



Nonlinear Optimization

FSS 2023

Dr. Andreas Sommer



Based on lecture notes by Claudia Schillings (U Mannheim), Michael Hintermüller (HU Berlin),
Oliver Kolb (U Mannheim), and Thomas Surowiec (HU Berlin)

2023/02/14



Course Information

- Dates
 - **Lecture:** Tuesday, 08:30 – 10:00 in Seminar Room II, B6 D 007
 - **Exercise:** Tuesday, 10:15 – 11:45 in Seminar Room I, B6 D 002

- Course Webpage and Contact
 - Website of Prof. Göttlich – Teaching – Nichtlineare Optimierung
<https://www.wim.uni-mannheim.de/goettlich/teaching/fss-2023/nichtlineare-optimierung/>
 - **ansommer@mail.uni-mannheim.de**

- Lecture:
 - Lecture notes will be provided on course web page
 - Lecture on February 28: must be rescheduled



- Exercises
 - **Tuesday, 10:15 – 11:45 in Seminar Room I, B6 D 002**
 - **Weekly homework assignments** at the course web page each Tuesday (first one today)
 - Exercises comprised of **theoretical and programming** tasks
 - Groups of 2-3 students
 - **Submit by e-mail before Sunday, 18:00** – The earlier, the better!
 - Scanned handwriting is fine
 - Suggested programming language: Matlab (Octave)
Tutorial available on course web page



Exercises: Do's and Don'ts

- DO: Send results in a **single zip-file** (plain ZIP ! No rar, ace, 7z, gz2)
 - Name the file by the **family names** of all group members, **lexicographically ordered**, separated by a **hyphen**.
 - Example: Laura Beta, Chris Gamma, and Catherine Alpha work together, so they send a single zip file containing all files and named `alpha-beta-gamma.zip`

Programming:

- DO: Comment your programs!
- DO: Add a script or functions that test the implementations.
Document how they shall be invoked!
- DO: Work through the Matlab tutorial (there will be some surprises!)
- **DO NOT:** Ignore hints from Matlab (red curly lines under the code)
- **DO NOT:** Ignore warnings
- **DO NOT:** Invoke `clear all` or `close all` or alike that mess around with the workspace



Course Information

▪ Assessment:

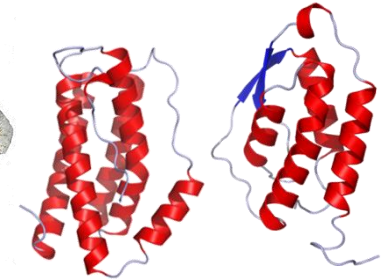
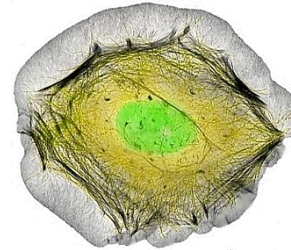
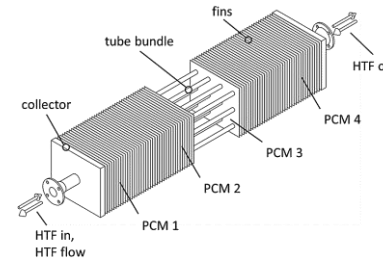
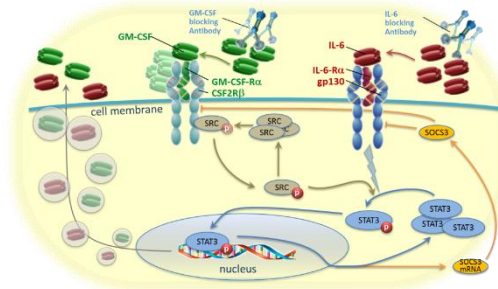
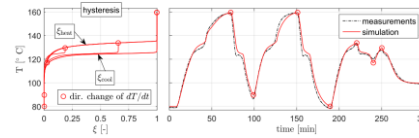
- Oral examination or written exam
- Course certificate requirements:
 - at least 50% of total exercise points
 - at least one presentation of results during exercise classes

▪ Literature

- **J. Nocedal and S. J. Wright, Numerical Optimization, Springer-Verlag, Berlin, 2006.**
- D. Bertsekas, Nonlinear Programming, Athena Scientific Publisher, Belmont, Massachusetts, 1995.
- A. R. Conn, N. I. M. Gould, P. L. Toint, Trust-Region Methods, SIAM, Philadelphia, 2000.
- J. E. Dennis, R. B. Schnabel, Numerical Methods for Unconstrained Optimization and Nonlinear Equations, SIAM Philadelphia, 1996.
- R. Fletcher, Practical Methods of Optimization, Wiley & Sons Publisher, New York, 1980.
- C. Geiger, C. Kanzow, Numerische Verfahren zur Lösung unrestringierter Optimierungsaufgaben, Springer, Berlin, 1999.
- F. Jarre, J. Stoer: Optimierung, Springer Verlag.
- C. T. Kelley, Iterative Methods for Optimization, Frontiers in Applied Mathematics, SIAM, Philadelphia, 1999.
- M. Ulbrich, S. Ulbrich, Nichtlineare Optimierung, Birkhäuser, 2012.

Nonlinear Optimization: Applications

- Engineering and Chemistry
- Biology and Medicine
- Environmental Systems and Geology
- Physics
- Social Sciences and Psychology
- Everywhere!



MATHEMATICS AND SOCIAL SCIENCES
Workshop, November 16 and 17, 2015
Imperial College in London, UK

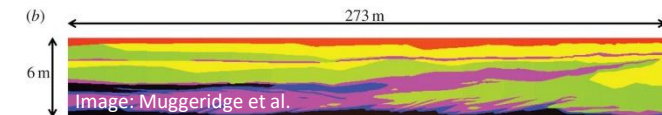
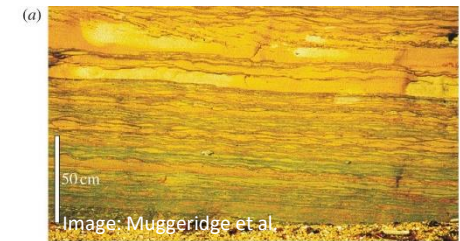
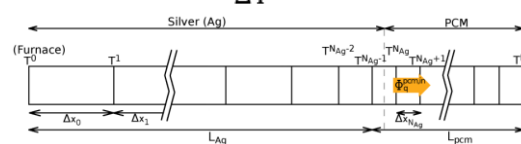
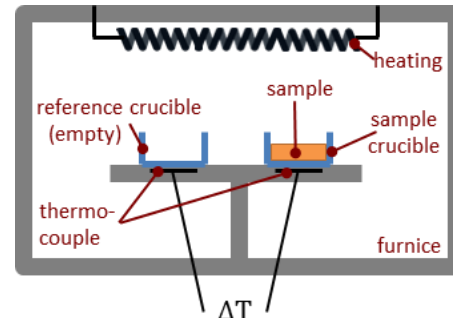


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Opinion dynamics
Crime
Urban studies
Networks and social sciences

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www.math.univ-toulouse.fr/MASS



- Introduction and Notations
- Optimality Conditions for Unconstrained Problems
- (Steepest) Descent Algorithms
- Convergence Analysis and Results
- Newton's Method
- Quasi-Newton Methods

- Optimality Conditions for Constrained Problems
- Methods for Constrained Optimization Problems

