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Applied Research for the Aerospace Industry

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Foreword

Imagining our world without aviation and space, is nearly impossible. Aviation is an integral part of our worldwide mobility and it performs indispensable logistics tasks for the global economy. Furthermore, everyday technologies we use in our communication and navigation would be inconceivable without space technologies.

However, we must transform the aviation and space industry for a world in which we use existing resources efficiently and take care of our planet. In this context, important goals such as climate neutral flying and sustainable space travel come into focus. We are convinced we can achieve all this through innovation. Fraunhofer AVIATION & SPACE pools the complete research power of the Fraunhofer-Gesellschaft for a climate neutral and sustainable aerospace industry. We invite you to get to know our technologies and developments and look forward to a cooperation.

Yours sincerely

Bernd Mayer
Chairman, Aviation
Fraunhofer AVIATION & SPACE

Michael Lauster
Chairman, Space
Fraunhofer AVIATION & SPACE

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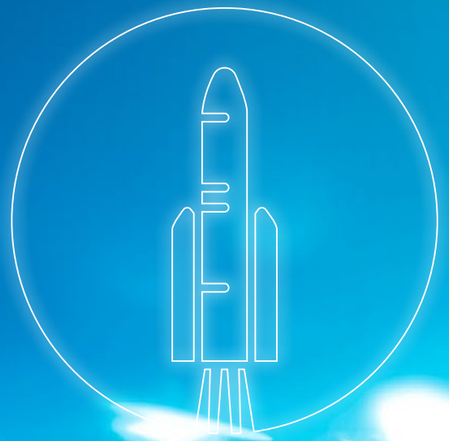

FRAUNHOFER AND THE NEW SPACE ECONOMY

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Aircraft manufacturing and the circular economy

From biodegradable materials to manufacturing and recycling concepts

The European Commission has adopted an action plan for the circular economy within its “Green Deal”. Products need to be sustainable, waste should be reduced, and resource consumption minimized. Prof. Bernd Mayer, chairman of the aviation unit within Fraunhofer AVIATION & SPACE, explains what this means for the aviation industry.

»Circular economy is not just about reusing materials and minimizing waste.«

What are the main design challenges for aircraft manufacturing within the circular economy?

In addition to the usual application criteria, the life cycle of an aircraft must be considered as early as the development stage. This concerns both the construction design and the selection of materials. These choices must be made in view of maintenance and repair during service life, but also with the goal of lifespan extension. A customized product design is necessary to make selected areas accessible for possible disassembly as well as subsequent recycling at the end of service life – for example, by using reshapable polymers or biobased and biodegradable materials.

What does the circular economy entail for product processes?

Circular economy is not just about reusing materials and minimizing waste. The manufacturing process of aircraft also has a significant impact on resource efficiency. The energy consumption of all procedures, possible waste and by-products during manufacturing, required storage capacities, not to forget the transport of large components between countries and much more – all these aspects determine not only the economic efficiency but also the eco-efficiency of aircraft manufacturing.

How will aircraft manufacturers be able to manage all these aspects?

In order to minimize the resource consumption during the production phase in the coming years, manufacturers need to analyze these multi layered influencing factors. Key to this will be the digitalization of the whole production process including digital twins of whole aircraft systems. In the near future, digital models will be the basis for aircraft manufacturing processes itself as well as the analyses and control of its eco-efficiency.

How can Fraunhofer support its industrial partners?

