PRESS RELEASE

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Turning factories into smart factories with AI

Machine learning raising efficiency levels in industrial production

Frankfurt am Main, 3 July 2023. *– Artificial intelligence (AI) has been on everybody's lips since the triumphant launch of the ChatGPT chatbot. AI is also making great strides in industrial production technology. Machine learning can increase the efficiency of manufacturing. But just how does it work? Find out how at EMO Hannover 2023, from 18 to 23 September. Under the banner of "Innovate Manufacturing", the world's leading trade fair for production technology will be inspiring its trade audience by presenting plenty of fresh ideas, with artificial intelligence featuring prominently.*

Can production machines really self-optimize? Can they learn from their mistakes? And is it possible for them to acquire know-how from other machines? Artificial intelligence (AI) makes all of this possible. When self-learning production machines function intelligently, this leads to greater productivity, lower costs, improved quality and reduced downtimes.

"We have spent a great deal of time on optimizing our production technology processes and have built up a competitive edge here. We now want to do the same in the digital transformation of industrial production," explains Markus Spiekermann, Head of the Data Economy Department at the Fraunhofer Institute for Software and Systems Engineering ISST. “Artificial intelligence is playing a decisive role in meeting the new requirements, " says Spiekermann.

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"Because only through the use of AI methods can high levels of automation be achieved."

Predictive maintenance for lathes
The AI trend is taking hold in industry. Machine tool manufacturer Weisser Söhne GmbH & Co. KG, for example, relies on AI models that enable predictive maintenance of its lathes.

"Predictive maintenance uses AI to forecast when a machine will require servicing to prevent it from breaking down," explains Dr.-Ing. Robin Hirt, CEO and founder of Karlsruhe-based startup Prenode GmbH. The software company helps machine builders equip their plants with customized AI-based features.

Modern production machines can self-optimize with the help of artificial intelligence, says Hirt. "They generally use so-called machine learning methods for this. These enable the machines to recognize patterns and correlations in the production data and automatically derive improvements from them." In many cases it is also possible for them to learn from their mistakes and adopt know-how from other machines.

Decentralized data used to generate a common AI model
The *federated learning* technique is often used, as the data obtained from a single lathe is often insufficient as the basis for an accurate AI model. Federated learning facilitates the “training” of a common AI model, with data stored in decentralized form but with no direct sharing of data. The individual data therefore remains on the respective machines and does not have to be stored centrally in one place (such as in the machine manufacturer’s cloud).

The AI models use ongoing lathe data to estimate the present status of the plant, and then forward this to the operating personnel. Deep learning neural networks are used for this.

Smart sorting assistant from Trumpf
Artificial intelligence is also used to operate the *Sorting Guide*, a system created by laser specialist Trumpf in Ditzingen, Baden-Württemberg, Germany, that helps sort produced parts and thus increase machine utilization levels. The Sorting Guide is a camera-based assist system that relies on decentralized machine learning. The main components of the AI system are a high-resolution camera, a large screen, an industrial PC and intelligent software for image processing.

"Decentralized machine learning involves linking together several machines to form an AI system," says Prenode CEO Hirt, explaining the principle. These machines continuously collect local data about their work processes. An AI model is developed for each machine, which is then centralized. “These models are then merged in a central cloud and transferred back to the individual systems," Hirt continues. The AI system can then draw locally on the experience of all the other machines without ever having to share sensitive raw data. "This allows the machines to run their processes more efficiently and achieve greater productivity," Hirt promises.

Trumpf’s Sorting Guide works as follows: The Sorting Guide uses existing master data and self-learning image processing to recognize the individual parts. It then issues a sorting recommendation on the screen. The manufactured parts are shown in different colors on the screen – coded by customer order or subsequent work steps such as bending, deburring, lacquering or shipping, for example. This makes aspects such as the time-consuming recounting of parts, manual confirmations and accompanying documents things of the past. Machine operators can see at a glance which parts are ready for further processing and whether post-production is necessary or not. This speeds up the sorting process and helps avoid errors – allowing the machine to return to production more quickly. AI and manufacturing go hand in hand, as humans and machines need to work together closely in the industrial production environment.

Optimized machining based on data analysis
A new method that analyzes tool wear in machining processes such as drilling or milling also relies on artificial intelligence. It is important to be able to use expensive tools for as long as possible. It is therefore also crucial to be able to estimate the remaining service life accurately. Tool breakages and the destruction of expensive workpieces, or even damage to the machine tool, must be avoided at all costs.

Up to now, these conflicting objectives have been resolved by replacing the tools prematurely after a given number of operations (based on experience) in order to avoid any loss in quality or even expensive downtimes due to tool breakages. However, tool replacement is costly and time-consuming, which is why it pays to optimize the change cycles.

This is where AI comes into play. Researchers at the Technical University of Kaiserslautern have developed a method that “trains” the system using real process and measurement data in order to obtain a reliable prediction of the wear condition and thus optimize cutting processes.

