Bachelor / Master – Thesis

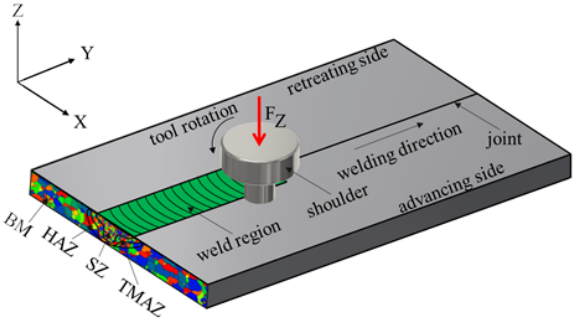
Robust control of a solid state joining process and its real application using model and not model based control strategy

Leuphana University of Lüneburg & Helmholtz-Zentrum Geesthacht **08. July 2019**

Introduction

Friction stir welding (FSW) is a solid state joining process. The process runs below the melting temperature of the workpiece material with heat only generated through friction and shear forces. The joint is formed by rotational and transversal motion of the FSW tool along the abutting edges of the workpiece. Various material combinations can be welded in different configurations that cannot be welded with fusion based processes. The process involves a number of adjustable parameters that make the system complex to control. In fact, the FSW process can be described as a multivariable system in which rotational speed, welding speed and vertical force as state variables are necessary to describe the system. To guarantee repeatable results, the temperature should be controlled for a given welding trajectory. This can be primarily achieved by varying either process power or welding speed or both. The main topic of the offered Master/Bachelor thesis is the development of a control system applied to the FSW process.

At the Helmholtz-Zentrum Geesthacht, three friction stir welding machines are available. One example is a FSW gantry system at HZG which will be used for the experimental part of the work.-



Schematic illustration of the FSW process, indicating the different zones of the microstructure appearing typical during the process (SZ: stirred zone; TMAZ: thermo-mechanically affected zone; HAZ: heat-affected zone; BM: bulk material)

HZG FSW gantry system.

Tasks

- Literature research related to the model of solid state welding processes in terms of state representation. In particular, a dynamic model should be built in which temperature, welding velocity, vertical force and rotating velocity as state variables should be analyzed and validated through simulations.
- Controlling the position trajectory avoiding deviation from a desired direction of welding.
- Controlling the system using temperature and velocity as desired set point variables.
- Validation of the conceived methods through simulations using Matlab/Simulink and in a real system is intended.
- The thesis will be performed in cooperation with Helmholtz-Zentrum Geesthacht.

Contact

Prof. Dr.-Ing. Paolo Mercorelli
Tel.: +49 4131 677 5571
E-mail: paolo.mercorelli@leuphana.de

Prof. Dr.-Ing. Benjamin Klusemann
benjamin.klusemann@leuphana.de
benjamin.klusemann@hzg.de