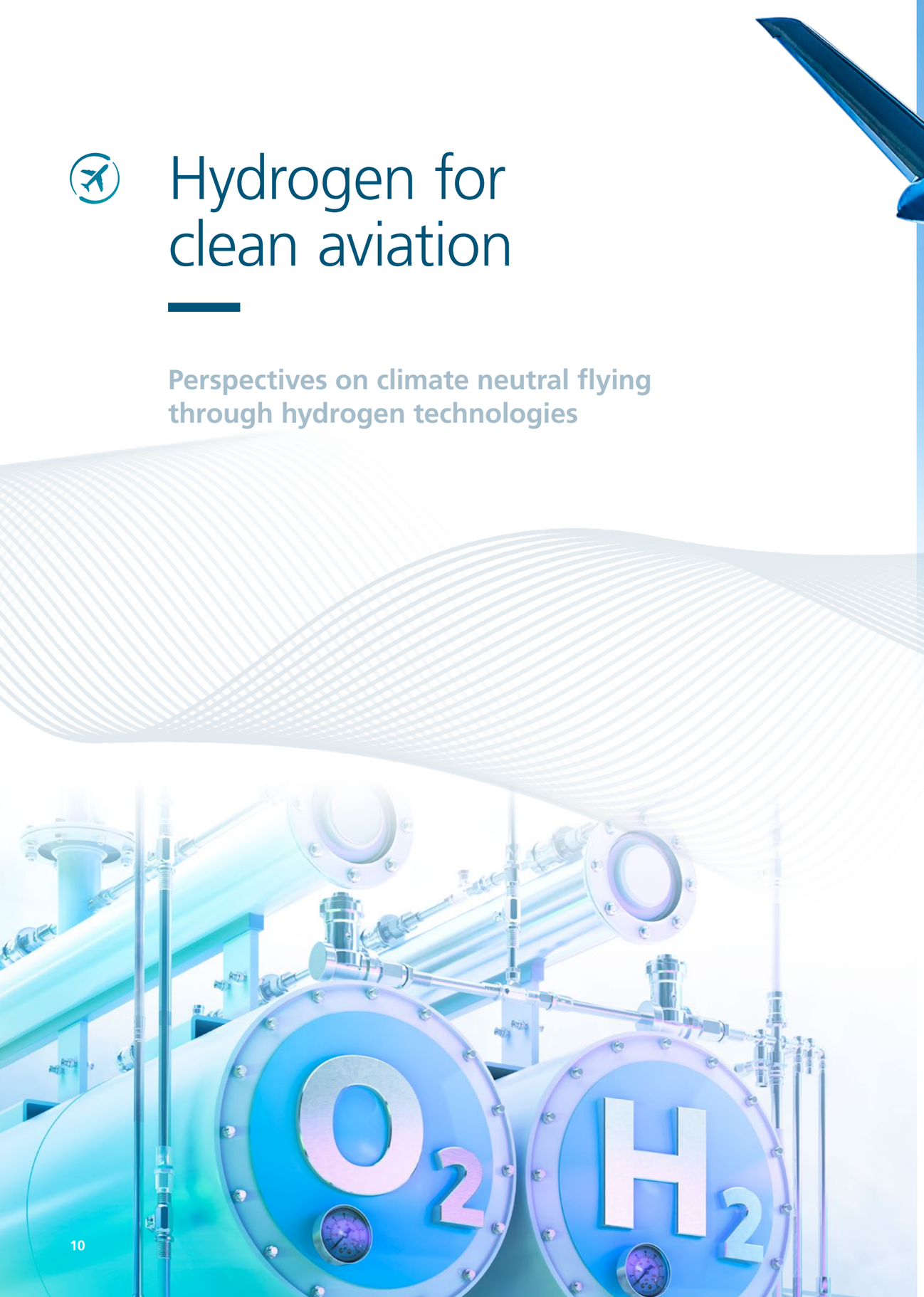
Fraunhofer is working with its partners on new materials and design concepts as well as cutting edge manufacturing processes and robotics. In terms of materials, the focus is on renewable raw materials, reshapable thermoplastic polymers, lightweight fiber-reinforced composites and metals as well as the use of materials from recycling processes. The associated processing technology is adapted to this material base and combined with specific quality assurance methods. In addition, Fraunhofer continues to develop additive manufacturing processes, which combine high design flexibility with an efficient use of materials. Moreover, several Fraunhofer institutes work on the digitization and simulation of materials, advanced production processes as well as on cyber-security concepts. All this is supported by detailed life cycle analyses.

Prof. Dr. Bernd Mayer
Short vita

Prof. Bernd Mayer is chairman of the aviation unit within Fraunhofer AVIATION & SPACE and director at the Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM. He is also professor for “Polymeric Materials” at the University of Bremen. His research departments contributes in particular to the development of new polymeric materials and resource-saving manufacturing processes. On top of that, Bernd Mayer promotes the expertise of over 25 Fraunhofer institutes for the aviation industry covering materials, manufacturing processes, digitization and simulation.

Hydrogen for clean aviation

Perspectives on climate neutral flying through hydrogen technologies



In the medium and long term, the hydrogen airplane will be the ultimate solution for the decarbonisation of aviation. Still, a lot of research and engineering is necessary to bring a hydrogen fuel cell airplane to the market that is capable of carrying passengers.

Learning from automotive

Today, the value chain of hydrogen technology is rapidly maturing and growing. Major driver is the automotive industry that looks to this energy carrier as a promising pathway to decarbonization. Aviation could benefit significantly from these advances made for mobility on the ground. Especially, in the field of technologies and components for fuell cell based electric drive trains Fraunhofer has built up experience in the past year.

Technologies for fuell cells

Fuel cell aircraft systems consist of various auxiliary components for media and thermal management. Several Fraunhofer Institutes are developing technological solutions for many of the system features in electric aircraft, including the high voltage/high power cables, power electronics, and the electric motors. But there are several challenges: higher electrical power from hundreds of kWs toward the MW-level but keeping low weight, high efficiency (kW/kg), and high-reliability properties. At Fraunhofer an air-cooled boost converter power stage for fuel cell applications for a maximum altitude of 15km and a SiC based DC/DC converter power stage were developed. Further big steps are urgently needed in view of the time scale, e.g. new semiconductor power modules with properties of high switching frequencies, high operation temperature and a much more comprehensive insulation as well as adapted cooling solutions.

