GEOS F493 / GEOS F693
Geodetic Methods and Modeling
Fall 2019, 3 credits
Lecture: M 13:00-15:00 AKDT, room: Murie 130, zoom: `https://alaska.zoom.us/j/876225953`
Lab: W 12:00-15:00 AKDT, room: WRRB 004, zoom: `https://alaska.zoom.us/j/635359023`
Syllabus v.1.0

Instructor: Dr. Ronni Grapenthin
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Office Hours: by appointment, W 3-5PM AKDT on zoom: `https://alaska.zoom.us/j/399930716`
Course Website: `http://grapenthin.org/teaching/geodesy`

Course Description: Theory and application of modern geodetic tools to measure Earth's surface deformation with emphasis on GPS and InSAR. Basics of data processing. Evaluation of signals and modeling of their sources. Applications range from magma system characterization and analysis of slip during an earthquake to interseismic strain analysis and evaluation of changes in the hydrosphere such as glacial melt, seasonal precipitation effects and ground water level monitoring.

Course Type: in-person, online synchronous, includes lab.

Important Note: Since this is an online course, we will use video streams that will be captured. These will be available for repeat streaming to course participants only. I do not intend to publish these more widely via any channel of the Internet. If this poses an issue to you, please contact me so we can find a solution.

Pre-requisites: Linear Algebra (e.g., MATH 314), some programming experience (e.g., GEOS F436), or consent of instructor.

Class Website: Assignments and supplementary material will be posted on the class website `http://grapenthin.org/teaching/geop555/`. Grades will be posted to canvas.

Required Text: No textbook required, but required readings will be posted on the class website.

Tentative Schedule: (subject to modification)

Week 1	August 26	Lecture 1	Introduction, logistics, Examples, Applications
	August 28	LAB 1	Getting accounts set up (geodesy lab), M/P intro, explanation of provided term projects
Week 2	September 02	*Labor Day, no class*	
	September 04	LAB 2	Coordinate Conversions

Week 3	September 09	Lecture 2	GPS: Basics
	September 11	LAB 3	Pseudorange Position Estimation
Week 4	September 16	Lecture 3	Linear Algebra review, GPS: Position Estimation, Carrier Phase, Ambiguities, Error Treatment
	September 18	LAB 4	GIPSYx: Static Positioning
Week 5	September 23	Lecture 4	GPS: Kinematic and Esoteric (SNR, phase delay)
	September 25	LAB 5	GIPSYx: Static Positioning 2
Week 6	September 30	5-minute pitches	Pitch your project idea to the class
	September 30	Lecture 5	InSAR: Overview, Interferometry, Topography
	October 02	LAB 6	Kinematic GPS – Gorkha earthquake
Week 7	October 07	Lecture 6	InSAR: phase unwrapping, Timeseries, Error Treatment (video or remote, Grapenthin out)
	October 09	LAB 7	gmtSAR Intro (video or remote, Grapenthin out)
Week 8	October 14	Lecture 7	Tilt
	October 16	LAB 8	gmtSAR time series, getting SAR data
Week 9	October 21	Lecture 8	Parameter Estimation & Regularization
	October 23	LAB 9	gmtSAR time series II
Week 10	October 28	Lecture 9	Strain
	October 30	LAB 10	Tilt Analysis
Week 11	November 04	Lecture 10	Plate kinematics (video or remote, Grapenthin out)
	November 06	LAB 11	Fitting Time Series (video or remote, Grapenthin out)
Week 12	November 11	Lecture 11	Applications I: Earthquakes
	November 13	LAB 12	Slip on a Fault
	November 15	*5 PM, Term paper draft due*	
Week 13	November 18	Lecture 12	Applications II: Volcanoes
	November 20	LAB 13	Pressure Source Modeling
Week 14	November 25	Lecture 13	Applications III: GIA, Surface Loading
	November 27	*Thanksgiving next day, work on class project*	
Week 15	December 02	Lecture 14	Applications IV: Reflectometry
	December 04	LAB 15	Estimate Snow Depth (Rinex2SNR)
	December 06	*5 PM, Term paper due, lab 15 due*	
Week 16	December 9–14	*no class, finals week*	

Instructional Methods: The course will be composed of 2 hours of lecture and 3 hours of lab each week. Lectures will be interactive, e.g., including group data set analyses and paper discussions.

