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

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