Highlight

Aachen,
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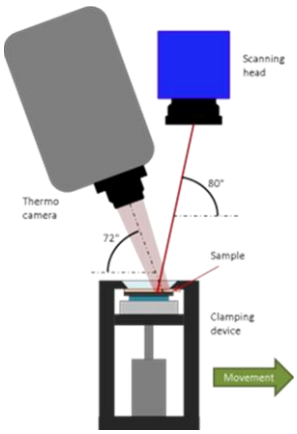
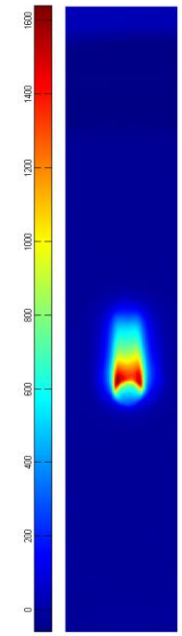
Thermal camera 2D imaging for monitoring TWIST laser welding process

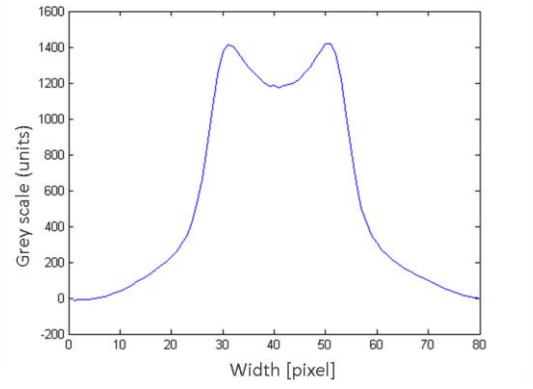
For laser polymer welding, a convenient method for process monitoring and control is the use of pyrometers, yielding temperature-dependant signals along the weld seam. The weld seam homogeneity which is important for weld strength and process window width, cannot be measured by pyrometers, since there is no spatial resolution. To achieve a 2D infrared top view of the weld seam region, a thermal camera is used to check the influence of TWIST welding parameters on the weld seam homogeneity.

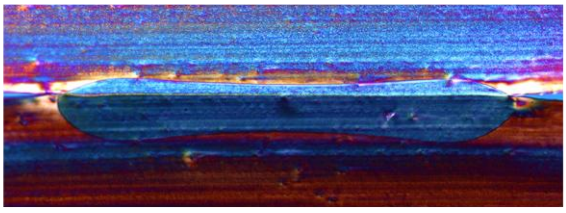
An infrared InSb 640 SM thermal camera (Thermosensorik, Germany) with a wavelength range 1,5-5 µm and up to 2,6 kHz frame rate is used. To get an accurate resolution the frame rate has to be less than 2,6 kHz. Depending on the frame size (208 X 508 pixels), the calculated frame rate is 228 Hz. The experimental setup is depicted in the small figure on the left side.

Below: Experimental setup for monitoring TWIST laser welding using thermal camera.
Right: 2D infrared image, averaged signal at right angle across the laser section and microtome slice cut showing the welding zone.
TWIST welding with 0,8mm diameter circle at 2000 Hz, welding speed 25 mm/s, Laser beam diameter 80 mm, Laser power 6W, wavelength 1060 nm









Circle; power 6 W; feed rate 25 mm/s; â = 0,4 mm; TWIST freq. 2000 Hz

SEVENTH FRAMEWORK PROGRAMME

The setup contains an IPG Ytterbium fiber laser with 1070 nm wavelength, a maximum power output of 20 W and a collimated beam diameter of 5 mm in the galvo scanner entrance aperture for beam deflection. It is composed of a SCANcube7 scanner (Scanlab, Germany) and a F-Theta lens with a focal length of 254 mm, resulting in a 80 µm focussed beam diameter.
Regions of high temperature, where polymer decomposition is possible, can be identified (see picture on previous page of infrared 2D image and signal level across the image at right angle). The thermal 2D image provides signals that indicate the heat affected zone shape inside the joining zone (see microtome slice cut) without providing an iterative detected temperature value. Quantification of any temperature is not possible with high accuracy. To assess the homogeneity of a welded joint, however the method provides useful information.
Due to the high camera investment costs, an industrial application seems economically reasonable only for selected applications.

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