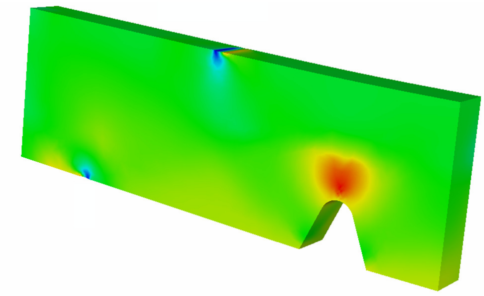
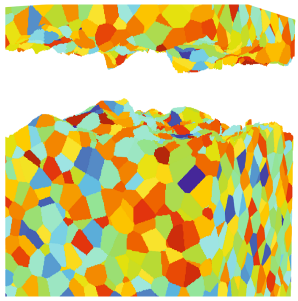
Information to the Course
Computational Mechanics of Materials





left: 3D-stress state in specimen under 4-point bending, right: Crack surface of a polycrystal [Ernesti, F., Schneider, M.: Computing the effective crack energy of heterogeneous and anisotropic microsturctures via anisotropic minimal surfaces]

Contents of the lecture

The lecture provides an introduction into the basic principles of continuum mechanics, based on sound kowledge of mechanics courses from Bachelor studies. First, a repetition of basics of tensor calculus is given. Kinematics and balance equations are discussed in detail. Isotropic and anisotropic elasticity as well as fracture mechanics will consequently be treated. An introduction into material modeling will be provided in the second part of the course. Thereby, special emphasis is put on viscoelasticity and plasticity to describe the material behavior of plastics and metals.
Tutorials and computational experiments will be offered to deepen the understanding of the principles. The commercial finite element software package ABAQUS will be introduced and students can perform first simulations of different materials under several loading conditions.
For native German speakers, this course offers an easy option to get started to the technical vocabulary in English in the research field of continuum mechanics.

Dates, Credits, Lecture Notes, Contact

Lecture	Tue, 09:45 - 11:15, Großer Bauingenieur-HS, bldg 10.50
First Lecture	Tue, Oct 28th, 09:45 - 11:15, Großer Bauingenieur-HS, bldg 10.50
Tutorial	to be defined during first lecture
SWS / Credits / Exam	2 SWS / 4 CP / written examination
Language	English / German (depending on the audience)
Lecture Notes	Englisch and German versions available
Contact	Prof. T. Böhlke (Tutorials: M.Sc. F. Hille, M.Sc. N. Lalovic)

Literature

[1] Gummert, P.; Reckling, K.-A.: Mechanik. Vieweg 1994.

[2] Gross, D.; Seelig, T.: Fracture Mechanics. Springer 2018.

[3] Maugin, G.: The thermomechanics of plasticity and fracture. Cambridge Univ. Press 1992.

Recommendation

This course on MSc level is suitable for students with interest and good background in engineering mechanics, especially in elasticity. Good knowledge in tensor calculus is assumed right from the start. Special knowledge of the commercial FE software package ABAQUS is not required.

Contents of the lecture

- **Repetition of Tensor calculus** (assumed to be known)
  Tensors of first and second order, basis transformation; transformation of tensor components; symmetry; skew symmetry;
- **Kinematics**
  Deformation; deformation gradient; strain tensor; infinitesimal vs finite deformations, Eulerian and Lagrangian description;
- **Balance equations**
  Balance of mass; Balance of momentum; transport theorem; stress vector and stress tensor; equilibrium conditions;
- **Basics of material modeling**
  Constitutive equations; elements of material theory;
- **Elasticity theory**
  Isotropic and anisotropic linear elasticity; material symmetries; exact solutions of isotropic linear elasticity; linear thermoelasticity;
- **Linear elastic fracture mechanics**
  Models of crack propagation; fields at crack tip; stress intensity factors; Paris law; energy release rate; fracture surface; Griffith cracks;
- **Viscoelasticity**
  Viscosity; one-dimensional viscoelasticity; stress-strain-relations; relaxation test; relaxation modulus; Maxwell model; storage and dynamic modulus; three-dimensional viscoelasticity;
- **Plasticity**
  Additive split of strain; yield condition; load condition; consistency condition; flow rule; Tresca and Huber-Mises-Hencky condition; strain hardening;