Technologies for the hydrogen value chain

Within the Fraunhofer Strategic Research Field Hydrogen, researchers and engineers are active in more than 20 institutes with all topics using hydrogen and fuel cells for energy generation and their applications. Some important issues are the automated production of fuel cells and the production of hydrogen tanks. New storage possibilities and transportation of hydrogen, composites and bonded structures, for cryogenic use are also important topics. For the application is essential the robustness to the strongly changing environmental conditions, especially temperature and humidity. A measurement and control concept for fuel cell systems in combination with a simulation model is another important topic. Furthermore, the brittleness of the materials used is examined in order to make service life predictions and risk assessments.

Sustainable and climate neutral aviation

New technologies that reduce emissions

Aviation in Europe must be climate neutral and sustainable along the entire value chain by 2050. To achieve this, climate neutral aircraft need to be available from 2035 onwards. Fraunhofer supports this change with research ranging from new materials and manufacturing technologies to digitalization and automation. All developments are geared towards a life-cycle oriented aircraft design that adheres to a circular economy and eco-efficiency in all aspects.

Materials and processes for a circular economy

As for materials and their processing technologies, aircraft must be designed considering all stages of their life cycle. To identify the real potential within the context of a circular economy, Fraunhofer developed a method called »life cycle gap«. The costs of manufacturing a product are directly compared with the revenue from its »end of life«. In addition, Fraunhofer researchers are making progress with recycling processes for carbon-fiber-reinforced polymers (CFRP), battery modules and electric motors.

But radically applying the principles of a circular economy to aircraft manufacture also means aircraft need to be designed and built using renewable resources primarily. Materials that can be recycled and are not derived from fossil raw materials are central to sustainability. Therefore, one research focus at Fraunhofer lies on bio-based resin systems for a range of applications in secondary structure and aircraft interior, e.g. elements for cabin interior and floor panels. Moreover, research on thermoplastics, that can be reshaped again even after curing, open up new assembly processes and possibilities for maintenance, repair and recycling. Current developments even explore fibre-reinforced thermoplastics for the use in aircraft fuselage.

In addition, additive manufacturing (AM) technologies are further refined. AM not only offers the benefit of high design flexibility, it also saves resources through a targeted material use, thus supporting a sustainable aircraft parts manufacturing.

Automated and digitalized processes for a sustainable aircraft production

To achieve climate friendly flying, a low structural weight of the aircraft is of crucial importance. For a typical passenger aircraft, each kilogram of weight saved reduces kerosene consumption by up to 120 kg per year. It is expected that a mixture of lightweight materials like fibre-reinforced polymers and metals like aluminum will make up the structure of future aircraft. To promote the development of these lightweight structures, Fraunhofer explores new forms of automated aircraft assembly.

In the Clean Sky 2 project "Multifunctional Fuselage Demonstrator", Fraunhofer is researching technologies for automated joining and assembly of lighter aircraft fuselages. The significant weight reduction results from a new type of construction, which in turn is being made accessible for this field of application as a result of thermoplastic fiber composites being used for the first time worldwide.

Finally, digitalization is the basis for modern day aircraft design and manufacture. It enables the design and simulation of sustainable materials, constructions and systems, but also automated production processes. Further applications lie in personnel training and MRO. Fraunhofer develops digital twin technologies AR-/VR-Tools that are applied in the context of aircraft design, but also the training of technicians.

Protection of critical infrastructures in and from orbit

Why the space industry is essential to sustaining our social life

Critical infrastructures must be protected. Recent events like the Corona pandemic or the Russia-Ukraine-conflict, which have huge impact on all our lives, make this particularly clear. The last few years have shown that our modern society depends on the development and maintenance of certain infrastructures. Prof. Michael Lauster, chairman of the space unit within Fraunhofer AVIATION & SPACE, explains why space activities enable and protect all of our lives in a modern industry society.

»In the past decades, not much emphasis had been laid upon the security aspects of critical infrastructure.«

What are the main challenges regarding the protection of critical infrastructures?

Critical infrastructures are the technological backbone of today's societies. Food and energy supply, communications, finance, and many other services heavily depend upon technological assets. Partial or total loss of these infrastructures would cause heavy disturbances or an entire breakdown of social life. However, in the past decades not much emphasis had been laid upon the security aspects of critical infrastructures. Thus, concepts for security now face a whole lot of practical problems. E.g. the extremely important pipelines and internet or communication wires in the Baltic sea extend to more than 8000 km making it impossible to protect them completely.

Which solutions does the space industry provide for these challenges?

Space based applications offer alternative solutions for communication, time and navigation services, and earth observation. Satellites could monitor large areas, especially on sea and detect malign military or terroristic activities. Different GNSS installations provide multiple ways for navigational services increasing the resilience of the logistics and finance sectors. Constellations of communication satellites open an additional path for internet and communication services able to supplement and temporarily replace cable-bound applications.

