SCPY 407/SCPY 670 - Inverse Theory and Applications

Instructor: Dr. Chaiwoot Boonyasiriwat

Course Home Page: http://mcsc.sc.mahidol.ac.th/courses/ita

Grading: Homework 40%, Project 30%, Midterm Exam 15%, Final Exam 15%

Course Outline

Inverse problems have many applications in science and engineering including medical imaging, optics, geophysical imaging, machine learning, non-destructive testing, signal and image processing. This course introduces the theory of inverse problems and numerical optimization. Examples of linear and nonlinear inverse problems are given as both in-class exercises and homework assignments. Student will learn both deterministic and stochastic optimization methods. Inverse problems are often ill posed and the process of solving an inverse problem is normally unstable. Regularization can stabilize the inversion process. Various regularization methods will also be introduced. In addition, the adjoint-state method will also presented for an efficient computation of the gradient and Hessian of the objective function.

References

- R. C. Aster, B. Borchers, and C. H. Thurber, Parameter Estimation and Inverse Problems, 3rd ed., Elsevier Academic Press, 2019.
- K. Du, and M. N. S. Swamy, Search and Optimization by Metaheuristics, Birhauser, 2016.
- W. Menke, Geophysical Data Analysis: Discrete Inverse Theory, 4th ed., Academic Press, 2018.
- J. Nocedal, and S. J. Wright, Numerical Optimization, Springer, 2006.
- A. Tarantola, Inverse Problems Theory and Methods for Model Parameter Estimation, SIAM, 2005.
- C. R. Vogel, Computational Methods for Inverse Problems, SIAM, 2002.
- M. S. Zhadanov, Inverse Theory and Applications in Geophysics, 2nd ed., Elsevier, 2015.