GEOP 5352: Geophysical Inverse Theory

Instructor: Julien Chaput, Geology 207, jachaput@utep.edu

Textbook: "Parameter Estimation and Inverse Problems", Aster, Borchers, Thurber

Overall Goals:
-Introduce Linear and Nonlinear Inverse Problems as developed through linear algebra.
-Learn basic coding structures and logic in Matlab
-Apply choice inverse methods and algorithms to problems revelent to student theses/dissertations

Skills:
-Learn various forms of data statistics, time series analysis, data set methods, and frame them in terms of inverse probems.
-Gain an understanding of broad inverse methods applicable to data sets from a range of earth science fields.

Structure:
Lecture material is sourced from several references, but is dominantly following the abve textbook. Material comprises of the mathematical background for coding assignments. Lectures are held mondays and wednesdays.

Course Outline:
The course is segmented into three broad themes: Scattered data and statistics, Time series data, and spatial data.

Least Squares Formulations to inverse problems:
- -Problem rank, ill-posed vs ill-conditioned
- -1-step LSQR inversions
- -Examples of continuous vs discrete problems

SVD implementations:
- -Solutions to rank deficient inverse problems
- -Minimum length regularization, data/model covariance structure, resolution matrix
- -Travel time tomography problems

Other forms of regularization:
- -Tikhonov of orders 0 through 2
- -Total Variation

Nonlinear Methods:
- -Gradient descent
- -MCMC
- -Levenberg-Marcquart equations

Projects:
Class projects will be oriented towards thesis/dissertation topics (for graduate students), and career aspirations (for undergraduate students). Emphasis will be put on producing short trial papers as class projects, and will form the majority of the grade.

Grading:

Homework assignments:	40 percent
Term projects:	60 percent

Students with Disabilities: If you think you may have a disability or if you are experiencing learning difficulties, please contact the Center for Accommodations and Support Services (CASS) at (915) 747-5148 (voice or TTY), in Union East Room 106, or by e-mail at cass@utep.edu. They will provide any necessary accommodations. You should also meet with me in order to facilitate your needs. You are expected to provide documentation of your disability in order to make special arrangements in this class.

Academic Honesty and other issues**:** The Geological Sciences Department has gone to great lengths in order to make learning the material easier than engaging in scholastic dishonesty, which is defined in the UTEP Student Handbook and also at http://sa.utep.edu/osccr/academic-integrity/. Proven violations of these detailed regulations may result in any of the consequences outlined in the Student Handbook. Cellular phones are to be turned off or placed in silent mode during class. Conducting telephone conversations or extensive text messaging during class time may result in disciplinary action.