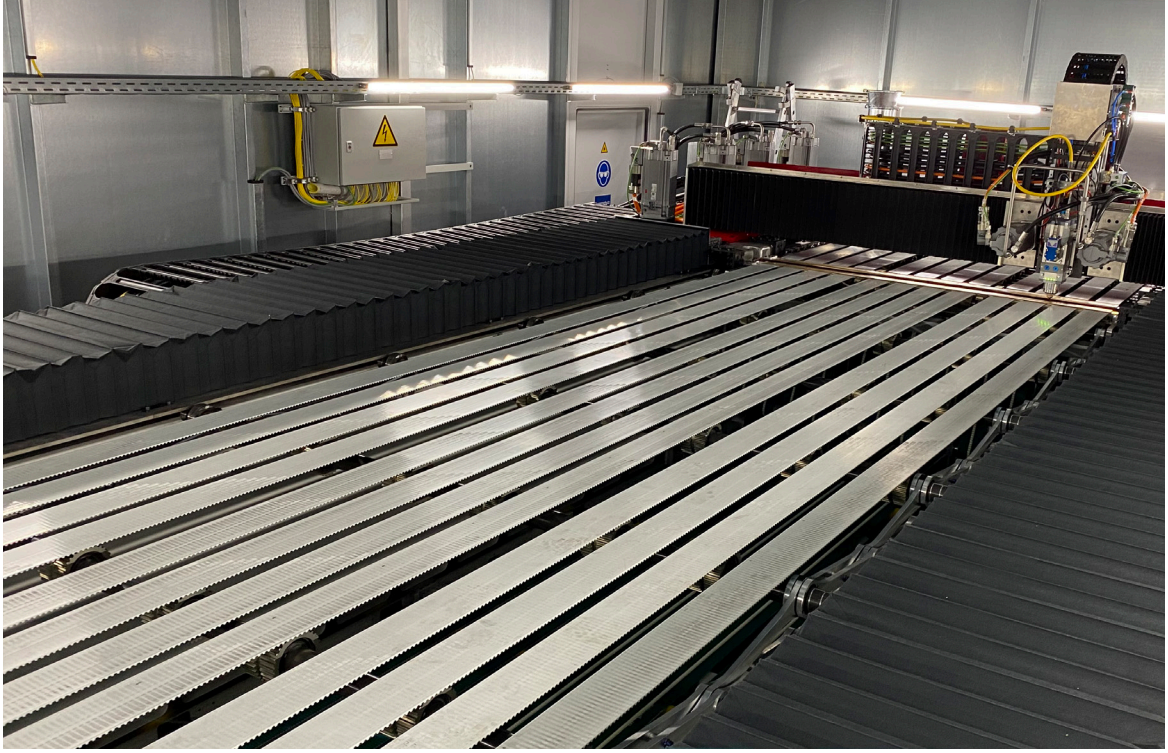

1 Laser blanking demonstrator system DIPOOL.

Process monitoring for laser blanking and laser welding with AI

Cutting blanks for automotive production with laser radiation from coil material, known as laser blanking, is a very efficient and flexible method of production – compared to conventional punching – while also saving resources. This is partly because waste is reduced and nesting in continuous production is very flexible. Continuous processes need to be extremely reliable, in particular, since an undetected cut and the associated system downtime are more costly to rectify than ejecting individual faulty parts from individual circuit boards. This also applies to other roll-based applications, such as the production of bipolar plates or battery electrodes. Monitoring with an AI-based analysis of the process signals helps to identify process limits at an early stage and reduce safety reserves, thereby increasing the productivity of the machines.

Intelligent laser machines

In a demonstrator laser blanking system, which is being set up at the DIPOOL project partner Dreher, Fraunhofer ILT used AI to evaluate the process status in real time based on a time series analysis of photodiode signals. Of the various machine learning methods tested, convolutional neural networks (CNN) show the best results for this application. With a process computer with FPGA, the cycle time for data acquisition, pre-processing and inference is 1 to 2 milliseconds and is, therefore, sufficiently fast for the high-speed cutting process.

A perfect duo: AI and MILM

Minimally invasive laser modulation (MILM) is crucial for high data quality, which makes reliable inference possible in the first place, and leads to characteristic, easily interpretable response signals, which can also be used to ensure that a brief crossing of the separation limit is detected. Fraunhofer ILT is pursuing an analogous objective in laser beam welding to detect process deviations and weld seam irregularities. To increase the information content in this application, the institute records the process data multispectrally within the DIPOOL project and uses it to detect the weld penetration limit. The joint project DIPOOL is funded by the Federal Ministry of Education and Research as part of the ProLern funding measure (reference 02P20A000) and supervised by the Project Management Agency Karlsruhe (PTKA).

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