



COGNITIVE PROCESS MONITORING

Task

The EU research project »MASHES« (Multimodal Spectral Control of Laser Processing) promotes the development of a multispectral, imaging and intelligent sensor system for process monitoring. This system has been integrated into processing optics and applied to a laser-beam welding and laser metal deposition process. The real-time data processing and the upstream sensor data fusion pose, however, a particular challenge. The relevant information of several different sensor data streams needs to be extracted during the process in order to be subsequently fed to a cognitive process monitoring algorithm for data processing.

Method

The development of the cognitive system includes the areas of »Computer Vision« and »Machine Learning«. These methods are used to determine relevant features from the image data, such as the cooling rate of the component surface or the surface geometry of the melt pool. The calculation and evaluation of the characteristics requires considerable processor power and is accomplished for the real-time application with a Field Programmable Gate Array (FPGA). The training phase provides the basis for evaluating the process monitoring features. By means of the calculated process characteristics and expertly assessed welding samples, the cognitive system learns to classify the characteristics and, thus, how to recognize different process imperfections clearly.

- 1 Test setup with integrated sensors.
- 2 Laser-beam welded sheet sample with induced binding errors.

Results

The classification is carried out with different algorithms from the family of machine learning and, at the moment, can make a rough distinction of the two classes into good and bad welds. The classification into different error classes is currently being implemented. In order to generate as robust a result as possible, Fraunhofer ILT is testing and comparing further classification methods within the scope of the evaluation.

Applications

Within the framework of the project, the cognitive system has been applied in the field of industrial laser beam welding of automotive components. Furthermore, the results can also be used in this industrial application to document and improve the process quality within the scope of the automation strategy »Industry 4.0«.

The work presented here is being funded within the scope of the EU project »MASHES« under grant number 637081.

Contact

Christian Knaak M.Sc.
Telephone +49 241 8906-281
christian.knaak@ilt.fraunhofer.de

Dipl.-Ing. Peter Abels
Telephone +49 241 8906-428
peter.abels@ilt.fraunhofer.de