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Fraunhofer at Hannover Messe 2025

Automation for Mid-Sized Manufacturing Businesses

To survive in global competition over the long term, companies have to be efficient, cost-effective and use resources wisely in their production operations. AI-based monitoring and control of production based on ECC4P offers medium-sized businesses customized solutions with comprehensive data security from a single source. The research team will be presenting their solutions at the joint Fraunhofer booth at this year's Hannover Messe trade show.

Many small and mid-sized enterprises are struggling to find enough skilled workers and to adequately automate their production. This often results in machine downtime and production errors. Standard monitoring solutions available on the market can be costly and inflexible. This is where ECC4P comes in: This automation solution is flexible, cost-effective and enables recording of process data. "Our ECC4P concept reduces waste, lowers testing costs and allows continuous production monitoring in an end-to-end data space with low latency," explains project manager Alexander Schuster from the Fraunhofer Institute for Machine Tools and Forming Technology IWU, who specializes in industrial manufacturing.

Full process control, wear detection and data storage

One key element of ECC4P is that it directly logs sensitive measurement data in the machines. Innovative sensor systems are used to achieve this: smartGRIND to monitor grinding processes, smartTOOL for machining and drilling processes and smartNOTCH for forming processes. These sensor systems use a specially developed interface to communicate with each other. This allows them to connect flexibly to various analysis systems or directly to the machine control system. Together with the machine data, the sensor data that is collected is then transmitted to the ECC4P interface. A full synchronization step takes place there before an AI-supported analysis module automatically processes and analyzes the data.

Depending on the application, this enables early detection of process anomalies, component waste or tool wear early on. The findings gleaned from this process are then fed back into the machine control system, so the machine can respond automatically when critical production events occur. At the same time, the process data and analysis results are stored in an overarching edge cloud. A user-friendly interface makes it easy to retrieve and visualize this measurement and analysis data. The data is available both on server or cloud instances and in the ECC4P cloud. In this way, the system ensures secure exchanges of data between edge and cloud, with ownership and custody of the

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data never in doubt. A graphical user interface allows intuitive adaptation of changes in production processes, with AI models autonomously adjusting and retraining during the process.

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The computationally intensive training this requires takes place in the cloud, while time-critical processes are handled and analyzed directly on the edge device. Ultimately, this makes production more efficient and secure and improves its viability for the future. There is no need for companies that use the system to retool, which can be costly and time-consuming.

ECC4P: low barriers to entry, high security and efficiency

The technology is based on developments from the Fraunhofer Cluster of Cognitive Internet Technologies CCIT. It combines edge and cloud computing to create a continuous production and data space. As a result, processing power is distributed as needed, depending on the volume of data involved and the latency requirements. The Fraunhofer Institute for Machine Tools and Forming Technology IWU (Chemnitz), Fraunhofer Institute for Integrated Circuits IIS (Erlangen), Fraunhofer Institute for Software and Systems Engineering ISST (Dortmund), Fraunhofer Institute for Intelligent Analysis and Information Systems IAIS (Bonn) and Fraunhofer Institute for Applied and Integrated Security AISEC (Munich) teamed up to develop a powerful solution for this. Michael Fritz, head of the central office at Fraunhofer CCIT in Munich, comments: "With ECC4P, we are paving the way for medium-sized businesses to move into advanced, efficient production with viability for the future."

The Fraunhofer experts will be showcasing their technology at the Fraunhofer joint booth (Hall 2, Booth B24) at the Hannover Messe 2025 (March 31–April 4, 2025).

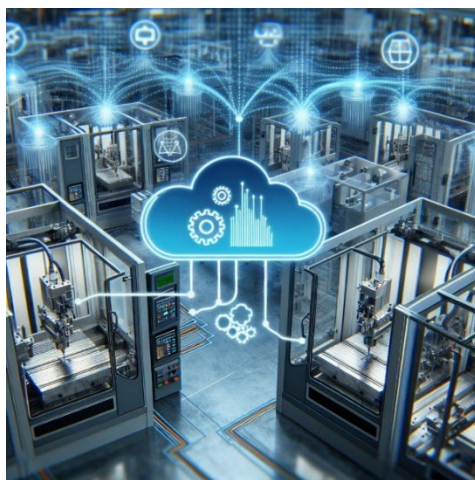


Fig. 1 ECC4P monitors and controls the production process centrally and visualizes the data on a monitor in real time. The combination of machine control, sensor system, edge device with AI analysis module and cloud connection forms the centerpiece of the solution. Multiple graphical user interfaces provide a detailed view of models and data and enable interaction between edge and cloud.

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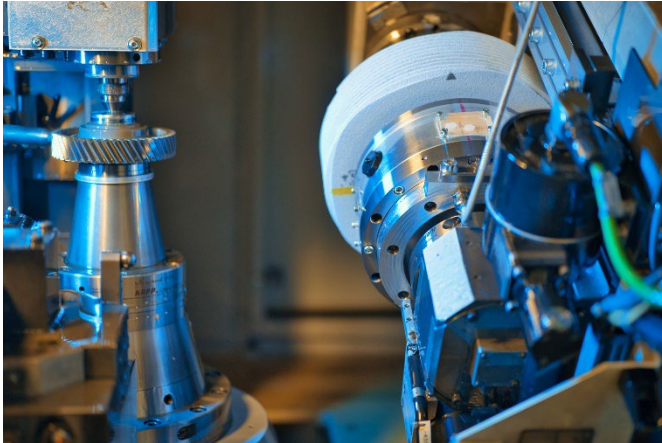


Fig. 2 Data supplier in ECC4P supports smartGRIND process control in intelligent and adaptive gear grinding: 100% process monitoring with anomaly detection ensures consistent, ongoing high quality. The adaptive control of the axial feed boosts productivity, while control of the shift travel extends the worm grinding wheel's service life.

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