Portfolio Automation and Robotics

Comprehensive Technology Modules

- Digitally supported conceptual design of automation solutions
- Digital process visualization and control – digital twin
- Self-organizing, resource-optimized production, optionally AI-supported
- Component handling, logistics, and asset tracking for production
- Plug-and-produce interface solutions, software modularization
- Human-robot cooperation, human-machine interfaces, ergonomics
- Robot calibration and sensor integration for precision positioning
- Hybrid drive systems and compensating kinematics for robots
- Autonomous mobile robots, swarm systems, and mobile component holding fixtures
- Integrated measurement and referencing technology
- Sensor-based path-controlled processes, optionally in real time

Process-specific Technology Modules

- Component shape and position adjustment for machining as well as assembly
- High-precision milling, drilling, and vacuum suction blasting
- Geometry and stress optimized joining
- Surface cleaning and treatment
- Peel$^{PLAS®}$ mold release film for activation of joining surfaces
- Precise filling of irregular gaps with adhesive or liquid shim
- Precise sealing of edges and rivet heads
- Application and cutting of adhesive tapes
- 3D printing with high-precision robots
- Thermoplastic welding for joining large structures

Contact

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Fraunhofer IFAM

Automation and Production Technology

Fraunhofer IFAM
Stade Branch

Fraunhofer IFAM in Stade

The Fraunhofer IFAM branch at the Research Center CFK NORD in Stade has been offering research and development services for the machining and assembly of large lightweight structures made of diverse materials since 2010. Orders from the aerospace, wind turbine, commercial vehicle, rail vehicle, and agricultural sectors are increasingly expanding the main R&D activities for aircraft construction.

In order to relieve customers of the “upscaling” in the direct transfer of research results to their production, Fraunhofer IFAM enables them, with regard to process and plant development, to validate the step from the laboratory into a production analog environment with real components on a 1:1 scale on the institute’s own premises. Among other things, a 4500 m² research hall with a height of 15 m under crane hooks is available for this purpose, including many flexibly deployable large-scale research facilities equipped with robots, holding fixtures, and high-performance measurement technology.

The range of services also includes design, construction, and putting into operation of customer-specific plants, simulation and implementation of high-performance processes, and providing the proof of process capability.

In this way, international customers receive sustainable solutions from a single source that can be implemented in large-scale applications without affecting their own production and that ensure a high level of innovation and technological advantage.

Automation and Production Technology

Efficient and Sustainable Large-scale Structure Assembly

Compatibility of efficiency, sustainability, and ergonomic workplace design is currently the challenge in large-scale structure assembly.

Fraunhofer IFAM is developing mutually compatible technology modules which – depending on the intended use – can be combined in a modular fashion to create partially or fully automated assembly solutions including production logistics, robotics, measuring, positioning, machining, and joining processes. The focus is not only on flexibility and ease of operation, but also on the continuous digital data flow in the sense of “plug-and-produce”.

R&D activities are centered on large components made of lightweight materials on a 1:1 scale, for which the entire process chain up to the fully assembled large structure can be designed and simulated after part production. Important for sustainability is the consistent saving of resources through acceleration, parallelization up to the elimination of process steps as well as by avoidance of defects. The timely consideration of assembly requirements in the design also significantly increases manufacturing efficiency.

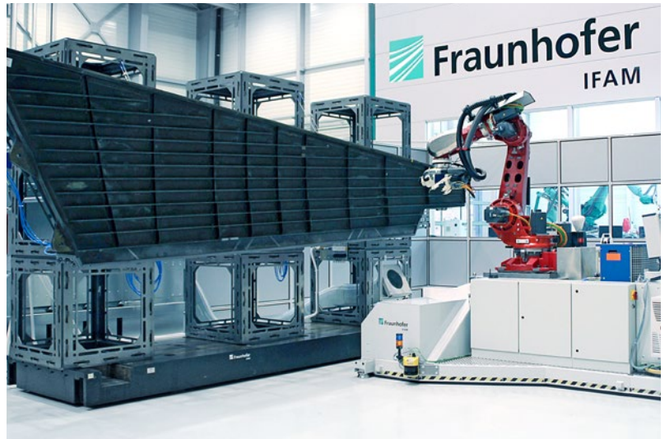
The central guiding principles in finding solutions are “automation not at any price” and “smart solutions through finely dosed combinations of sensor technology and AI”. Moreover: people must feel welcome and comfortable in this new working world.

Competence “Integrated Production Systems”

Production technology as a building block of modern industry is in a state of change. The focus on sustainability, flexibility, and economy, coupled with increasing demands for effectiveness and efficiency, requires new approaches to the design of production environments. In particular, with regard to large components made of ultra-lightweight materials, the focus is increasingly on versatile machining processes.

In order to realize flexible, reusable, and modular machining solutions, Fraunhofer IFAM in Stade relies on mobile robot systems. With sensor support, powerful calibration, long-range measurement technology, and interacting holding fixtures, they achieve comparable performance to stationary special-purpose machines at lower cost.

As the degree of complexity of production increases, so does the need for smart, intuitively controllable production systems that provide the user with visual assistance at the right time. Other efficiency-boosting components include automated programming and immediate feedback via automatic process monitoring. An additional benefit of these systems is the facilitated configuration of new production lines.



Competence “Joining Technologies”

The design of individual joining processes on and with large components involves a variety of challenges. In times of resource optimization to improve sustainability, new technologies are becoming increasingly interesting.

A wide range of automated processes is available to meet materials, components and loads. Depending on the requirements, riveting, bolting or welding, for example, may be the best solution. For components made of high-performance lightweight materials with low wall thicknesses, the two-dimensional force transmission of bonded joints is particularly in high demand.

The selection and qualification of suitable adhesive systems in conjunction with the quality-assured production of the bonded joints through automation ensure the desired safety of the product.

A large number of influencing variables have to be controlled in order to produce an optimum joint. What is already a challenge on a small scale is often much more complex for mechanically unstable large components. These include surface qualities, precise positioning, and compliance with quality-determining parameters of the actual joining process. The integration of the joining processes into a digitally networked production environment allows comprehensive quality monitoring with optimized resource requirements.

Competence “Assembly Technologies”

In addition to the fundamental requirements for efficiency and quality in the automation of assembly processes, the aspects of sustainability and eco-efficiency are achieving great importance in manufacturing.

In the course of digitalization, end-to-end approaches offer opportunities to create digital representations – of both the product and the production – with end-to-end data flow models. In addition to the simulation and visualization of production processes, the linking of real production with the virtual image allows continuous digital process design, taking into account ecological and economic balancing. Uniform and formalized descriptions of processes and technical resources as well as the standardization of corresponding interfaces between them support this.

Another option is the modularization of assembly technologies. Complex assembly processes can be made more efficient by subdivision, outsourcing, and parallelization. The focus here is on mobilized robotics that collaborate with humans and machines and can be integrated into intelligent assembly assistance systems. In addition, assembly components designed according to core capabilities enable increased reusability and thus more efficient utilization of resources through dynamic combinations oriented to the application.