Press Release

Hannover Messe 2026

Automation, digitalization and robotics for the efficient, high-rate and versatile production of the future

At Hannover Messe 2026, Fraunhofer IFAM in Stade, Germany, together with its partners, will present the Machine Tool Robot (MTR), honored with the second place of the Robotics Award 2026, as well as other automated, high-precision machining, joining and assembly technologies, right up to humanoid robotics

The Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM offers R&D services for the automated machining and assembly of large lightweight structures – among others, for the aircraft, wind turbine, commercial vehicle, rail vehicle and agricultural sectors. This includes process and plant development up to a 1:1 scale for the smart factory, modular automation and digitalization solutions for large lightweight structures as well as efficient, sustainable and ergonomic large-scale assembly.

The focus on the trade show presentation of Fraunhofer IFAM is on

- The Machine Tool Robot with hybrid drive, honored with the Robotics Award 2026, second place
    - Live and in action at the Siemens AG booth, Hall 26, Booth C70
    - Application Park, Hall 26, Booth G44
- The robot training center for cognitive and humanoid robotics – Application Park, Hall 26, Booth G44
- Automated abrasive vacuum suction blasting, including for repair – Application Park, Hall 26, Booth G44
- Automated local chemical surface treatment, including local anodizing – Application Park, Hall 26, Booth G44
- Aerospace-X – this research project focuses on developing a collaborative data ecosystem for the exchange of data among aerospace companies, with the aim of resilient and sustainable supply chains through digitalization and data sovereignty – Industry 4.0 Platform, Hall 13, Booth C24

MTR – New type of machining robot closes the gap between traditional industrial robots and machine tools – Maximum precision and dynamics in production

The Machine Tool Robot (MTR), developed in collaboration with Siemens AG and autonox Robotics GmbH, featuring a robot spindle from Weiss Spindeltechnologie, was honored with the prestigious Robotics Award 2026, second place, by the Hannover Messe on February 25, 2026.

The Fraunhofer IFAM in Stade has developed a pioneering technology to improve the dynamics and precision of industrial robots, combining intelligent, model-based control strategies with innovative drive technologies and an optimized mechanical structure of the robot. This development enables dynamic errors to be compensated for and vibrations to be effectively damped. That significantly improves path accuracy, even at high feed rates and complex path movements.

A particular advantage is the optimized disturbance rejection which ensures constant precision even with highly dynamic process forces. This drive concept therefore enables machining with higher material removal rates as well as the ability to operate with higher jerk settings, both of which lead to a significant increase in productivity.

Thanks to these properties, the Machine Tool Robot (MTR) closes the gap between classic industrial robots and machine tools. It is particularly suitable for demanding manufacturing processes, e.g., in the machining of harder materials, and open up new possibilities for automation technology as well as smart industry.

www.ifam.fraunhofer.de/en/technologies/hybrid-drive-for-robots.html

Robot training center in Stade – Enabling humanoid robotics for industrial applications

A training and competence center is currently being established at Fraunhofer IFAM in Stade, which provides an interdisciplinary environment for industry professionals, trainees and researchers. Feasibility studies, demonstrators and concepts for integration can be developed and tested here. Practical knowledge in the application of humanoid robotics is captured through a bidirectional learning approach, abstracted using AI-based methods and transferred into system-independent models. This scalable pool of knowledge facilitates and supports industrial applications.

The center enables scientific evaluation of technical feasibility, economic benefits and impacts on the workplace. Through practice-oriented training, targeted competencies are developed and the acceptance of humanoid robotics is strengthened. By linking research, education and application, Stade positions itself as a key site for the establishment of humanoid robotic systems in the context of Industry 5.0.

R&D Mission
The ability of humanoid robot systems to learn established manufacturing, joining and assembly technologies, to develop them further in a targeted manner and to execute them reproducibly in real-world production environments is being analyzed as part of research activities.

The goal is to scientifically evaluate the adaptation and integration potential of such systems and to generate practical insights for their industrial application.

Research Offerings

- Development of adaptive tools and end-effectors for humanoid robotic systems
- Research on sensor-based process control and multimodal perception
- Validation of process stability and quality
- Derivation of models for safety and cycle times
- Comparison of humanoid, conventional and manual processes

www.ifam.fraunhofer.de/en/technologies/humanoid-robots.html

Pre-treatment by vacuum suction blasting
Automated and clean – FRP surface activation

Vacuum suction blasting is an automated and clean process for removing and roughening of surfaces before adhesive bonding. The direct off-suction of the blasting particles creates a residue-free surface. The process enables simultaneous pre-treatment and activation of surfaces and can also be used as a removal method of FRP individual layers, i.e. scarfing for repairs.

