

Module Description

MA5511: Ill-Posed Problems in Image and Signal Processing Applications

TUM Department of Mathematics

Module Level:	Language:	Duration:	Occurrence:
Master	English	one semester	irregularly
Credits:*	Total Hours:	Self-study Hours:	Contact Hours:
6	180	120	60

* Number of credits can vary according to study program. Please see Transcript of Records.

Description of Achievement and Assessment Methods:

Exercise sheets will be passed out every week, containing both theoretical problems and programming exercises. In a weekly exercise group, we will discuss the solutions to the theory problems and implement the programming problems (typically in MATLAB). Active participation in the exercises will prepare the students for the final exam. This will be written or oral, depending on the number of attendees. The questions will cover all material presented in class.

Type of Assessment:	Duration of Assessment (min.):	Assessment Retake:
written or oral	30 (oral) or 60 (written)	End of Semester

(Recommended) Prerequisites:

Working knowledge of the Bachelors courses in mathematics, particularly in analysis and linear algebra. Some prior knowledge about numerics is recommended since the homework sheets will contain programming exercises.

Content:

Many problems in real world applications have the property that their solution is not unique or that an arbitrarily small change in the measured data can lead to an arbitrarily large change in the solution. Such problems are ill-posed. One commonly addresses the solution of ill-posed problems with the help of regularization \tilde{n} for instance by using variational methods. In this lecture we will discuss the notion of ill-posedness and the concept of regularization. Furthermore, we will introduce the Bregman distance and show that it is an excellent tool for the convergence analysis of variational methods as well as for improving them by removing the bias introduced by the regularization. Applications in the fields of image and signal processing will be discussed.

Intended Learning Outcomes:

The aim of this class is to provide students with a clear understanding of the theory and the algorithms dealing with inverse problems in image and signal processing. After successful completion of the module students are able to understand and analyze the ill-posedness of a problem and approach it by (variational) regularization.

Teaching and Learning Methods:

Lecture, exercise sheets, exercise group.

Media:

Black board, beamer, exercises.

Reading List:

Lecture notes.

J. Mueller, S. Siltanen, "Linear and nonlinear inverse problems with practical applications."

M. Burger. "Lecture notes on inverse problems", (http://wwwmath.uni-muenster.de/num/Vorlesungen/IP_WS07/skript.pdf).

H.W. Engl, M. Hanke, G. Neubauer, "Regularization of Inverse Problems."

References to further scientific papers will be given in the lecture.

Responsible for Module:

Michael Möller, michael.moeller@in.tum.de

Courses (Form of Teaching, Weekly Hours per Semester) Lecturer:

For further information regarding the Module please click www.campus.tum.de or [here](#).