies market and technology trends, addresses needs at an early stage, and – in close coordination with the **Research and Development (RD) Division** – uses these insights to generate new impetus for **research topics, expertise, and service offerings**. A particular focus is on acquiring larger, cross-disciplinary industrial projects with a holistic character. In this way, ITC helps translate future-oriented topics into market-driven innovation projects and sustainably strengthen the institute's positioning in the industrial sector.

In addition, ITC organizes the transfer of innovations and research results into application and commercialization, is responsible for key IP management tasks, expands national and international

customer networks, and handles the professional project management of larger research and industrial projects. Key points of contact include strategically relevant working groups, expert committees, and trade shows, as well as collaborations with companies, universities, and research institutions.

The division comprises the departments of **Transfer, Project Management, and Technology Marketing and Communications (TMC)**. TMC aligns Fraunhofer LBF's external image with its strategy and translates technological developments into targeted transfer and communication initiatives. In this way, the ITC Division helps to position the Fraunhofer LBF's service and research fields visibly to the outside world through a clear market message, and to anchor them in market-relevant collaborations with industry and in technology transfer activities.



Division Director

Dr. Christoph Bleicher
+49 6151 705-8359
christoph.bleicher@lbf.fraunhofer.de

www.lbf.fraunhofer.de/research-services



We identify future-oriented topics early on, bring the right partners together, and turn them into viable projects for the market and practical applications."

Division Research and Development (RD)



In particular, the interplay between materials, function, and sustainability is a key driver of innovation – scientifically grounded, application-oriented, and focused on circular solutions.

The **Research and Development (RD)** Division forms the scientific and technological backbone of Fraunhofer LBF. Here, our scientists develop the institute's key scientific competencies across the entire chain – from materials to components to systems – thereby laying the foundation for new R&D services, scientific excellence, and long-term innovation capability. RD supports partners in thoroughly addressing complex development tasks, making robust technical decisions early on, and systematically developing reliable, sustainable, and increasingly data-driven solutions.

The division is structured into six **departments**:

- Additives & Polymer Design
- Engineering Materials & Components
- Material Analytics
- Rotating Components
- System Dynamics
- System Reliability

Fraunhofer LBF pools its scientific strengths across the entire value chain to holistically examine interactions between materials, components, and systems and to systematically address future-oriented topics. This is complemented by cross-departmental scientific task forces and competence hubs, particularly in the fields of **AI-based engineering and monitoring and prognostics**. In this way, RD combines scientific depth with the goal of effectively translating interdisciplinary research results into industrial practice.

The division's core tasks include building expertise and further developing scientific priorities, ensuring scientific excellence, identifying suitable funding opportunities, and rapidly translating relevant research into industrial practice. Collaborations with universities, research institutions, and industry partners are just as essential for this as the targeted development of proposals and consortia for national and European funding programs. In close collaboration with ITC, new topics are identified at an early stage, translated into competencies, and translated into joint projects; for experimental project work, RD also involves the **Test Facility Design, Implementation, and Operation (TIO) unit** within the Research and Development Center. In this way, RD creates the scientific prerequisites for transforming research into reliable, sustainable, and solutions with future viability for industry.



It is precisely in the interplay of material, function, and sustainability that a decisive lever for innovation lies – scientifically grounded, application-oriented, and with a focus on circular solutions.”



Division Director

Dr. Sven Herold
+49 6151 705-259
sven.herold@
lbf.fraunhofer.de

[www.lbf.fraunhofer.de/
research-development](http://www.lbf.fraunhofer.de/research-development)



Division Director

Dr. Elke Metzsch-Zilligen
+49 6151 705-8609
elke.metzsch-zilligen@
lbf.fraunhofer.de

[www.lbf.fraunhofer.de/
research-development](http://www.lbf.fraunhofer.de/research-development)



LBF Management Team

Research and Development



Dr.-Ing. S. Herold
+49 6151 705-259
sven.herold@lbf.fraunhofer.de



Dr. rer. nat. E. Metzsch-Zilligen
+49 6151 705-8609
elke.metzsch-zilligen@lbf.fraunhofer.de



Science Management
Prof. Dr.-Ing. Th. Bein
+49 6151 705-463
thilo.bein@lbf.fraunhofer.de



System Dynamics
Dipl.-Ing. H. Atzrodt
+49 6151 705-349
heiko.atzrodt@lbf.fraunhofer.de



