GPGN461/561 SEISMIC DATA PROCESSING

Course Description: (I) This course covers the basic processing steps required to create images of the earth using 2D and 3D reflection seismic data. Topics include data organization and domains, signal processing to enhance temporal and spatial resolution, identification and suppression of incoherent and coherent noise, velocity analysis, near-surface statics, datuming, normal- and dip-moveout corrections, common-midpoint stacking, principles and methods used for poststack and prestack time and depth imaging, migration velocity analysis and post-imaging enhancement techniques. Realistic synthetic examples and field data sets are extensively used throughout the course. A three-hour lab introduces the student to hands-on data processing using Seismic Unix software package. The final exam consists of processing a 2D seismic line with oral presentation of the results. Prerequisites: GPGN305 and GEOL308. Co-requisites: GPGN404. 3 hour lecture, 3 hour lab; 4 credit hours for undergraduates, 3 credit hours for graduate students.

Course Designation: Advanced Geophysics Elective.

Instructor or Coordinator: Ilya Tsvankin (lecture; ilya@mines.edu); John Stockwell (lab; john.19071969@gmail.com).

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Textbook and/or other requirement materials:

Required Text:

Illustrated Seismic Processing, Parts I and II, Hill & Ruger, 2016.

Other Required Supplemental Information:

*Geophysical Image Processing with Seismic Un*x, Stockwell, 2017.*

Specific Course Goals:

Instructional Outcomes:

At the conclusion of this course, students should be able to successfully perform the following:

1.) Demonstrate knowledge and understanding of basic seismic data processing steps.

2.) Process a 2D marine seismic line using Seismic Unix. Design a processing sequence, evaluate possible processing steps, and apply appropriate quality-control tests to guide the data

processing flow. This project should result in a properly imaged section that meets a specific processing goal.

Student Outcomes Addressed by Course:

a	b	c	d	e	f	g	h	I	j	k	1	2			
x	x					x				x		x			
Criterion 3											Program-specific outcomes				

Subject Area Classification: This course contributes 4 credit hours to Engineering Topics.

Brief List of Lecture Topics:

- Reflection seismic experiment
- Seismic data acquisition
- Time-to-depth conversion
- Zero-offset time migration
- Migration velocities and artifacts
- NMO correction and stacking
- f-k domain and spatial aliasing
- Multiples and their attenuation
- S/N improvements
- Statics corrections
- AGC, filtering, and coherence enhancement
- Amplitude analysis and corrections
- Temporal resolution
- Fresnel zone and spatial resolution
- Depth vs. time migration
- Reverse time migration
- Migration velocity analysis
- Reflection tomography
- Velocity analysis and migration in anisotropic media
- Basics of full-waveform inversion (FWI)
- Elements of multicomponent acquisition and processing

Brief List of Lab Topics:

- Introduction to Unix
- Introduction to Seismic Un*x
- Seismic data formats and trace headers

- Display gaining
- Trace gaining
- Radon transform
- Wavelet estimation
- Deconvolution: deterministic vs. statistical
- Velocity analysis: semblance and CV stack
- RMS vs. interval velocity
- Several types of poststack migration
- Velocity model building
- Prestack migration (optional)

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