Technische Universität Braunschweig

MUSEN

Computational additive manufacturing: Modelling and simulation of selective beam melting

Lecture of
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Abstract:
Selective beam melting processes like e.g. selective laser melting (SLM) of polymers or selective electron beam melting (SEBM) of metals are additive manufacturing processes to successively build geometrically complex parts from thin layers of powder material. Due to the high energy of the beam extreme temperatures and temperature gradients occur which may result in residual stresses upon solidification and eventually in distortions of the produced parts.
The aim of this contribution is modelling and simulation of these additive manufacturing processes to predict transient temperature distributions during the process and to capture residual stresses in the produced part. A thermomechanical model is developed which accounts for temperature-dependent material behavior, phase-transitions between powder, melt and solid material, energy input by a moving heat source and thermo-viscoplastic material behavior. Simulation results will be compared to experimental data from the CRC 814 “Additive Manufacturing” established in Erlangen. In particular for additively produced metals mesoscopic simulations using a gradient crystal plasticity model will be introduced. The macroscopic material behavior is derived whereby the process-induced mesostructured is taken into account based on experimental findings.