Invitation to the talk *On the three-dimensional numerical analysis of residual stresses on two scales in hot bulk forming parts* by Dr.-Ing. Sonja Hellebrand at the GAMM Junior Research Group at TU Dortmund University

Place: MB I - HS 1 (hybrid)
Zoom Link: Link
Meeting ID: 951 3296 8464
Passcode: bulk

Date: Friday, 24th August 2024
Time: 4:00pm (16:00)

Preliminary agenda

TOP 1: Seminar talk by **Dr.-Ing. Sonja Hellebrand** (see abstract below)

TOP 2: Discussion and Questions

TOP 3: Joint barbecue on the meadow outside of MB I or in case of rain, in the seminar room

Abstract

On the three-dimensional numerical analysis of residual stresses on two scales in hot bulk forming parts

Dr.-Ing. Sonja Hellebrand - Universität Duisburg Essen

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On the three-dimensional numerical analysis of residual stresses on two scales in hot bulk forming parts

Sonja Hellebrand[1], Dominik Brands[1], Lisa Scheunemann[2], Jörg Schröder[1]

[1]Institute of Mechanics, Faculty of Engineering, University of Duisburg-Essen, Universitätsstraße 11, 45141 Essen, Germany
sonja.hellebrand@uni-due.de, dominik.brands@uni-due.de, j.schroeder@uni-due.de

[2]Chair of Applied Mechanics, Department of Mechanical and Process Engineering, RPTU Kaiserslautern, 67653 Kaiserslautern, Germany
lisa.scheunemann@rptu.de

Current research focuses on the induction of residual stresses in a component during its manufacturing process, which shows a significant impact on the final component's properties. For instance, compressive residual stresses in regions that undergo tensile loading can prevent crack initiation or crack growth and, as a consequence, can lead to an improved service life. In order to analyze these stresses and for a cost and time efficient process design to obtain targeted residual stress distributions, a combination of experimental measurements and numerical simulations provide a good toolbox. Microscopic characteristics such as the phase transformation motivate a multi-scale investigation [1], in which residual stresses of different types (macroscopic and microscopic) can be depicted, see [2, 3]. In the context of microscopic analyses, different representative volume elements are discussed, which are used to describe the occurring phase transformation in a microscopic boundary value problem within a multi-scale finite element method. This approach enables to calculate stresses during the cooling process as well as the final residual stress states at the different scales, [4]. It is shown, that the inclusion of the microscopic stress distribution enables a profound evaluation of the resulting stress distribution.

References

[1] J Schröder. A numerical two-scale homogenization scheme: the FE^2-method. In J. Schröder and K. Hackl (Eds.), *Plasticity and Beyond - Microstructures, Crystal-Plasticity and Phase Transitions*, Volume 550 of *CISM Courses and Lectures*, 1–64. Springer, (2014).

[2] S. Uebing, D. Brands, L. Scheunemann and J. Schröder. Residual stresses in hot formed bulk parts - Two-scale approach for austenite-to-martensite phase transformation, *Archive of Applied Mechanics*, 91, 542–562, (2021).

[3] S. Uebing, D. Brands, L. Scheunemann and J. Schröder. Residual stresses in hot bulk formed parts: microscopic stress analysis for austenite-to-martensite phase transformation, *Archive of Applied Mechanics*, 91, 3603–3625, (2021).

[4] S. Hellebrand. Numerical simulation of microstructural residual stresses of hot bulk forming parts with targeted cooling. *PhD Thesis*, University of Duisburg-Essen, (2023).