Robot-guided blasting process with many advantages

- Integrated off-suction for dust-free environment
- Activated surface
- Cost-effective and low-energy system
- Robust process
- Quality-assuring online monitoring
- Replacement of ergonomically demanding manual grinding activities

Vacuum suction blasting is an important technology in surface treatment, which Fraunhofer IFAM is using and developing further. In particular, methods for the automated pre-treatment and adhesive bonding of components are being developed. A robot-guided system for vacuum suction blasting is available in Stade.

www.ifam.fraunhofer.de/en/technologies/abrasive-pre-treatment-vacuum-suction-blasting.html

Local chemical surface modification –
Automated local anodizing for functional surfaces

During local anodizing, functional oxide layers are selectively created only in the areas where they are needed – e.g., for corrosion protection or as a pre-treatment for adhesive bonding processes. Unlike conventional bath anodizing, neither complete immersion of the component nor time-consuming masking processes are required. This significantly reduces the costs associated with media, plants and processes.

At Fraunhofer IFAM in Stade, the technology has been integrated into a fully automated process cell. A robot-assisted end effector applies the electrolyte locally and precisely, monitors contact and process control, removes residues inline and rinses the treated areas immediately after the process. This allows even complex 3D geometries to be processed with high reproducibility and minimal contamination. The process is suitable for both manufacturing and repair applications, such as on weld seams, structural joints or large and geometrically

demanding components. It is particularly advantageous wherever only defined functional surfaces are to be treated.

Key advantages

- Oxide layers only on functional areas
- Fully enclosed and automated process
- No masking required – saves time and resources
- Inline rinsing, neutralization and suction
- Closed-loop control via force feedback and trajectory planning
- Ideal for numerous industries, e.g., aviation, aerospace, automotive, rail vehicle construction and repair technologies

At Fraunhofer IFAM in Stade, this process is being developed for industrial integration – with a focus on digital control, process monitoring and high surface quality under demanding conditions.

www.ifam.fraunhofer.de/en/technologies/local-anodizing-as-functional-coating.html

Aerospace-X

As part of the Manufacturing-X initiative, the flagship project Aerospace-X is setting new standards for secure data exchange between companies by collaborating with industry to develop standards and applications for a sovereign data ecosystem for the aerospace sector of the future. Aerospace-X is a research project aimed to create a collaborative ecosystem for sustainability and the circular economy in the aerospace industry and to future-proof supply chains through digitalization and data sovereignty.

Funded by the Federal Ministry for Economic Affairs and Energy (BMWE), this project for the aviation industry involves Fraunhofer IFAM in Stade conducting research and development in collaboration with a total of 14 partners from industry and research, under the leadership of Airbus Operations GmbH.

Digital Product Passport (DPP)
The R&D work focuses on how the Digital Product Passport (DPP) can be implemented using specific aviation components and securely exchanged between companies, with an emphasis on:

- Scalable standards and data models that ensure interoperability between small and medium-sized enterprises (SMEs) and original equipment manufacturers (OEMs) – without rigid software solutions or centralized platforms
- Hands-On Circular Economy, which makes sustainability data – such as the Product Carbon Footprint (PCF) – tangible and securely exchangeable
- Demand and Capacity Management, which enables shorter response times during supply bottlenecks

A corresponding demonstrator, consisting of a monitor and an aircraft side panel, will be on display at the trade show.

www.aerospace-x.net/en.html

Further Information

- **Website**
  www.ifam.fraunhofer.de/en/stade
- **Flyer**
  https://s.fhg.de/7wp
- **Trade fair**
  Find out more – visit us at Hannover Messe 2026 in Hannover from April 20 to 24, www.ifam.fraunhofer.de/en/Events/hannover-messe-2026.html

Photos

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www.ifam.fraunhofer.de/en/Press_Releases/Downloads.html

Figure 1 l Caption
The newly developed flexible milling kinematics on a linear axis machines with high precision a CFRP vertical tail plane of an aircraft on a 1:1 scale at Fraunhofer IFAM in Stade (© Fraunhofer IFAM).

Figure 2 l Caption
Research into bidirectional learning approaches for the acquisition of established manufacturing, joining, and assembly technologies in human-robot collaboration (© Fraunhofer IFAM; generated by AI).

Figure 3 l Caption
In addition to the robotic end effector including vacuum suction blasting nozzle, the developed vacuum suction blasting system includes a removal control sensor for inline monitoring for quality assurance (© Fraunhofer IFAM).

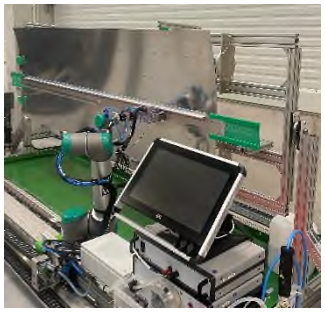

Figure 4 l Caption
Anodizing station with robust component holder, precise linear axis and robotics, equipped with a specialized anodizing end effector for targeted, high-precision surface treatments (© Fraunhofer IFAM).

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