Data:	PINSM. MA. Nr. 3589 / Examination number: 41910	Version: 12.07.2017	Start Year: WiSe 2019
Module Name:	**Parameter Identification in Nonlinear Solid Mechanics**		
(English):			
Responsible:	Kiefer, Björn / Prof. PhD.		
Lecturer(s):	Kiefer, Björn / Prof. PhD. Abendroth, Martin / Dr. Ing.		
Institute(s):	Institute of Mechanics and Fluid Dynamics		
Duration:	1 Semester(s)		
Competencies:	Successful participation will enable students to apply concepts of nonlinear optimization to the problem of parameter identification for complex material models. In this context, they will be able to code, test and use classical optimization methods - as well as employ more advanced tools available in standard libraries (matlab, python) - and to combine them with algorithmic materials models and experimental data sets. The knowledge obtained in this course is transferrable to a broad spectrum of inverse problems in technology and the natural sciences.		
Contents:	The calibration of parameters plays a central role in establishing predictively accurate constitutive models for complex, nonlinear material responses. In numerical optimization-based approaches to parameter identification an objective function that measures deviations between simulation results and experimental data is minimized to compute optimal parameter sets. After motivating the inverse problem of parameter identification the course provides an introduction to fundamental theoretical and algorithmic concepts of (constrained) nonlinear optimization. The lectures are accompanied by programing exercises that lead to hands-on experience with implementing and testing such optimization methods. In the second part of the course students learn to apply these numerical tools to the specific problem of parameter identification for nonlinear (elasto-plastic, visco-elastic etc.) material models. To obtain the necessary experimental data, students will help conduct experiments in the materials characterization laboratory of the solid mechanics group. The lectures will further address advanced concepts, such as the parameter identification via inhomogeneous deformation processes by combining digital image correlation and finite element analysis. Lastly, it is demonstrated that very similar numerical concepts can be employed in solving structural optimization problems of nonlinear solid mechanics.		
Literature:	• D. P. Bertsekas, *Nonlinear Programming*, Athena Scientific, Belmont, MA, 2nd edition, 1999. • D. G. Luenberger, *Linear and Nonlinear Programming*, Addison-Wesley, Reading, MA, 2nd edition, 1984. • R. Mahnken, *Identification of Material Parameters for Constitutive Equations*, In Encyclopedia of Computational Mechanics, chapter 19, pages 637-655. John Wiley & Sons, New York, 2004. • J. Nocedal and S. J. Wright, *Numerical Optimization*, Springer-Verlag, Berlin, 2nd edition, 2006.		
Types of Teaching:	S1 (WS): Lectures (2 SWS) S1 (WS): Taught in English and German. / Exercises (1 SWS)		
Pre-requisites:	**Recommendations:** Continuum Mechanics, 2017-05-18 Mechanics of Materials, Basic Knowledge of Numerical Methods		
Frequency:	yearly in the winter semester		

Requirements for Credit Points:	For the award of credit points it is necessary to pass the module exam. The module exam contains: MP/KA (KA if 10 students or more) [MP minimum 30 min / KA 120 min] Possible in German.
Credit Points:	4
Grade:	The Grade is generated from the examination result(s) with the following weights (w): MP/KA [w: 1]
Workload:	The workload is 120h. It is the result of 45h attendance and 75h self-studies.