How will the space industry develop in this field?

Space industry will very rapidly develop capabilities in the fields of (very) small to medium size satellites, constellations, micro launchers and fast access to space on demand. Economies of scale will dramatically reduce the costs per kilogram to orbit and there will be a wide-spread transfer of technologies between the space sector and other industrial branches.

How can Fraunhofer support its industrial partners?

Fraunhofer with its overarching goal of supporting industry with tailored solutions through applied research is the prime partner for all enterprises who are already active in the space sector or are intending to enter it. Fraunhofer AVIATION & SPACE is the single point of contact for our industrial partners, granting access to the universe of cutting-edge technologies being developed by Fraunhofer.

Prof. Dr. Dr.
Michael Lauster
Short vita

Prof. Dr. Dr. Michael Lauster is chairman of the space unit within Fraunhofer AVIATION & SPACE and director of the Fraunhofer-Institute for Technological Trend Analysis INT in Euskirchen. He also has a chair for Technology Analysis and Foresight in the Faculty of Mechanical Engineering at RWTH Aachen University. After Officer Training, he studied Aerospace Technology at the University of the Federal Armed Forces, where he also gained his Doctorate in Irreversible Thermodynamics at the Aerospace Engineering Faculty. Finally, he earned his Habilitation Degree in Statistics at the Faculty of Economics and Organizational Sciences, which qualified him to conduct independent teaching at university.

Fraunhofer and the New Space Economy

How the New Space Economy changes the industry and research

New Space has been coming for a while, and now it is here to stay. It is challenging traditional business models and development regimes, while at the same time offering huge opportunities, not only for the European Space Sector, but for the European continent as a whole. Fraunhofer with its focus on applied research and development is an important stakeholder in the emerging European New Space ecosystem, providing technological expertise found in no other organization in Europe.

What is New Space? There is no definition covering all aspects that are generally associated with the topic, but there are recurring features that should not be left out. First of all, the aspect of privatization and commercialization are a central feature. While for decades the public sector in the form space agencies played the leading role in all space missions, the last ten years showed that private companies have the technological means and the ressources to launch space missions of their own. The necessity to have a viable business case to capitalize on the space assets is also something attributed to New Space.

These two criteria together lead to a third important criterion: The prevalence of venture capital in many New Space projects is directly connected to the intention of making space missions commercially successful. This in turn leads to the need to maximise profits by streamlining budgets, which can be achieved by small batch production of space assets and the use of commercially available Commercial off the shelf (COTS) components. Especially the use of COTS is something that would have been completely unheard of a few years ago and is now commonplace.

Finally, New Space is characterized by the emergence of a multitude of small and new companies, mostly Start Ups, that, unlike traditional space companies offer very flat hierarchical structures with fast and agile decision-making processes. This is something that has become rather uncommon in traditional space companies and organizations. Also, the decreasing reliance on funding provided by space agencies and governments is something characteristic of the New Space economy.

Connecting space and non-space stakeholders

A significant part of New Space business cases is centered on making space assets available for non-space industries and companies. Satellite based communication and the use of satellite imagery in the context of operating and maintaining of spatially distributed infrastructures are common use cases. For instance, railway companies such as Deutsche Bahn or operators of offshore wind parks heavily rely on services provided by new space companies.

Taking all this into account, Fraunhofer is ideally posed to support emerging space actors and players who are new to the field. Start Ups usually have a basic technology concept and a viable business case, but often lack specific competences and dedicated infrastructures needed to bridge the gap between idea and marketable solution. Those infrastructures can be clean rooms, thermal vacuum chamber, irradiation facilities and many more. Many of these infrastructures, along with expert knowledge and space relevant experience, can be found at Fraunhofer.

Fraunhofer is creating Start ups

Fraunhofer is supporting the creation of Spin-offs, taking ideas developed by Fraunhofer scientists and engineers who then get support by Fraunhofer Venture to establish their own Start Up. This effort is ongoing, but has already yielded extremely promising results: Spaceoptix (founded out of Fraunhofer IOF) and Constell:R (founded out of Fraunhofer EMI) have developed an infrared instrument for the specific use case of monitoring global water consumption in agriculture. The project will play a role in the global battle against food and water shortages. Fraunhofer as the German research organization focusing on industry and applications is perfectly situated to serve the needs of new space Start Ups.

Bringing together the competences of 30 Fraunhofer Institutes, Fraunhofer AVIATION & SPACE conducts applied research in the field of industrial aerospace technology.

Technology Areas: Aviation

For many years, Fraunhofer Institutes have been supporting the aviation industry and the development of specific materials and processes applicable for aircraft structures. The introduction of new production technologies together with digitization and digital twin technology are an integral part of these activities. Furthermore, the life cycle performance has become an integral competitive factor for the products and production processes and specific expertise is necessary for this. Another big challenge is the issue of zero emissions of air travel. Therefore the Fraunhofer extensive research and test activities on the subject of battery and hydrogen technology are of high interest for the aviation industry.

