Math 5750-001 / 6880-001 Computational Inverse Problems

Spring semester 2011

T Th 2:00 - 3:20 pm LCB 215

Instructor: Prof. Elena Cherkaev
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Office hours: T 3:30 - 4:30 pm and by appointment
Course home page: www.math.utah.edu/∼elena/
Text: Computational Methods for Inverse Problems, Curtis Vogel, SIAM, 2002

Additional Reading: Geophysical Inverse Theory, R.L. Parker, 1994
Rank Deficient and Discrete Ill-posed Problems, P.C. Hansen, 1998
Statistical and Computational Inverse Problems, J. Kaipio and E. Somersalo, 2005
Inverse Problem Theory and Model Parameter Estimation, Albert Tarantola, 2005 (can be downloaded from author's website)
Parameter Estimation and Inverse Problems, R. Aster, B. Borchers, C. Thurber, 2005

Matlab codes can be downloaded from the authors' website:
http://www.math.montana.edu/∼vogel/
http://www2.imm.dtu.dk/∼pch/Regutools/

Exam: Final exam will be substituted by a final project.

Homework: Homework will be a combination of theoretical and computational assignments. You are encouraged to discuss homework problems with friends and make study groups, but each homework should be written individually. You can use any software of your choice for computational assignments.

Grading: The homework counts for 60% of the grade, the final project is 40%.

Course Outline: The course provides an introduction to methods of solution of ill-posed inverse and imaging problems, such as parameter estimation, signal processing, solution of integral equations, statistical inverse problems, ill-posed optimization problems, identification of coefficients of partial differential equations. Applications are numerous, we will discuss formulations and examples of inverse problems in medical and geophysical imaging, non-destructive testing and image processing, optical imaging and inverse scattering, ultrasound and X-ray computed tomography, optimal design, acoustic and seismic imaging, frequency and time-domain problems. The studied topics and techniques are de-convolution methods, ill-posedness, various regularization techniques, choice of regularization parameters, adjoint method, iterative methods for non-linear problems, non-convex optimization, statistical estimation, variational methods.
The course is addressed to senior undergraduate and graduate students in mathematics, science, and engineering.

Holidays: Martin Luther King Jr. Day: Monday, January 17;
Presidents' Day: Monday, February 21;
Spring break: March 21-26

ADA statement: The American with Disabilities Act requires that reasonable accommodations be provided for students with physical, sensory, cognitive, systemic, learning, and psychiatric disabilities. Please contact me at the beginning of the semester to discuss any such accommodations for the course.