The labs will revolve around processing of various geodetic data sets with modern methods, as well as modeling of observed deformation. Lectures and labs will be online synchronous for distance delivery. A term project will allow students to apply the learned material to a self-selected problem they are invested in.

Evaluation: There will be approx. 6 homework assignments roughly every two to three weeks throughout the semester. Many of these assignments will require you to write code and produce computational results using MATLAB or Python (preferred). This software is available in the computer labs across campus or you may purchase a student copy of MATLAB (Python is free).

You will participate in weekly lab assignments. A lab report will be due at the beginning of the following lab period (except for the last lab, which will be due at the end of the week).

Graduate students will prepare and present a term project in the form of an expository term paper of roughly 10-12 pages. The topic of this project should be related to the course content and objectives and should involve some data processing, modeling and interpretation. You might apply techniques from the course to process, analyze and interpret data that you have gathered in your research, or you might choose one of the provided projects. If you choose thesis related work, it must be a new aspect; recycling of existing work is not permitted. Your topic must be approved by the instructor before you begin to work on it. After about 2/3 of the semester the term paper is due. This version is graded on completeness, not correctness.

Grading:

Undergraduate Students: Homework: 25%, Labs: 75%.
Graduate Students: Homework: 15%, Labs: 45%, Term Project 40%.

Grades will be assigned for each lab and homework assignment based upon assignment completeness and accuracy in the form of absolute scores. Final grade is average of individual exercise grades, weighted as specified above. Unless otherwise noted, assignments will be due one week after they are assigned they must be submitted prior to the beginning of subsequent lab period. Assignments are due electronically. **Assignments will not be accepted late.** There are no exams in this class.

I follow the University of Alaska Fairbanks Incomplete Grade Policy, which states that the letter "I" (Incomplete) is a temporary grade used to indicate that the student has satisfactorily completed (C or better) the majority of work in a course but for personal reasons beyond the students control, such as sickness, has not been able to complete the course during the regular semester. Negligence or indifference are not acceptable reasons for an "I" grade.

Term Project Ideas: If you cannot come up with a suitable project of your own, I have a few that would benefit from someone working on them. Get in touch with me.

Course Learning Outcomes: By the end of this course, students will have a working understanding of the geodesy and a set of modern geodetic tools. Students will be able to process basic GPS, InSAR, and tilt data and thus create observations of Earth processes. The students will have an understanding of common error sources that affect geodetic data. A rich set of applications and examples gives the students the mathematical tools to model some processes of this dynamic Earth; such as magma volume changes, earthquake slip and hydrological loading. The term project will allow the students to apply the material learned in the class to one problem in depth. Students will be able to critically evaluate work on geodetic problems presented in the research literature and be able to use geodetic methods in their own research.

Student Protections and services Statement: Every qualified student is welcome in my classroom. As needed, I am happy to work with you, disability services, veterans' services, rural student services, etc. to find reasonable accommodations. Students at this university are protected against sexual harassment and discrimination (Title IX), and minors have additional protections. For more information on your rights as a student and the resources available to you to resolve problems, please go the following site:

`https://www.uaf.edu/handbook`

Academic Honesty: This course will follow and enforce UAF's Center for Student Rights and Responsibilities Academic Misconduct Policy:

`https://uaf.edu/csrr/student-conduct/academic-misconduct.php`

You are responsible for knowing, understanding, and following this policy.

Technology Requirements: Access the internet, create pdfs, play video/audio.

Effective Communication: Students who have difficulties with oral presentations and/or writing are strongly encouraged to get help from the UAF Department of Communications Speaking Center (907-474-5470, speak@uaf.edu) and the UAF Englishs Departments Writing Center (907-474-5314, Gruening 8th floor), and/or CTCs Learning Center (604 Barnette st, 907-455- 2860).

Cell phones: Cell phones will be set on vibrate to accommodate potential emergencies.