Materials, Processes and Production

Due to the very increasing environmental awareness, recyclable biopolymers are in theses days also of particular interest for certain applications and are in focus of the aviation industry. Another continuous development topic are cost-optimized processes in the technological areas of CFRP component production that are tailored to the manufacturing requirements. New advanced automation and manufacturing processes are constantly an important topic.

Aircraft Structures, Cabin and Cargo

In the area of aircraft structure and cabin/cargo, tailor-made solutions are developed. Due to our permanent preliminary research, advanced technical solutions are developed and in cooperation with the aviation industry, new concepts and product ideas are implemented. In addition to that, special large-scale equipment is available, e.g. a Flight Test Facility and an aircraft door surround test facility. On the subject of SHM, new sensors and analysis methods are developed continiously, including data acquisition and demanding complex IT evaluation.

Engine, Propulsion and Energy Carriers

The environmental impacts and operating costs are the two driving forces that cause considerable pressure to innovate. In addition to improvements in the aerodynamic efficiency of the aircraft structure, considerable efforts are made to reduce engine emissions and to develop new types of propulsion. E.g. with cutting-edge large-volume 3D additive manufacturing processes newly designed engine parts could be manufactured economically.

New Mobility Concepts (UAM, UAS, UAV)

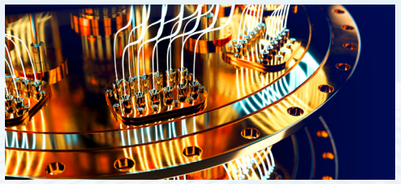
Urban Air Mobility (UAM), Unmanned Aircraft Systems (UAS) and unmanned aerial vehicle (UAV) are disruptively changing the way people and goods move from one location to another. This is possible by the application of innovative material technologies and driven by the usability of new electric and hybrid drives for autonomous aircraft. Drones are already being used today for inspection, maintenance and repairs, e.g. on wind turbines. The technology portfolio shows expertise in the areas of materials, electronics and data processing for these economically attractive mobility concepts.

Aircraft Avionics, Systems and Equipment

Aircraft systems and aircraft subsystems are necessary for the reliable and safe operation of aircraft. With its expertise, e.g. in the field of airspace monitoring, radar signature control and security control and protection of critical infrastructure, Fraunhofer supports state-of-the-art technology trends in these applications.

Quantum Technologies

Quantum technologies open up entirely new and unexplored applications in the fields of measurement technology, imaging and secure communication as well as for highly complex calculations. They have a high disruptive potential in different market sectors. The goal of quantum research at Fraunhofer is to transfer basic research into applications as quickly as possible. Current topics are high-precision sensor systems, secure quantum communication and calculations based on Fokker-Planck equations.



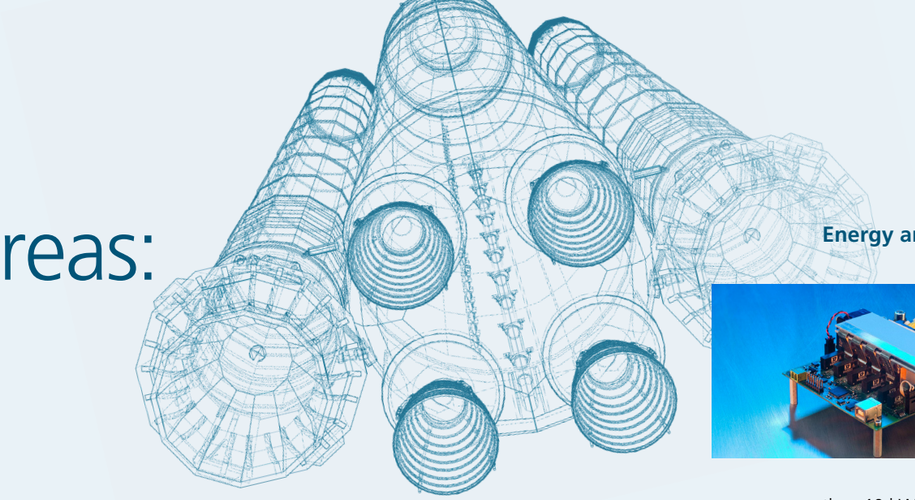
Cyber security

With the digitization in industry, information technologies are an important building block in production and are being used e.g. for the creation of a digital twin. However, if IT is used to network the production-machines with each other and with the Internet, the system must be intelligent protected against cyber-attacks in order to avoid significant damage due to security gaps and attacks on the IT infrastructure. Several Fraunhofer Institutes are active in the field of cyber security and enable companies to recognize their own IT security level and develop specific security solutions in cooperation with the respective company.

