TEXTURE-BASED SEAM TRACKING

Task

When the shipbuilding and vehicle construction sectors weld components from sheet metal, they must be able to reliably identify the seam geometry and position with an automatic image processing system. In contrast to classical approaches based on brightness gradients, an alternative approach has been pursued here: segmenting the image data based on textures, whereby changes in the texture of adjacent image details are used for their differentiation and delineation. In this texture-based analysis, the image information is classified by means of a filter bank and complex statistical algorithms. Because of the computing power required for this, real-time implementation has hitherto been uneconomical. The performance of field-programmable gate arrays (FPGA) as well as PC hardware, however, has been improving constantly, as used, for example, in graphic cards with a large number of graphic processor cores operating in parallel. Nowadays such advances make it possible to economically implement, in real time, the image processing algorithms needing such computational power required for the seam tracking control.

Method

The system has an image sensor arranged coaxially in the beam path of the focusing optics for the laser beam. By means of real-time image processing, it measures the distance between the butt joint and the interaction point (TCP) as well as the joint width for an adaptive control during joining with the laser-assisted GMAW welding process.

Results

Algorithms for the (pre) processing of the image data were implemented on programmable FPGA hardware as well as for texture-based joint tracking on GPUs. An arc-synchronous illumination and image acquisition has been implemented with a pulsed diode laser and will soon be optimized with cost-effective VCSEL devices. With this approach, Fraunhofer ILT has developed and implemented a real-time process monitoring and control system.

Applications

In the medium term, the developed system will provide an inline-capable seam tracking system for applications in shipbuilding, rail vehicle construction and steel building.

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3 Laser-assisted welding process.

4 Integrated process monitoring system.

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