Information to the Lecture
Nonlinear Continuum Mechanics

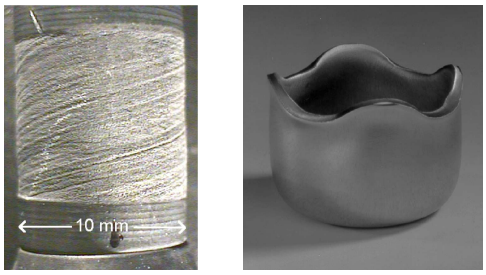

Figure: Plastic Torsion (left); earing with deep drawing (right)

Content of the Lecture

The lecture conveys the basics of kinematics of finite deformations. In addition, balance equations for volumes with singular surfaces are generally introduced and specified for typical applications. The material equations of, e.g., thermoelasticity and plasticity are derived based on a general description of the principles of the theory of materials. With the skills conveyed in this lecture, the students can use the principles of theory of materials to applications of geometrically and physically nonlinear continuum mechanics relevant in mechanical engineering.

Dates, exam, script

Date of lecture	Tuesday, 12:00-13:30h
Form of lecture	Online/synchronous
First lecture	Tuesday, 13.04.2021, view ILIAS-Kurs
Date of tutorial	Will be announced
First tutorial and form	Will be announced
exam	Oral exam
SWS / LP	Lecture 2 SWS, Tutorial 1 SWS / 4 LP
Contact	Prof. Dr.-Ing. Thomas Böhlke, M.Sc. Tobias Karl, M.Sc. Daniel Wicht
Course material	ILIAS, access possible from 05.04.

Literature

[1] Truesdell, C., Noll, W.: The Non-Linear Field Theories of Mechanics, Springer 2004.

[2] Liu, I-S.: Continuum Mechanics, Springer 2002.

[3] Silhavy, M.: The Mechanics and Thermodynamics of Continuous Media, Springer 1997.

[4] Krawietz, A.: Materialtheorie, Springer, 1986.

[5] Gurtin, M., Fried, E., Anand, L.: The Mechanics and Thermodynamics of Continua, Cambridge University Press 2010

Content of the Lecture

- **Kinematics**
  Motion, Eulerian and Lagrangian description of field quantities, material time derivative, deformation gradient, transformation of line, surface and volume elements, polar decomposition of the deformation gradient, generalized strain measures, kinematic compatibility condition

- **Balance equations**
  Inertial systems, general structure of balance equations, transport theorem, divergence theorem, local forms of balance equations in regular points, jump conditions, Eulerian vs Langrangian forms of balance equations, implication of the second law of thermodynamics in regular points and points on a singular surface

- **Principles of material theory**
  Constitutive equations, dependent and independent variables, state variables, internal variables, change of reference placement, symmetry transformation of a constitutive function, change of observer, change of frame, observer dependence of kinematical properties, principles of local action, material objectivity and frame indifference, simple materials, gradient materials

- **Discussion of selected types of materials**
  Rigid heat conductors, elasticity, thermo-elasticity, rigid visco-plasticity, elasto-visco-plasticity, thermo-elasto-visco-plasticity

Prerequisites:
Excellent knowledge of tensor algebra/analysis and linear continuum mechanics.

Remark:
In agreement with the students, the lecture and the tutorial is offered in German.