COURSE SYLLABUS

GEO 6600/7600 (Topics): Signal Analysis

Fall 2017 Lecture: TR 1:00–2:20 GEOL 217a

Professor: Tony Lowry (Department of Geology)

- Geology Bldg Room 106 (Phone: 797-7096)
- Email: Tony.Lowry@usu.edu
- Office Hours: TR 10:00-12:00
- Course website: http://aconcagua.geol.usu.edu/%7Earlowry/Signal/index.html

COURSE DESCRIPTION

Most geophysical data consist of “signals” which are sequences of measurements sampled in time (“time series”) or in space. In this course we will examine, and learn techniques for analyzing, signals containing random elements and study their applications in Earth Science.

About the professor:

I am a geophysicist (“Physics of the Earth”) who focuses on measuring and understanding how and why planets deform. On Earth, this relates directly to processes of fault slip, earthquakes and volcanoes, but also has implications for mass transfer in the atmosphere, hydrosphere and cryosphere.

Course Text

There are no required texts for this course. However, recommended reference materials might include:

Allen, R.L., & Mills, D., 2004, Signal analysis: time, frequency, scale, and structure, Wiley.

Bendat, J.S., & Piersol, A.G., 1986, Random data, analysis and measurement procedures, Wiley.

Bendat, J.S., & Piersol, A.G., 1980, Engineering applications of correlation & spectral analysis, Wiley.

Brown, R.G., 1983, Introduction to random filtering analysis and Kalman filtering, Wiley.

Davis, J.C., 1986, Statistics and data analysis in geology, Wiley.

Haykin, S., Ed. 1979, Nonlinear methods of spectral analysis, Springer-Verlag.

Jenkins, G.M., & Watts, D.G., 1968, Spectral analysis and its applications, Holden Day.

Kay, S.M., 1988, Modern spectral estimation, Prentice-Hall.

Kesler, S.B., 1986, Modern spectral analysis II, IEEE Press.

Mohanty, N., 1987, Signal processing: Signals, filtering and detection, Van Nostrand Reinhold.

Otnes, R.K., & Enochson, L., 1978, Applied time series analysis, Wiley.

Papoulis, A., 1984, Probability, random variables, and stochastic processes, McGraw-Hill.

Papoulis, A., 1977, Signal analysis, McGraw-Hill.

Robinson, E.A., & Treitel, S., 1980, Geophysical signal analysis, Prentice-Hall.

Schwartz, M., & Shaw, L., 1975, Signal processing: Discrete spectral analysis, detection, and estimation, McGraw-Hill.

TOPICS

In this course I hope to cover these topics (and sample geoscience applications):

- Stochastic processes
- Linear systems with stochastic input
- Autocorrelation, cross-correlation and "interferometry"
- Transforms
- Wavelets
- Nonparametric spectral estimation
- Signal detection: matched filters
- Signal estimation: stacking
- Frequency response estimation for multiple-input systems
- Wiener filtering
- Predictive deconvolution
- Parametric spectral analysis
- State variables
- Kalman filtering
- Kriging
- Factor analysis
- Two-dimensional signal processing
- Simulation as an analysis tool

Dates that we will not have class include:

07-09 Sep	(Prof out of town)
05 Oct	(Prof in Boulder at UNAVCO)
19 Oct	(Fall Break: Friday schedule)
24-26 Oct	(Prof out of town)
25 Nov	(Thanksgiving break)
11-15 Dec	(Final Exam week)

Each of you is expected to come up with a course project, which you will present during the last week of class. This project must use signal analysis topics discussed in class to address signals or measurements that are a topic of your thesis or a topic of interest. If you are taking this as a graduate student, it should use actual data to develop new methodology or algorithms. A write-up of the project will be turned in along with the ppt of the final presentation. **Course Project Presentations** 13 Dec (1:30-3:20)

Grading:

Presentations & Exercises	30 pts
Semester Project	70 pts
Total	100 pts

Late Assignment Policy:

All assignments are due at the date & time specified; no late assignments will be accepted. If you are not finished, just hand in what you have. Note that, because all assignments can be submitted to me by email, I will not accept illness as an excuse for late assignments (unless the illness induces a coma).

Differences between the 6000 and 7000 level course:

Both 6000- and 7000-level students are expected to do a semester project for the course. Requirements for 6600 differ from those of 7600 in that the semester project, presumably related to their thesis efforts, should involve substantial quantities of data and/or significant theory/algorithm development. There will also be some additional exercises at 7000-level.

Key university policies that govern classroom behaviors, risk, etc., are found at http://catalog.usu.edu/portfolio_nopop.php?catoid=2&add=1&navoid=96#nav_links and http://catalog.usu.edu/content.php?catoid=4&navoid=546.

USU Academic Policies

- Academic Honesty
- Assumption of Risk
- E-mail Communication Policy
- Equal Opportunity Affirmative Action
- Notification of Rights Under Family Educational Rights and Privacy Act FERPA
- Student Right-to-Know and Campus Security Act
- Additional Policies