Education Services and Scientific Reports

The fast transfer from research to safe application is very important. New manufacturing technologies and materials can only be successfully implemented if companies train their employees accordingly. In accordance with this need, application-oriented and quality-assured seminars for personnel qualification are being offered. Furthermore, for the very important topic of cyber- security, Fraunhofer offers seminars and training courses on a wide variety of subjects relating to IT-security and cyber security. This includes seminars on the threat situation for industrial production systems, also in conjunction with the digital transformation. In addition, reports and analyses for various advanced technologies of special interest in different industries are carried out as contract services.

Technology Areas: Space



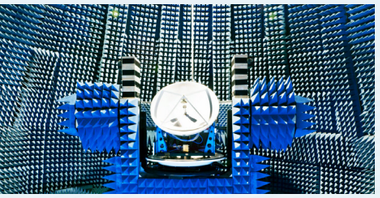
For many years, Fraunhofer has been addressing space applications and technologies in the field of applied research. The Institutes of Fraunhofer AVIATION & SPACE cover a wide range of space-related topics. With our competence portfolio we address the national and international space industry and act as a competent partner for research and development needs of the industry.

Communication and Navigation

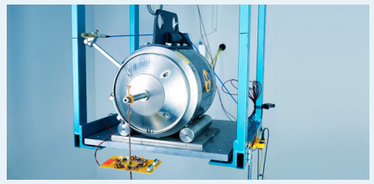
Central focus of our satellite communication activities is the development of technologies for almost unlimited data exchange between satellite and ground stations. It ranges from transmission technologies to concept to implementation, comprising system and architecture definition and also to components such as antennas, transmitters and receivers.

The developed solutions enable reliable and robust data exchange in use of satellite-based technologies. In addition, continuous research on the development of wideband-capable equipment and techniques is practiced to further enhance true wideband transmission via satellite with respect to high throughput gains.

Topics: satellite communications & navigation, antenna technologies, communications security, scientific payloads, laser communications



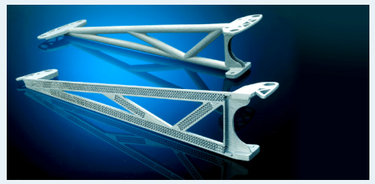
Protection Technology and Reliability



Several factors can influence and damage space systems in space. These include, for example, high-energy particles and ionising radiation, but also space debris. Fraunhofer therefore offers qualification services and improvements in the protection and reliability of space systems against environmental hazards. Our portfolio includes research on technologies such as radiation sensors and impact detectors; software products for qualifying space components against environmental effects; and services like scientific models for describing the effects. For this purpose, we are equipped with experimental facilities that are unique in Europe.

Topics: rescue systems, propulsion engines, protective layers, radiation protection, space reconnaissance, space debris & micrometeorites, quantum sources.

Materials and Processes



Thanks to our many years of experience in various aerospace projects, we provide solutions for the development and production of assemblies, components and structures at the highest quality level. Our central tasks in this field are the development, improvement and application of materials, processing and manufacturing methods.

Topics: Green propellants, bonding processes, non-destructive testing, shielding effects, microtechnologies, additive & hybrid manufacturing processes.

Energy and Electronics

A highly reliable and efficient power supply is a fundamental requirement for the functioning of all electronic systems onboard any spacecraft or satellite. The power consumption of satellites reaches from less than 100 W up to more than 10 kW. The primary energy source are often solar cells, which directly convert light into electric energy. Fraunhofer develops highly efficient solar cells with efficiencies up to 46 percent as well as power converters with efficiencies up to 99 percent.

In addition to the power supply system another focus of our work is the development of highly reliable satellite bus controllers and camera systems.

Topics: electric propulsion, electronics for radar, total ionising dose & single event effects, coatings, power electronics, electronics for payloads, circuits & systems, power-by-light systems.

Sensor Systems and Analysis

We provide technologies required to enhance space situational awareness (SSA). This includes sensor systems for the acquisition and measurement of space related data and information, analysis and exploitation of datasets and satellite images as well as understanding of and modelling techniques for the complex space environment. Our areas of expertise include surveillance and measurement of orbital objects, high-precision orbit determination, support to the German Space Situational Awareness Centre (GSSAC), interactive visualization of earth and space observation data for SSA, (automated) analysis and interpretation of high-resolution satellite data, performance optimization of satellite-based EO-sensors, open geospatial service architectures and measurements of reflection properties of space materials (BDRF).

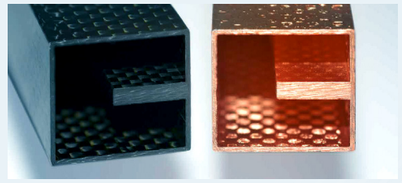
Topics: Visualisation technologies, printed sensors, radar sensors, layered sensors, detection techniques, LIDAR, on-board radiation sensing, radiation & environmental monitoring.

