This course explores solution methods for inverse problems with examples taken from geophysics and related fields. We will be concerned with making inferences from physical data which are inaccurate, incomplete, and/or inconsistent. We will begin by surveying a number of common inverse problems, classifying them according to the existence, uniqueness, and stability of their solutions. Emphasis will be placed on discrete problems, although means of discretizing continuous problems will be discussed.

Applications will include deconvolution, tomography, seismic profiling, image processing, and radio/radar imaging.

Topical Outline:

- Overview and classification of inverse problems in physical science
- Minimum length methods for discrete linear problems
- Discretizing continuous inverse problems (Backus and Gilbert method)
- Data and model resolution
- Generalized inverses and SVD
- Maximum likelihood (statistical) perspective
- Regularization
- Interactive methods
- Regularized iterative methods
- Bayesian statistics and maximum entropy
- Stochastic optimization methods

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