Information to the Course
Process Simulation in Forming Technology

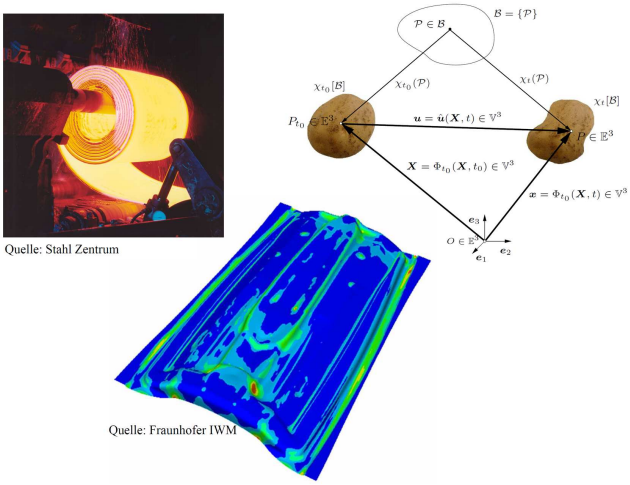

Abb.: Process simulation in forming technology: forming processes, continuum echanics and simulation methods

Contents of the lecture

Forming processes play a central role in the value chains for manufacturing products from metallic materials. Process simulations support the sustainable and resilient design of manufacturing processes and products. On the basis of continuum mechanics, material theory, and numerical methods, the lecture imparts practice-relevant knowledge for the simulation of forming processes that enables manufacturing processes to be designed efficiently and precisely. In the first part of the lecture, the fundamentals of metal plasticity are addressed from the perspectives of manufacturing engineering and materials science, and the most important forming processes are discussed. The discussion of the technological aspects of the individual forming processes provides important requirements for the computational methods for the simulation of forming processes. Building on this state of knowledge, the elementary fundamentals of modelling and simulation are then conveyed. This includes a brief introduction to continuum mechanics and material theory. A particular focus is the modelling of metal plasticity at small and large deformations. This is followed by an introduction to the numerical solution of initial?boundary value problems, including the solution of the contact problem using the finite element method. Finally, using technologically relevant forming processes, real process simulations are presented and their capabilities and limitations are discussed.

Dates, Exam, Contact

Lecture date	Do., 15:45 - 17:15, SR 308.1, bldg 10.23 (in weekly format)
	Do., 14:00 - 17:15, SR 308.1, bldg 10.23 (in biweekly format)
First lecture	Do., 06.11.2025, 15:45, SR 308.1, bldg 10.23
Exam	oral
SWS / Credits	2 SWS, 4 CP
Contact	Dr. Dirk Helm, dirk.helm@iwm.fraunhofer.de

Contents of the lecture

- Metal plasticity: dislocations, twinning, phase transformations, anisotropy, hardening.
- Classification of forming methods and discussion of selected forming processes.
- Fundamentals of tensor algebra and tensor calculus.
- Continuum mechanics: kinematics, finite deformations, balance equations, thermodynamics.
- Material theory: basic principles, modeling concepts, plasticity and viscoplasticity; yield functions (von Mises, Hill, ?); kinematic and isotropic hardening models; damage; thermomechanical coupling phenomena.
- Contact modeling
- Finite element method: explicit and implicit formulations; element types; general procedure; numerical integration of material models.
- Process simulation using selected examples from bulk and sheet metal forming.