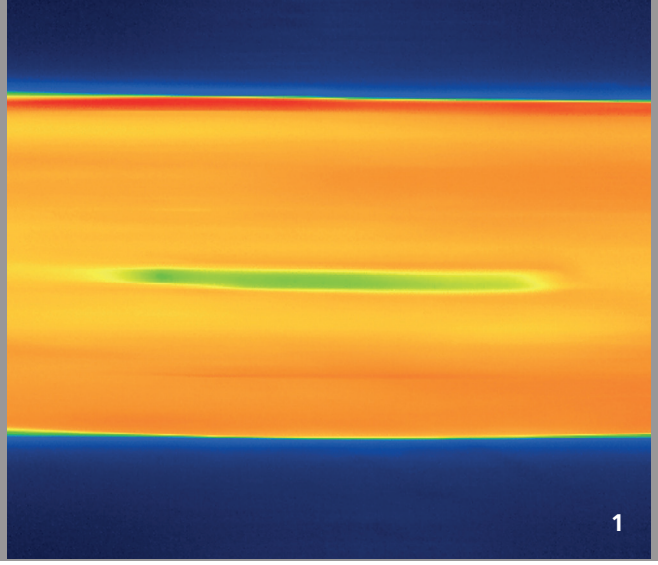
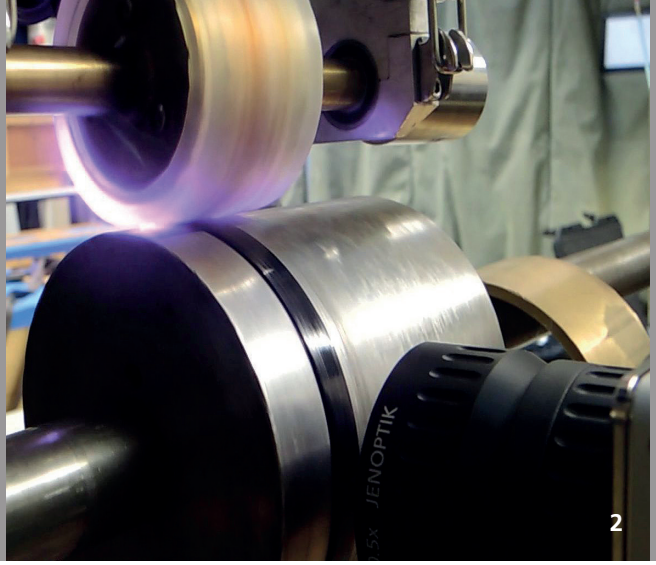


1



2

PROCESS MONITORING IN THE LASER-BASED TAPE-LAYING PROCESS FOR FRP COMPONENTS

Task

Automation, flexibility and resource efficiency all play a key role in the production of fiber-reinforced plastic (FRP) components based on a laser-based tape-laying process. In the system development, this project is focusing on the process-controlled laser-beam welding of fiber composite tapes in order to detect inline defects in the component reliably and safely.

Method

The process control is implemented using imaging thermography and machine learning. For the control to detect insufficient lamination during the tape laying process, the institute has introduced artificial micro-embossments in FRP tapes in advance. Thanks to »live« thermography images from the joining process, the system can recognize and then evaluate the embossments with regard to the remaining geometry after welding. This is then used to derive the welding quality. The process control algorithm is based on machine learning: In the first step, the embossments on the tape are recognized and in the second step, the quality assessment is carried out.

1 IR photograph of a FRP tape with imprinting applied.
2 Laser welding process for tape laying of FRP tapes with thermographic camera, source: Fraunhofer IPT.

The process monitoring learning required in this process was performed using reference lamination of known quality. After the learning phase, process monitoring is able to evaluate new unknown laminations.

Results

The developed process monitoring is capable of working in real-time and easy to integrate due to the existing interfaces. The system was evaluated with 150 available datasets. To train the model, 75 percent of the data was used and 25 percent as test records. As a result, 98 percent of the existing embossments on the FRP tape were recognized and the quality of the lamination was correctly evaluated for all recognized embossments.

Applications

The »ambliFibre« monitoring system is suitable for all applications whose goal is to detect structures on surfaces with different temperature controlled areas. The method can be easily adapted and flexibly expanded by machine learning. The secure object recognition not only recognizes known imperfections, but also new ones created in the process.

The work has been carried out as part of the EU project »ambliFibre« under grant number 678875.

Contact

Andrea Lanfermann M.Sc.
Telephone +49 241 8906-366
andrea.lanfermann@ilt.fraunhofer.de

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

Fraunhofer Institute for Laser Technology ILT, www.ilt.fraunhofer.de
DQS certified by DIN EN ISO 9001, Reg.-No.: DE-69572-01