

Optimization at Humboldt University

Information for Bachelor-/Master theses

20 June 2019

Humboldt-Universität zu Berlin



Modules

- **Nonlinear Optimization**
(Nichtlineare Optimierung)
Prof. Michael Hintermüller, winter semester 2018/19
- **Foundation of Numerical Mathematics and Optimization**
(Grundlagen der Numerischen Mathematik und Optimierung)
- **Calculus of Variation and Optimal Control**
Variationsrechnung und Optimale Steuerung

Seminar

- **Seminar on Optimization**
Prof. Axel Kröner

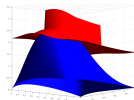
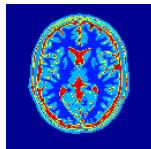
Modules

- **Advanced Topics in Optimization**
(Ausgewählte Themen der Optimierung)
Prof. Michael Hintermüller, summer semester 2018/19
- **Optimization of partial differential equations**
Optimierung bei partiellen Differentialgleichungen
Prof. Axel Kröner, summer semester 2018/19
Prof. Michael Hintermüller, summer semester 2017/18
- **Theory and methods in nonsmooth optimization**
(Theorie und Verfahren der nichtglatten Optimierung)
Prof. Axel Kröner, summer semester 2017/18
- **Stochastic Optimization**
(Stochastische Optimierung)

Seminar

- **Joint Research Seminar on Mathematical Optimization/Non-smooth Variational Problems and Operator Equations**
Prof. Michael Hintermüller, Weierstrass Institute, on weekly basis

- Image Processing
- Optimal control of PDEs
- Quasi-variational inequalities
- Nash equilibrium games
- Applications in energy (gas transport)
- ⋮



- Basic Analysis and linear algebra courses
(Analysis I, II, III)
- Numerical Linear Algebra
(Numerische Lineare Algebra)
- Nonlinear optimization
(Nichtlineare Optimierung)
- Theory and methods in nonsmooth optimization
(Theorie und Verfahren der nichtglatten Optimierung)
- Functional Analysis
(Funktionalanalysis)
- Partial Differential Equations
(Partielle Differentialgleichungen)

- ➊ Approach potential supervisor (Prof. Hintermüller),
⇒ first discussion
⇒ advice on prerequisites
- ➋ Selection of a specific topic
- ➌ Making of a time plan and a rough work program
- ➍ Initial reading list
- ➎ Regular meetings, additional support & mentoring from group members

Approx. Duration:

- Master: Officially 6 months (but typically up to 9 months)
- Bachelor: 2 months

- **Nash Games under Uncertainty**

Capture markets where goods are exchanged between players in a non-cooperative fashion.

Key tools: Uncertainty quantification, PDEs, adaptive finite elements

- **Gas Transport**

Modelling and simulation of gas market, as a Nash game on a network,

Key tools: Hyperbolic PDEs, Variational Inequalities

- **Physics Integrated Image Processing**

Incorporation of physical laws for the improvement of medical image reconstruction techniques, e.g. Magnetic Resonance Imaging.

Key tools: Bilevel Optimization, Neural Networks

- **Optimal control of non-smooth structures**

Quasi-variational inequalities (stability, analysis) and applications, e.g. thermoforming.

Key tools: Functional and Set-valued analysis, Monotonicity methods

- **Optimal transport and applications**

Applications in image analysis (e.g. color transfer, image retrieval, image classification).

Key tools: Interplay between geometry, probability and PDEs, machine learning

The student will obtain:

Expertise on a selected area and topic of applied maths and optimization with respect to:

- Motivation of the problem
- Modelling
- Analysis
- Algorithmic aspects
- Numerical realization

that could **lead to**:

- a job in industry
- a PhD

Further informations:

- hint@math.hu-berlin.de
- https://www.math.hu-berlin.de/~hp_hint/teaching.php
- <https://www.mathematik.hu-berlin.de/de/forschung/forschungsgebiete/mathematische-optimierung/>

Thank you for your attention!