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# Adaptive real-time anomaly detection in laser welding using multiple convolutional neural networks on embedded devices

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## Abstract

The application of machine learning approaches for process monitoring in complex manufacturing processes such as laser materials processing enables the detection of defects based on complex sensor signals but remains challenging in industrial practice. Therefore, a novel and adaptive approach is proposed to detect weld anomalies in real-time without the need for labor-intensive and continuous data labeling. The monitoring setup consists of a coaxially integrated camera that observes the thermal radiation emitted by the laser interaction zone at a specific wavelength. The image data are subsequently used together with semi-automatically generated annotations to build four convolutional neural networks (CNNs) running in parallel to detect process anomalies during the welding process. Experimental results indicate that the proposed approach can be used for real-time anomaly detection at high frame rates (>840fps) and low latency using a GPU-based embedded system.

Keywords: Machine learning; laser materials processing; neural networks

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