Course Syllabus of
InSAR and Its Applications
GEOS F639 Fall 2006

First Class Meeting
4:00 PM at 601B Elvey (GI Board Room)
August 31, 2006 (Thursday)

For those who can not attend, please call
Rudi Gens (7621)
Shusun Li (7676)
Craig Lingle (7679)

Lecture: Twice a week with one hour per lecture
Lab: 2-3 hours each week at WRRB 004

COURSE RATIONALE AND OBJECTIVES

Repeat-pass spaceborne SAR interferometry (InSAR) provides a means for measuring displacements of the solid earth, glaciers, ice sheets, and fast sea ice to a precision of fractions of a radar wavelength (a few centimeters) during the time intervals between observations. This technique uses 30 m nominal resolution synthetic aperture radar (SAR) imagery such as that downloaded by the Alaska SAR Facility on the UAF campus. Since the launch of the First European Remote Sensing satellite (ERS-1) in 1991, this rapidly-evolving technology has been employed to measure, for instance, earthquake deformations; the motion of glaciers and ice sheets in Alaska, Greenland, Antarctica and elsewhere; the retreat of the grounding line of a major West Antarctic ice stream; deflation of a European volcano following an eruption; and crustal stretching around potentially-active volcanic vents in SW Alaska. In addition, InSAR can be used to derive accurate digital elevation models (DEMs) of the earth's surface.

COURSE FORMAT

The course will consist of 2-hour lecture and 2-3-hour laboratory every week. The lecture section is aimed at presenting the concepts of SAR, InSAR, and SAR processing, the basics of interactions between microwaves and surface materials, the principles and theory of InSAR with applications. The lab will involve hands-on experience with use of the InSAR software to derive displacements of the solid earth, glaciers, and ice sheets to a precision of a few centimeters and accurate digital elevation models of the earth's surface.

Students are expected to attend all lectures and labs.

PREREQUISITE

Basic remote sensing course (e.g., GEOS 422 - Geoscience Applications of Remote Sensing, or equivalent), or permission from instructor.

GRADING

Term project: 50 % of final grade
Oral presentation of final results: 20%
Final report: 30%
(10-15 pages double-spaced, excl. figures and tables)
Labs and Lab reports: 30% % of final grade
Quiz: 10%
Homework assignment: 10% of final grade

ACADEMIC INTEGRITY

Each student in this course is expected to abide by the UAF Student Code of Conduct. Any work submitted by a student in this course for academic credit will be the student's own work.

Students are encouraged to discuss information and concepts covered in lectures and the lab sections with other students. Students can give "consulting" help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an e-mail, an e-mail attachment file, a diskette, or a hard copy.

Should copying occur (term project, lab reports and quiz), both the students involved will be penalized for violation of this code of conduct and may fail the course.

ACCOMODATION FOR STUDENTS WITH DISABILITIES

Students who anticipate needing accommodations should contact as early as possible, ideally before the beginning of classes, the coordinator of Disability Services at (907)474-7043.

TENTATIVE LECTURE SCHEDULE

Week	Lecture		Lab
1	Class Meeting		
2	Introduction to SAR (CL)		ASF Tour, Ordering data, corner reflector (RG/ASF)
2	Basics of SAR, and radar backscatter (CL)		
3	Polarization and Radar Interaction with Surface Materials (SL)		Introductory UNIX . Basics of Image Display (RG/ASF)
3	SAR Processing (JN)		
4	Map Projection (RG)		SAR Processing (RG/ASF)
4	Geocoding and Terrain Correction (RG)		
5	Introduction to InSAR (SL)		Geocoding and Terrain Correction (RG)
5	Data Selection (SL)		
6	Limiting Factors of InSAR (RG)		InSAR Processing Setup (RG)
6	InSAR Processing – General Processing (RG)		
7	Interferogram Generation and Coherence estimation (SL)		IPS products and Intermediate products - amplitude, phase, and coherence, color representation (RG)
7	Differential Interferometry (SL)		
8	Phase Unwrapping (RG)		Co-registration (RG/ASF)
8	DEM Generation (RG)		
9	Baseline and InSAR (SL)		Phase Unwrapping and DEM Generation (ASF/RG)
9	Baseline Refinement (SL)		
10	Deformation extraction and analysis (SL)		Baseline and InSAR/ Baseline Refinement (SL)
10	Volcano Applications (RG)		
11	Earthquake Applications (RG)		Deformation extraction /analysis (SL)
11	Motion Detection via Cross-Correlation (CL)		
12	Glacier Applications (CL)		Project
12	Sea Ice, River Ice, and Snow Applications (SL)		

13	**Forest, Land Cover and Land Use Application (SL)**		**Project**
13	**Thanksgiving Holiday**		
14	**Atmospheric Effects (SL)**		**Project**
14	**Future Directions (CL)**		
15	**Preparation for presentation**		**Project**
15	**Presentations and Discussion**		
16	**Final Week**		
16	**Final Week**		

REFERENCES

Books/journal publications:

Reference

Hanssen, Ramon, F., 2001. Radar Interferometry, Data Interpretation and Error Analysis, Kluwer Academic Publishers, Dordrecht, 308p.

Henderson, F.M., and A.J. Lewis, ed., 1998. Principles & Applications of Imaging Radar, Manuals of Remote Sensing, 3rd Edition, Vol. 2., John Wiley & Sons, Inc., New York, 866p.

Massonnet, D., and K.L. Feigl. 1998. Radar Interferometry and Its Application to Changes in the Earth's Surface, *Reviews of Geophysics*, **36**(4), 441-500.

Peltzer, G., K. W. Hudnut, and K. L. Feigl, 1994. Analysis of Coseismic Surface Displacement Gradients Using Radar Interferometry: New Insights into the Landers Earthhquake, Journal of Geophysical Research, 99 (B11), 21971-21981.

Woodhouse, Iain, H., 2006. Introduction to Microwave Remote Sensing, Taylor & Francis, Boca Raton, 370p.

Zebker, H. A., and J. Villasenor. 1992. Decorrelation in Interferometric Radar Echoes, *IEEE Trans. Geosci. Remote Sens.,* **30**, 950-959.

Zebker, H.A., C.L. Werner, P.A. Rosen, and S. Hensley. 1994. Accuracy of Topographic Maps Derived from ERS-1 Interferometric Radar, *IEEE Trans. Geosci. Remote Sens.*, **32**, 823-836.

Resources on the web:

http://www.stanford.edu/group/radar/