

Forschungskolloquium Computational Science and Engineering

Resource efficiency through modern mechanics – a journey from material microstructure to process simulations

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Zusammenfassung: A particular challenge in engineering is the ever-increasing importance of the resource efficiency of technical components. In order to reach the overarching societal goals of sustainability and resource efficiency, the performance of engineering components must be maximized. In modern lightweight construction, this paradigm requires highly accurate, simulation-based prediction capabilities with regard to the behavior of complex materials and structures in operational use. However, only with precise knowledge of the actual state of the manufactured component can optimizations be made to the material and manufacturing process, and the operating behavior of technical components can be precisely predicted in a subsequent step. Along this process chain, the first step is the modelling and simulation of material behavior, as the interaction between material phenomena and the manufacturing process determines the actual state of the resulting component – characterized, among other things, by the distribution of phase fractions, plasticity, residual stresses, and damage. The simulation framework is embedded into a superordinate optimization framework in view of optimization-based model calibration and validation. This includes measurements of spatially inhomogeneous field data and the application of digital image correlation methods. Aspects of evolving anisotropy, gradient-enhanced model formulations and machine learning-assisted parameter identification are covered in this talk.

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