Surfaces and Optical Systems

Space Optics play an important role in many Space Missions and our Institutes have a strong competence in this field. Extremely precise free form optics, bandpass filters used on Mars and in deep space missions and beam sources for LIDAR applications and laser communication are only a few examples of technologies developed at Fraunhofer. Furthermore, optical competences at Fraunhofer open up a whole series of quantum technology applications, with Quantum Key Distribution being the most prominent example.

Competence in the preparation and coating of surfaces is vital for many aspects of applications in space: Metal coating of CFRP combines light weight with metallic properties, such as electric conductivity for antennae, or reflectivity for optical mirrors. Coating technologies developed at Fraunhofer also enable new ways of functional integration, for example in the form of thin film sensors integrated into surfaces.

Topics: Coatings, adhesive technology, laser technology, millimetre wave imaging, frequency stabilisation, degradation analysis, reflection properties, optical spectroscopy.



The Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft based in Germany is the world's leading applied research organization. Prioritizing key future-relevant technologies and commercializing its findings in business and industry, it plays a major role in the innovation process. It is a trailblazer and trendsetter in innovative developments and research excellence. The Fraunhofer-Gesellschaft supports research and industry with inspiring ideas and sustainable scientific and technological solutions and is helping shape our society and our future.

The Fraunhofer-Gesellschaft's interdisciplinary research teams turn original ideas into innovations together with contracting industry and public sector partners, coordinate and complete essential key research policy projects and strengthen the German and European economy with ethical value creation. International collaborative partnerships with outstanding research partners and businesses all over the world provide for direct dialogue with the most prominent scientific communities and most dominant economic regions.

Founded in 1949, the Fraunhofer-Gesellschaft currently operates over 75 institutes and research units throughout Germany. Over 30,000 employees, predominantly scientists and engineers, work with an annual research budget of €2.9 billion. Fraunhofer generates €2.5 billion of this from contract research. Industry contracts and publicly funded research projects account for around two thirds of that. The federal and state governments contribute around another third as base funding, enabling institutes to develop solutions now to problems that will become crucial to industry and society in the near future.

The impact of applied research goes far beyond its direct benefits to clients: Fraunhofer Institutes enhance businesses' performance, improve social acceptance of advanced technology and educate and train the urgently needed next generation of research scientists and engineers.

Highly motivated employees up on cutting-edge research constitute the most important success factor for us as a research organization. Fraunhofer consequently provides opportunities for independent, creative and goal-driven work and thus for professional and personal development, qualifying individuals for challenging positions at our Institutes, at higher education institutions, in industry and in society. Practical training and early contacts with clients open outstanding opportunities for students to find jobs and experience growth in business and industry.

The prestigious nonprofit Fraunhofer-Gesellschaft's namesake is Munich scholar Joseph von Fraunhofer (1787–1826). He enjoyed equal success as a researcher, inventor and entrepreneur.

Fraunhofer AVIATION & SPACE

Aerospace is a technology-intensive industry sector that has a significant impact on economic and sociopolitical life. Aviation facilitates global mobility and thus enables cultural and economic exchange. Space travel promotes this global mobility by providing satellite navigation and communication. Orbit based earth observation instruments can be used to solve essential questions on the protection of climate and environment.

Bringing together the expertise of over 30 Fraunhofer Institutes, Fraunhofer AVIATION & SPACE offers a wide range of competences and technologies for the aerospace industry. While developments for aviation have a focus on aircraft manufacturing, space developments cover upstream and downstream technologies. At the same time, this strong alliance of institutes sees the aviation and space industry holistically: synergistic research topics address sustainable materials and processes, technologies for advanced air mobility, simulation and digitization as well as cyber security. In addition, Fraunhofer AVIATION & SPACE provides in-depth expertise in various fields of technology, such as optics, sensors, communication, automation, as well as digitalization and AI.

With its broad portfolio of expertise, Fraunhofer AVIATION & SPACE supports the strategies of the European aviation and space industry and helps to secure and expand its competitive position. To this end, Fraunhofer makes important contributions to national and European research funding programs (e.g. the LuFo program and InnoSpace Masters or Clean Sky 2, Clean Aviation, ESA spaceflight programs and Horizon Europe). Fraunhofer also works closely with corresponding associations, for example: BDLI, BDI and EASN.

Fraunhofer AVIATION & SPACE is the doorway to Fraunhofer's technology portfolio for the aviation and space industry. Here, industry, science and politics gain access to the innovations of the Fraunhofer-Gesellschaft for these sectors. The central office supports, among other things, the identification of suitable contact persons at the institutes and organizes cross-institute technology offers.

