EAS 8803/4803: OBSERVATIONAL SEISMOLOGY

SPRING 2019

Time and Location: Tuesday/Thursday 1:30 pm – 2:45 am, ES & T, L1125

Instructor: Zhigang Peng, ES&T 2256, 404-894-0231, zpeng@gatech.edu

Office Hour: Tuesday/Thursday 2:45 pm – 3:30 pm (immediately after class)

General description: This is an advanced level course designed to involve students into seismological research. The topics covered include digital signal processing, seismometers and seismic networks, basic and advanced seismic data processing tools, travel time and synthetic seismogram calculations, earthquake location, magnitude, and microseismic analysis, etc. The class also includes a field trip to learn how to deploy seismometers in the field.

Prerequisite: Introduction to Geophysics or equivalent

Grading: 50% homework assignment; 20% paper reading and discussion; 15% term paper project; 15% Field Trip or Final exam.

Recommended Textbook:
S. Stein and M. Wysession (2003), An Introduction to Seismology, Earthquakes, and Earth Structure, Blackwell Publishing.
Zhou, H.-W. (2015), Practical Seismic Data Analysis, Cambridge University Press.
P. Shearer (2008), Introduction to Seismology, 2nd edition, Cambridge University Press.
T. Lay and T. C. Wallace (1995), Modern Global Seismology, Academic Press.
Additional material will be either handed out in class or made available on the course website.

Class website: http://geophysics.eas.gatech.edu/classes/ObsSeis

Course Outline:
1. Digital Signal Processing
    a. Fourier analysis
    b. Linear systems
    c. Discrete time series and transforms
2. Seismometers, Seismic Networks, and Data Centers
    a. Historical development and the Earth's background noise
    b. The damped harmonic oscillator
    c. Basic types of seismic sensors and digital recording devices
    d. Global and regional seismic networks and data management centers
    a. Instrument response removal
3. Observational Seismology
    b. Basic data processing tools
    c. Data request and management
    d. Waveform stacking, cross-correlation and deconvolution

    e. Polarization and array analysis
4. Theoretical and Computational Seismology
    a. Ray theory and travel time calculation
    b. Theoretical seismogram calculation
    c. Earthquake location and magnitude
    d. Travel-time tomography/Surface wave inversion
5. Current topics in observational and computational seismology (tentative)
    a. Seismic event detection
    b. Seismic interferometry
    c. Imaging earthquake ruptures
    d. Machine-learning in seismology

Homework assignment: There will be five homework problems, which will involve analysis of selected issues, including analytical calculations, computer simulations, or data analysis. The homework is designed for each student to work by him/herself. The homework will count as 50% of your overall course grade, with each counting 10%.

Paper reading and discussion: In the last four weeks we will discuss four topics of modern research in observational seismology. You are required to submit (electronically) a 2-page summary after each topic. Paper reading and discussion comprises 20% of total grade, with each counting 5%.

Term paper project: You are required to write a term paper with any topic related to this course. These can be literature reviews, or research projects involving calculations, data analysis, or theoretical results done in consultation with the instructor. The topic needed to be approved by the instructor before the spring break. Your paper should be written up in journal form with length (double space, 12-point fonts, minimum 12 pages), figures and referencing in a format suitable for submission to journals like Geophysical Research Letters (GRL). Preliminary version of the final paper should be shown to the instructor for approval at least two weeks beforehand. You will present your term paper in a 15 minute AGU-style talk; a 12 minute presentation with 3 minutes of questions. The project will count as 15% of your overall course grade, in which 10% will be based on the quality of the project, 5% on written and oral presentation.

Field trip/Final exam: We will organize a local field trip to learn how to deploy seismometers in the field. The time and location is to be determined, but will likely happen in mid-March. Those participating in the field trip are required to write a 5-page field report to document experience learned in the field. The field trip component will count as 15% of the overall grade, in which 5% will be based on the participation in the field trip, and 10% on the field report. Those who are unable to attend the field trip will be required to take a final exam, which covers all the topics (including those in paper discussions) for the entire semester.

Academic honesty: It is expected that all students are aware of their individual responsibilities under the Georgia Tech Academic Honor Code, which will be strictly adhered to in this class. The complete text of the Georgia Tech Academic Honor Code is at http://www.honor.gatech.edu/.