PRESS RELEASE

KI-PREDICT: Electronics for distributed AI in sensor-based process and status monitoring

Erlangen: The German Federal Ministry of Education and Research (BMBF) invests in the development of new electronic systems and supports joint research projects that advance the Industry 4.0 agenda. KI-PREDICT, a project funded by the BMBF, aims to use artificial intelligence (AI) at various levels of the manufacturing process to enable condition-based, predictive maintenance for factory equipment and to monitor product quality on the fly during production. Seven partners are taking part in this project, one being the Fraunhofer Institute for Integrated Circuits IIS. It is developing a sensor interface application-specific integrated circuit (ASIC). Fine-tuned for sensors that monitor the condition of equipment and help control processes in real time, this ASIC will enable energy-efficient feature extraction and local, on-sensor signal processing.

Microelectronics, when combined with sensors and embedded software, can capture and process data generated by industrial plants. This information can serve to digitalize manufacturing processes and operational workflows for Industry 4.0. There is a catch, though: Today's electronic data acquisition and signal processing systems have yet to be optimized for this application, so they are fairly pricey in comparison to the components they are supposed to monitor.

The cost, space requirements and power consumption of digital signal processors (DSP) and field-programmable gate arrays (FPGA) are too high for many frequently used Industry 4.0 sensors, so manufacturers seeking to digitalize their processes cannot simply swap sensors in a one-to-one replacement scheme.

The KI-Predict project addresses this problem in a holistic manner. The idea is to combine new AI methods with optimized, integrated hardware to provide intelligent process monitoring with local signal processing and feature extraction. This new quality of on-sensor data processing enables reliable, decentralized analysis and prediction with a defined, low latency. Researchers engaged in this project are developing a dovetailed hardware and software architecture to this end. It will fuse, reduce and assess sensor-related data, and interpret anomalies to detect faulty sensors.

Aside from executing the usual functions, such as capturing digital data on electrical current, position, vibration, acoustics, pressure, force and temperature, it will also

Head of Corporate Communications
Thoralf Dietz | Phone +49 9131 776-1630 | thoralf.dietz@iis.fraunhofer.de | Fraunhofer Institute for Integrated Circuits IIS | Am Wolfsmantel 33 | 91058 Erlangen, Germany | www.iis.fraunhofer.de

Editorial notes
Denise Mueller-Friedrich | Phone +49 9131 776-4409 | denise.mueller-friedrich@iis.fraunhofer.de | Fraunhofer Institute for Integrated Circuits IIS | www.iis.fraunhofer.de

provide the machine learning (ML) capabilities needed to process and reduce data locally.

The interface is able to detect features even in high-frequency sensor signals in an energy-efficient way. It delivers these features to the control level for sensor data fusion, or uses them directly for classification, clustering or anomaly detection.

Aggregated features are extracted from the data stream at the sensor to reduce the amount of data. This reduction is necessary to connect to standard industrial interfaces and networks. These features can also serve a higher purpose: When forwarded to process control or enterprise resource planning (ERP) software, they help determine the equipment's status, assess product quality and track trends using sophisticated AI and ML methods. This hardware is not tailored to any specific applications, so automated routines can 'train' it for new use cases.

About Fraunhofer IIS

As one of the world's leading application-oriented research institutes, the Fraunhofer Institute for Integrated Circuits IIS develops microelectronic and IT system solutions and services. The Integrated Sensor Systems department at Fraunhofer IIS focuses on defining, developing, simulating and assessing integrated circuits for sensor applications. The institute has steadily expanded and improved upon this skill-set since its inception.

Fraunhofer IIS's priority in this project is to develop an ASIC that enables analog signal acquisition and digital AI-driven signal processing for industrial sensors. Engineered mainly for warehouse monitoring, machining and forming applications, this ASIC is designed to readily adapt to many other use cases. With its flexibility and broad range of potential applications, it can serve to scale autonomous systems to size and deploy them at various levels of the process chain. In the long term, it could even assure product quality in diverse product chains, thereby helping to hone Germany's competitive edge.

The Fraunhofer-Gesellschaft is the leading organization for applied research in Europe. Its research activities are conducted by 74 institutes and research units at locations throughout Germany. The Fraunhofer-Gesellschaft employs a staff of 28,000, who work with an annual research budget totaling 2.8 billion euros.

The **Fraunhofer Institute for Integrated Circuits IIS** is one of the world's leading application-oriented research institutions for microelectronic and IT system solutions and services. It is the largest of all Fraunhofer Institutes. Research at Fraunhofer IIS revolves around two guiding topics:

In the area of **"Audio and Media Technologies"**, the institute has been shaping the digitalization of media for more than 30 years now. Fraunhofer IIS was instrumental in the development of mp3 and AAC and played a significant role in the digitalization of the cinema. Current developments are opening up whole new sound worlds and are being used in virtual reality, automotive sound systems, mobile telephony, streaming and broadcasting.

In the context of **"cognitive sensor technologies"**, the institute researches technologies for sensor technology, data transmission technology, data analysis methods and the exploitation of data as part of data-driven services and their accompanying business models. This adds a cognitive component to the function of the conventional "smart" sensor.

More than 1100 employees conduct contract research for industry, the service sector and public authorities. Founded in 1985 in Erlangen, Fraunhofer IIS has now 14 locations in 11 cities: Erlangen (headquarters), Nuremberg, Fürth, Dresden, further in Bamberg, Waischenfeld, Coburg, Würzburg, Ilmenau, Deggendorf and Passau. The budget of 169.9 million euros is mainly financed by projects. 26 percent of the budget is subsidized by federal and state funds.

Detailed information on: www.iis.fraunhofer.de/en