

Module title Nonlinear Optimization				
Module code NOP	Level Master (M.Sc.)	Hours per week 4 + 2	ECTS credits 7,5	Duration 1 semester
Module instructor Prof. Dr. Körkel	Lecture type Lecture + Tutorial/Practical	Prerequisite(s) Analysis 1,2, Linear Algebra 1,2, Linear Optimization, Mathematical Software		Grading Written exam (90- 120 min) or oral exam (15-45 min)
Objectives				
<ul style="list-style-type: none"> • Understanding of the modeling of nonlinear optimization problems • Knowledge of important prototypes of nonlinear optimization models • Detailed knowledge of structure and properties of important algorithms for the solution of nonlinear optimization problems • Implementation of software modules for the solution of nonlinear optimization problems 				
Content				
<ul style="list-style-type: none"> • Optimality conditions for unconstrained and constrained problems (Lagrange, Karush-Kuhn-Tucker) • Convex optimization problems • Descent methods for unconstrained problems (e.g. gradient method, CG method) • Descent methods for constrained problems (e.g. method of feasible directions, projected and reduced gradients, penalty methods) • Newton-type methods (e.g. quasi-Newton methods, SQP methods, in particular BFGS, Gauß-Newton) • Analysis of the local convergence behavior of the methods (i.a. Theorem of Dennis-Moré) • Methods for the globalization of convergence (e.g. line search, trust region, Theorem of Zoutendijk) • Methods for inequality constrained problems (e.g. active set, interior point) • Methods for the evaluation of derivatives (e.g. numerical vs. automatic differentiation) • Application examples (especially nonlinear fitting problems) • Algorithms and software (i.a. MATLAB) 				
Textbook/teaching material				
<ul style="list-style-type: none"> • Own lecture notes • Nocedal, J., Wright, S. J.: Numerical Optimization • Luenberger, D. G., Ye, Y.: Linear and Nonlinear Programming • Geiger, C., Kanzow, C.: Numerische Verfahren zur Lösung unrestringierter Optimierungsverfahren • Geiger, C., Kanzow, C.: Theorie und Numerik restringierter Optimierungsaufgaben • Stoer, J., Jarre, F.: Optimierung • Ulbrich, M., Ulbrich, S.: Nichtlineare Optimierung 				

Note: this is not the official course descriptor according to the "Studien- und Prüfungsordnung" (SPO)