Nozzle-to-Work Distance Measurement and Control in Wire Arc Additive Manufacturing

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What is it about?

In multi-axes Wire Arc Additive Manufacturing, keeping the correct nozzle-to-work distance is crucial to avoid collisions and process defects. Measuring this distance is challenging as the welding arc complicates the usage of conventional distance measurements without positional offset in-process. For that reason, this study investigated and evaluated the usage of several sensors (wire feed sensor, current and voltage sensor, microphone, welding camera, spectrometer, structural acoustic sensor) for a direction independent
in-process measurement. Features were extracted based on domain knowledge and selected by means of a correlation analysis. The spectrometer (Pearson's r = -0.90) showed the most robust measurements for stable process parameters when computing the relative intensity at a wavelength of 960 nm, followed by the welding camera (Pearson's r = 0.84) when analyzing the images with a convolutional neural network. Based on the findings, a closedloop- control was created. As a system identification revealed a high impact of the welding speed on the track height in comparison to the wire feed rate (Pearson's r - 0.90 <> -0.16), the closedloop- control

was realized by means of a simple P-control for the welding speed. The proposed approach enabled the manufacturing of multi-layer multi-bead parts with multi-axes deposition paths.

Why is it important?

Industrialization of Wire Arc Additive Manufacturing;
First Time Right Printing;
Reduce Time for Process Parameter Optimization

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