Additives and Polymer Design
Dr.-Ing. R. Klein
+49 6151 705-8611
roland.klein@lbf.fraunhofer.de



Rotating Components
Dipl.-Ing. I. Krause
+49 6151 705-480
ivo.krause@lbf.fraunhofer.de



Material Analytics
Dr. rer. nat. R. Brüll
+49 6151 705-8639
robert.bruell@lbf.fraunhofer.de



System Reliability
Dr.-Ing. E. M. Slomski-Vetter
+49 6151 705-589
elena.maja.slomski-vetter@lbf.fraunhofer.de



Engineering Materials and Components
Dr.-Ing. B. Möller
+49 6151 705-8443
benjamin.moeller@lbf.fraunhofer.de

Innovation, Transfer and Communication



Dr.-Ing. C. Bleicher, M. Sc.
+49 6151 705-8359
christoph.bleicher@lbf.fraunhofer.de



Senior Expert Innovation and Technology Projects
Dr.-Ing. C. Beinert
+49 6151 705-8735
christian.beinert@lbf.fraunhofer.de



Senior Expert Innovation and Technology Projects
Dr. Michael Großhauser
+49 6151 705-8757
michael.grosshauser@lbf.fraunhofer.de



Senior Expert Innovation and Technology Projects
Dipl.-Ing. Martin Lehmann
+49 6151 705-416
martin.lehmann@lbf.fraunhofer.de



Senior Expert Innovation and Technology Projects
Dipl.-Ing. M. Matthias
+49 6151 705-260
michael.matthias@lbf.fraunhofer.de



Senior Expert Innovation and Technology Projects
Dipl.-Ing. M. Wallmichrath
+49 6151 705-467
marc.wallmichrath@lbf.fraunhofer.de



Technology Marketing and Communication
H. Hahnenwald
+49 6151 705-8330
heiko.hahnenwald@lbf.fraunhofer.de

Institute Director



Prof. Dr.-Ing. T. Melz
+49 6151 705-1000
tobias.melz@lbf.fraunhofer.de

Staff Sections



Strategic Management
Prof. Dr.-Ing. S. Biehl
+49 6151 705-282
saskia.biehl@lbf.fraunhofer.de



Scientific and Technical Organisation
Dr. K. Burlon
+49 6151 705-8899
konrad.burlon@lbf.fraunhofer.de



Organisational Development
I. Langer
+49 6151 705-648
ilona.langer@lbf.fraunhofer.de



Health and Safety
R. Wirth
+49 6151 705-332
reinhard.wirth@lbf.fraunhofer.de

Central Services



Administration
Dipl.-Betriebswirt P. Betzholz
+49 6151 705-233
peter.betzholz@lbf.fraunhofer.de



Technical Management
Dr.-Ing. T. Hering
+49 6151 705-8514
thorsten.hering@lbf.fraunhofer.de



Test bench design, Implementation and Operation
Dipl.-Ing. Daniel Hofferberth
+49 6151 705-665
daniel.hofferberth@lbf.fraunhofer.de

Associated Department



Systemzuverlässigkeit, Adaptronik und Maschinenakustik
Prof. Dr.-Ing. T. Melz
www.sam.tu-darmstadt.de/index.en.jsp