Members

- Fraunhofer Institute for Additive Manufacturing Technologies IAPT
- Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM
- Fraunhofer Institute for Production Systems and Design Technology IPK
- Fraunhofer Institute for Telecommunications, Heinrich Hertz Institute, HHI
- Fraunhofer Institute for Surface Engineering and Thin Films IST
- Fraunhofer Institute for Applied Polymer Research IAP
- Fraunhofer Institute for Factory Operation and Automation IFF
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- Fraunhofer Institute for Applied Optics and Precision Engineering IOF
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Contact

Central Office

Aviation

Dr.-Ing. Simon M. Kothe
Head of Central Office, Aviation

Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM
Wiener Straße 12
28359 Bremen, Germany
Phone +49 421 2246-582
simon.kothe@ifam.fraunhofer.de

Space

Thomas Loosen
Head of Central Office, Space

Fraunhofer Institute for Technological Trend Analysis INT
Appelsgarten 2
53879 Euskirchen, Germany
Phone +49 2251 18-308
thomas.loosen@int.fraunhofer.de

www.aviation-space.fraunhofer.de

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Chair of Fraunhofer AVIATION & SPACE

Prof. Dr. Bernd Mayer
Chairman, Aviation
Director, Fraunhofer Institute
for Manufacturing Technology
and Advanced Materials IFAM

Prof. Dr. Dr. Michael Lauster
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Editorial Team

Laura Limberg, B.A.
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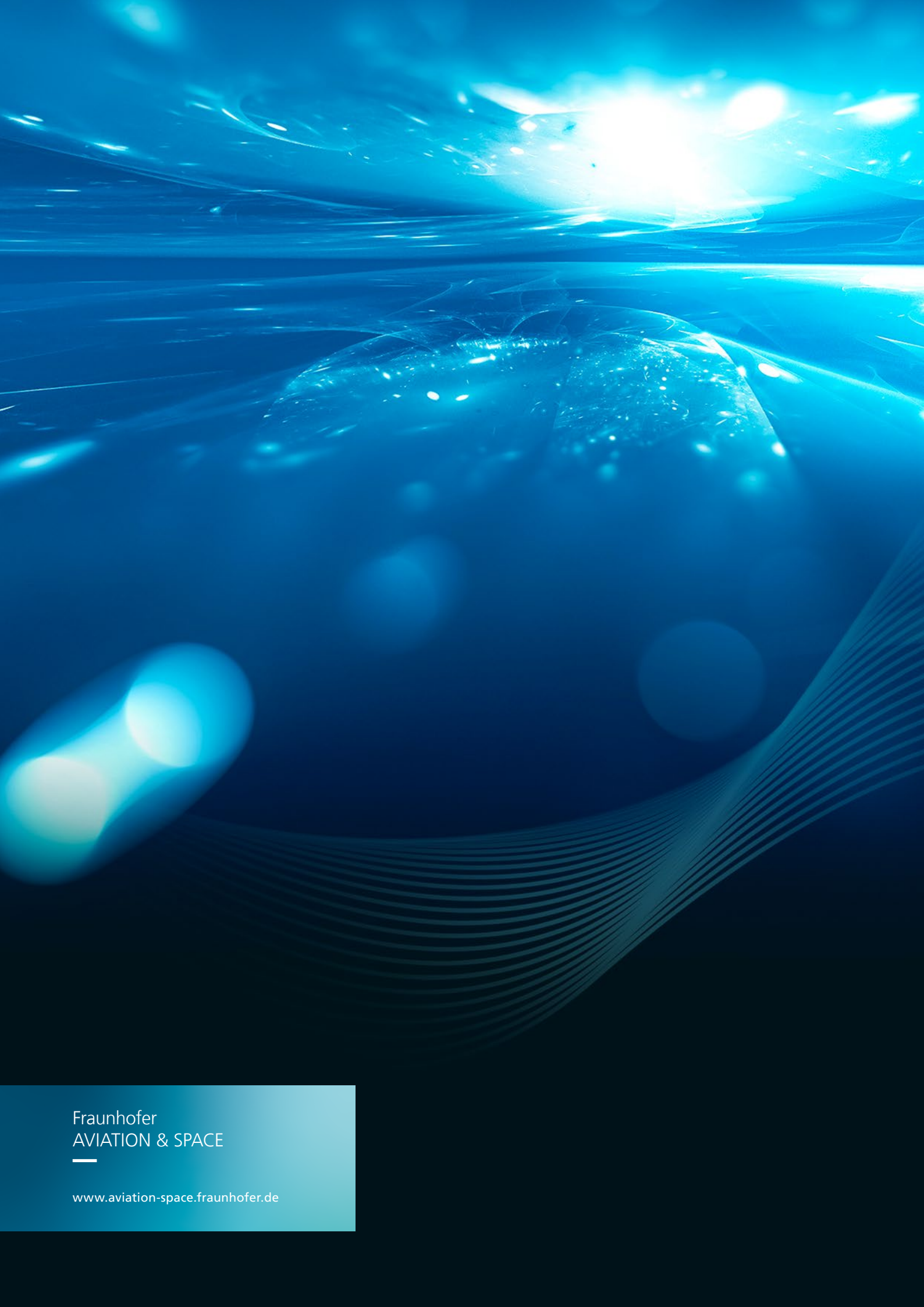

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