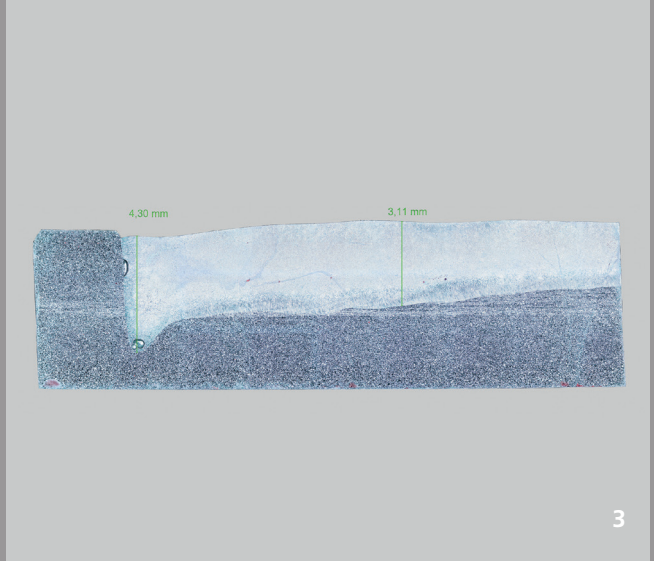
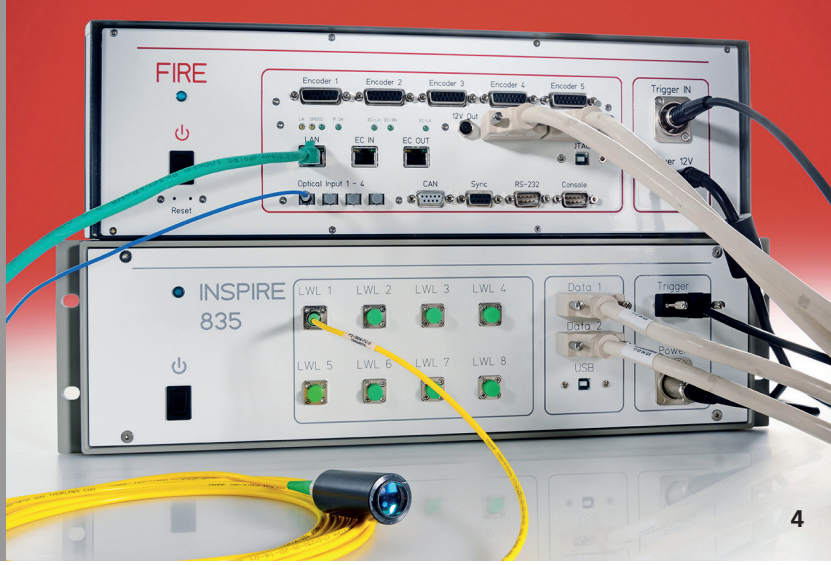


3



4

WELDING DEPTH MEASUREMENTS WITH RAPID VARIATION OF LASER POWER

Task

In laser welding processes, camera systems and pyrometers are commonly used to monitor the melt pool and document the treatment process. Another important process parameter is the welding depth, which can be controlled using easily adjustable system parameters such as laser beam power and traverse speed. When components have complex geometric shapes, varying distances between the welding optics and the workpiece surface can lead to different spot diameters and, thus, to variations in the welding depth.

Method

Fraunhofer ILT has developed inline-capable, interferometric sensors for geometry measurement meeting the highest accuracy requirements. These sensors of the »bd-x« family have already been successfully put into operation for inline thickness measurement on rolled metal strips and foils. Now, for the first time, the »bd-x« sensors have been tested under various process conditions for measuring the welding depth in laser-beam welding. At fixed feed rates between 6 m/min and 14 m/min, the laser beam power was varied linearly between 0.5 kW and 6.0 kW in each case. On a welding length of 40 mm, the spot diameter of the welding laser was 600 µm. The spot diameter of the interferometric sensor was 70 µm; it was initially aligned to the keyhole at a feed rate of 8 m/min and was not changed during the entire test series.

Results

When measuring at a frequency of 70 kHz, the interferometric sensor system delivered 30 to 60 depth readings per millimeter of welding length, depending on the traverse speed. In superimposed images of microscopic cross-sectional micrographs, these measured values could be clearly assigned to the local welding depths.

Applications

In combination with FIRE – the real-time capable data processing electronics developed at Fraunhofer ILT – the interferometric sensor technology can be used to control production processes, e.g. by adjusting the laser beam power during the welding process. With a delay time of only 110 µs between measurement and output of an analog control voltage, the interferometric sensor technology can quickly and accurately control welding processes with high quality requirements.

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Contact

Dr. Stefan Hölters, Ext.: -436
stefan.hoelters@ilt.fraunhofer.de

Dr. Achim Lenenbach, Ext.: -124
achim.lenenbach@ilt.fraunhofer.de

3 Transverse micrograph of the blind weld with linear variation of the laser beam power.
4 »bd-4« sensor technology and data processing electronics.