In practice it works like this: Process-related parameters first need to be identified in order to predict the wear condition of cutting tools. These include the different machining forces, vibrations of the machine, and the power requirements of the machine axes. Data taken from continuous measurements of the tool and the workpiece is collected. The biggest challenge is then to identify correlations in the data collected.

Search for patterns
In order to achieve this, the researchers are training the AI-supported system. This uses machine learning methods to detect possible patterns and derive conclusions about the state of wear. It should also be able to predict which process parameters companies need to use in specific cutting processes in order to keep the tool in reliable use for a given service life. The data the system needs to learn from is collected from five partner companies – including both global players as well as small and medium-sized enterprises. Different variants are trialed with regard to tool and material types or process parameters, for example. A broad database is thus collected over the entire service life up to and including failure of the tool.

Artificial intelligence is already pretty intelligent, but it is still far from perfect. The processes are too different in the individual use cases. Machine learning therefore supports the tool change decision. The aim is to make the system better and better through so-called transfer learning. Here, knowledge from previously learned related tasks is used to train machine learning models more quickly for new (yet related) tasks.

IIP-Ecosphere for low-threshold access
Nevertheless, in the case of industrial manufacturing, the benefits of artificial intelligence are not always obvious, especially for small companies. Many are concerned about handing over their production data for in-depth analysis by computers.

For manufacturing companies that are still unsure about the added value of AI, the IIP-Ecosphere project, in which the Fraunhofer Institute for Software and Systems Engineering (Fraunhofer ISST) is collaborating, aims to provide low-threshold access to vendor-independent AI solutions for complex production problems. The goal of the project is to establish a new type of ecosystem, and for all the different players – including universities and research institutions, industrial companies and AI solution providers – to promote the use of AI in manufacturing. Artificial intelligence thrives on the networking of knowledge. The result is to create the "Ecosphere for Intelligent Industrial Production", or IIP-Ecosphere for short.

A platform for discovery
Markus Spiekermann, Head of the Data Economy Department at the Fraunhofer Institute for Software and Systems Engineering ISST, explains: "The so-called AI solution catalog, for instance, is being developed as part of the IIP-Ecosphere project. This is a platform for discovering and analyzing existing AI solutions to production-related problems." In addition to facilitating access to information on existing solutions, the catalog offers targeted filters based on use cases and shows the added value of the solutions. "Individual AI applications can then be implemented directly using the open-source IIoT platform also developed in the project," says Spiekermann.

Knowledge represents power in the struggle to survive among the fierce international competition – but so, too, does data. In comparison to rivals in the USA and Japan, is Germany ahead of the game in the development and use of artificial intelligence in industrial production technology? The jury is still out on this. "As far as I can tell, we don’t currently have a development lead over the competition which would allow us to rest on our laurels," says Fraunhofer expert Spiekermann. "Indeed, in terms of AI, we’re actually lagging behind the international providers, including in industrial production technology," says Spiekermann says.

Conversely, the Fraunhofer expert also states: Nevertheless, we are still ahead of the game in terms of optimizing domain-specific processes. What data is available and needed for specific use cases? What are the pitfalls and what exceptions need to be considered? If we can rapidly improve our professional and technological AI expertise, we can carve out a major lead for ourselves in Germany with this domain know-how."

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Author: Daniel Schauber, specialist journalist, Mannheim

((INFO BOX))

Artificial Intelligence at EMO Hannover

When machines link up and share their knowledge, they become ever smarter. Artificial intelligence makes it possible. In industrial production, machine learning plays a crucial role in raising efficiency levels. Deep learning neural

networks are used for this. At EMO Hannover, numerous companies will be presenting equipment, systems and components that can optimize manufacturing through the use of data-based models. The machine tool builder J.G. Weisser Söhne GmbH & Co. KG will be providing insights into the future of metalworking at EMO Hannover 2023 on Stand E64 in Hall 11. Laser specialist Trumpf will be presenting itself on Stand G22 in Hall 9.

Background

EMO Hannover 2023 – World's Leading Trade Fair for Production Technology
International manufacturers of production technology will be presenting smart technologies for the entire value chain at EMO Hannover 2023 from 18 to 23 September 2023. Under the banner of Innovate Manufacturing, the world's leading trade fair for production technology will showcase the entire range of modern metalworking technology which is at the heart of every industrial production process. The latest equipment will be on display, as will efficient technical solutions, product-related services, sustainable production methods and much more besides. The main focus of EMO Hannover is on cutting and forming machine tools, manufacturing systems, precision tools, automated material handling, computer technology, industrial electronics and accessories. EMO visitors come from all major industrial sectors including machine and plant construction, the automotive industry and parts suppliers, aerospace technologies, precision engineering and optics, shipbuilding, medical engineering, tool and mold making, steel and lightweight construction. EMO Hannover is the number one international meeting place for the industry. More than 2,200 exhibitors from 47 countries attracted nearly 120,000 trade visitors from around 150 countries at EMO Hannover 2019. EMO is a registered trademark of the European machine tool association Cecimo. EMO is organized by the VDW (German Machine Tool Builders' Association), Frankfurt am Main, Germany.

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