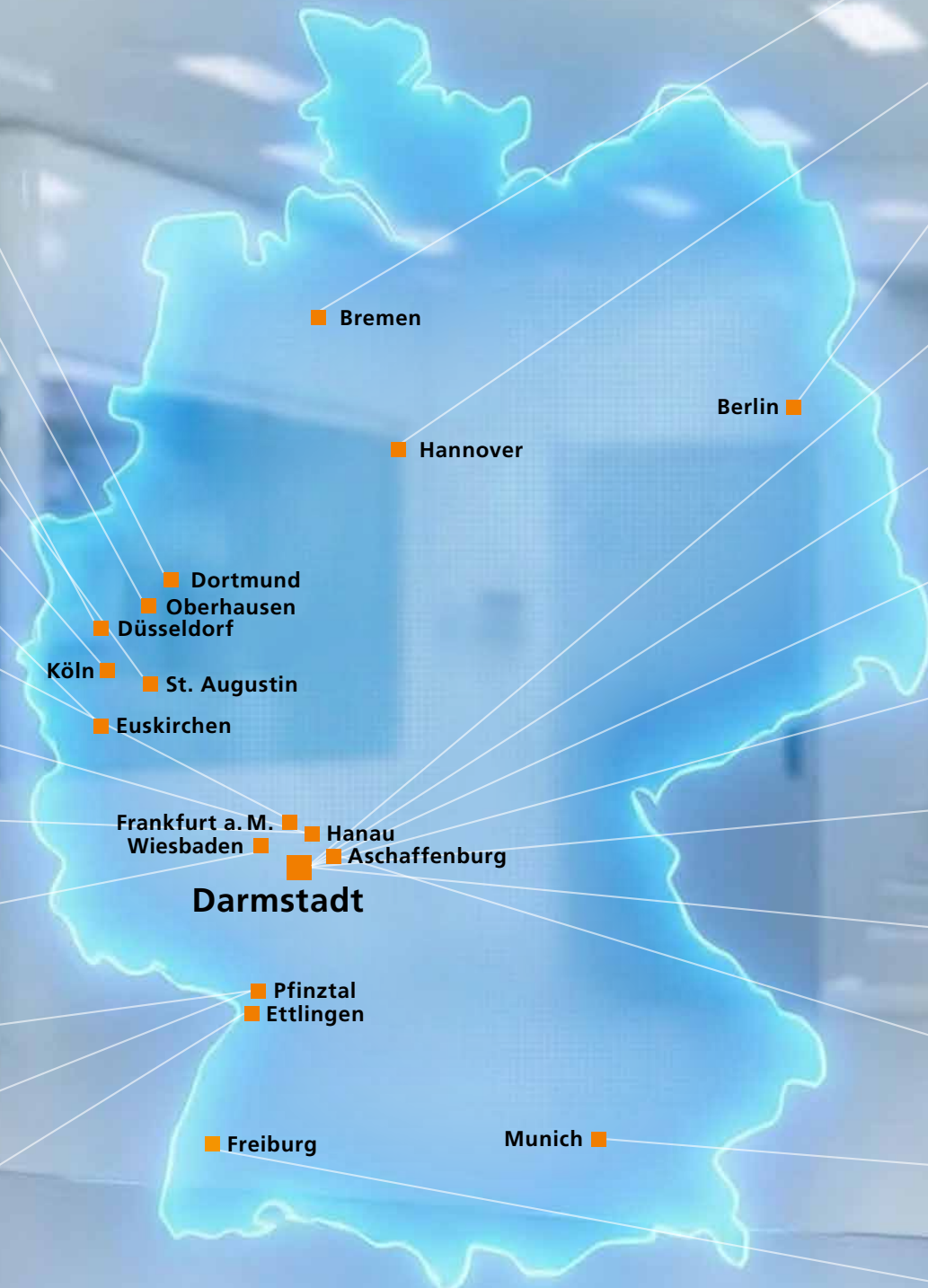
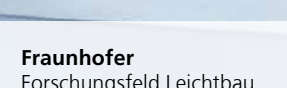
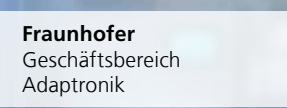
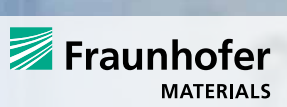
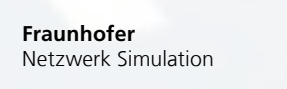
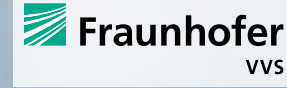
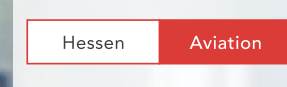


Networks

With our involvement in alliances and market-oriented networks both within and outside of the Fraunhofer-Gesellschaft, we expand your and our possibilities in technical and economic terms. LBF is firmly anchored in the Fraunhofer Group for Materials and Components, which has been pooling the expertise of the materials science-oriented institutes of the Fraunhofer-Gesellschaft for more than 20 years. In addition, the close, interdisciplinary cooperation with our specialized sister institutes in lead-market-oriented alliances creates excellent conditions for the development of our system services and reinforces our innovative strength for the design of your product developments. Since 2019, we have also been involved in the Group for Defense and Security (VVS).

At the same time, we can work with industry partners in the business-related networks across the process chain to competitively and efficiently discover new developments from business, science and applied R&D. Take advantage of our extensive opportunities in a network of experts from business, science and applied R&D!

AI-generated





Digital Dialogue

Fraunhofer Institute for Structural
Durability and System Reliability LBF
Bartningstrasse 47
64289 Darmstadt, Germany



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