SUR 6538 - Principles and Applications of Radar Interferometry

1. Course Description
A comprehensive overview of radar interferometry in remote sensing and geosciences, principles of radar interferometry, advanced techniques and applications of Interferometric Synthetic Aperture Radar (InSAR). Topics covered include radar imaging, interferometric phase measurement, phase unwrapping, coherence estimation, error analysis, and InSAR applications to natural hazards. Hands-on experience with processing InSAR data using software tools like ISCE, Mintpy, and SNAP.

- Fall semester 2024, 3 credits.
- In-person for the Gainesville campus, synchronous lectures through Zoom for remote students (https://ufl.zoom.us/my/chunli).
- http://elearning.ufl.edu/

Prior coursework in Geodesy such as **SUR 4530** or equivalent is recommended.

Instructor:
Dr. Chunli Dai, 406B Reed Lab, Gainesville, FL.
Email: chunlidai@ufl.edu

Teaching assistant:
None.

- Please use the Canvas message/Inbox feature for the fastest response.
- Students are also welcome to arrange a video conference meeting to go over any questions.

Time and location:
Lectures:
Monday, 9:35 – 11:30am (Periods 3 and 4) - Reed Lab 302
Tuesday, 9:35 – 10:25am (Period 3) - Reed Lab 302

First day of class: August 26, 2024. Last day of class: December 3, 2024.

Office hours: Thursdays, 10:30 AM to 11:30 AM. Other times by appointment.

Exam dates: (Honorlock)
Mid-term exam: Tuesday, October 8, 2024, 9:35 am to 11:35 AM
Final presentation: Tuesday, December 3, 2024, 9:35 am to 11:35 AM.

Textbooks and materials (purchase not required):

- Hanssen, R.F., 2001. Radar interferometry: data interpretation and error analysis (Vol. 2). Springer Science & Business Media. Free download at: https://repository.tudelft.nl/islandora/object/uuid%3Aa83859d5-c034-427e-b6a9-114c4b008d19
- ESI InSAR guidelines: https://www.esa.int/About_Us/ESA_Publications/InSAR_Principles_Guidelines_for_SAR_Interferometry_Processing_and_Interpretation_br_ESA_TM-19

2. LEARNING OUTCOMES

The course objective is to provide the students with competencies to apply InSAR for monitoring Earth surface dynamics. At the completion of the course, the student should be able to:

- apply the fundamental principles of radar interferometry.
- handle and analyze large datasets from satellite radar sensors.
- use InSAR data processing using software tools such as ISCE, Mintpy, and SNAP.
- interpret interferometric phase measurements and identify phase unwrapping techniques.
- explain coherence estimation and its significance in data quality assessment.
- conduct error analysis to identify and mitigate sources of error in InSAR data.
- conduct independent research for various geoscience applications using InSAR.
- communicate the interpretation of computational results to professional standards.

3. COURSE LOGISTICS

- For each graded item (assignment, quiz, discussion post) a due date and time is given, which is usually the beginning of the next class.
- Assignments are graded based on timeliness, correctness of computations and interpretation of numerical results; quizzes are graded based on correctness of multiple-choice questions, and discussion items are graded based on creativity, completeness, and technical correctness.
- There is a 1-week turnaround for assignment and discussion grading. Quizzes are auto-graded instantaneously in Canvas.
- Lecture materials can be downloaded from weekly modules on the Canvas website.

The Canvas system should be used as the primary platform for written communication between students and the instructor. Questions and suggestions to the whole class can also be posted under the Discussions tab. Any short-term changes concerning lectures or other course components will be announced through Canvas. Feel free to call the instructors with any questions.

Technology Requirements:

- A computer with a high-speed internet connection and a supported browser (Google Chrome) for the online exams through Honorlock.
- For remote students: headset and microphone.
- For Zoom: A supported web browser on a supported operating system (Windows, Mac OS, Linux); and minimum bandwidth.

Using Zoom:
Live lectures and office hour meetings (per individual student requests) will be conducted with the Zoom conferencing software. Sessions can be joined by clicking a link posted by the instructor on Canvas.
Synchronous online sessions will be recorded. By sharing your video, screen, or audio during any synchronous online class sessions, you are consenting to be recorded for the benefit of students who cannot attend live as well as for class review during the current semester. If you have special circumstances or concerns about privacy, it is your responsibility to discuss them with your instructor.

4. GRADES AND GRADING SCALE

Item	Percentage
Timeliness and quality of assignments (3 assignments and 2 quizzes @ 8% each)	40%
Online discussions (2 discussions @3% each)	6%
Attendance (Gainesville students required in person; Online students in real-time)	10%
Mid-term exam	22%
Final presentation	22%
Total	100%

Assignments: Written reports will describe the results of running ISCE/Mintpy applications on Hipergator notebook.
Quizzes: Online assessments of students' understanding of lectures through multiple choice questions.
Online discussions: Self introduction and your interests about InSAR.
Mid-term exam: Online assessments of students' understanding of concepts in lectures through multiple choice questions.
Final Presentation: Oral presentation of your project for a selected case study using tools learned in the course.

Final grading follows University standards based on the following scale (https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx):

Letter Grade	**A**	**A-**	**B+**	**B**	**B-**	**C+**	**C**	**C-**	**D+**	**D**	**D-**	**E**
Course Score	93.0-100	90.0-92.99	87.0-89.99	83.0-86.99	80.0-82.99	77.0-79.99	73.0-76.99	70.0-72.99	67.0-69.99	63.0-66.99	60.0-62.99	0-59.99
Grade Points	4	3.67	3.33	3.0	2.67	2.33	2.0	1.67	1.33	1.0	0.67	0

5. COURSE SCHEDULE

Week	Topic	Readings	Assignments
Week 1	Introduction and case studies of InSAR	Chapter 1	Introductions Register in NASA EarthData
Week 2	ISCE & MintPy Processing I	Chapter 2.5	Assignment 1
Week 3	ISCE & MintPy Processing II	Chapter 2.5	Assignment 2
Week 4	SAR imaging and geometry I	Chapter 2.1, 2.2	Quiz 1
Week 5	SAR imaging and geometry II	Chapter 2.3	
Week 6	InSAR basics	Chapter 2.4	
Week 7	InSAR error sources Midterm (Oct 8)	Online resources	Mid-term
Week 8	Fundament InSAR equations	Chapter 3.1	
Week 9	Phase unwrapping	Online resources	
Week 10	Artifacts in interferograms	Chapter 3.2, 3.4, 6	Assignment 3
Week 11	Multi-interferogram processing	Online resources	
Week 12	DEM generation from multi-interferogram processing	Online resources	Project
Week 13	Atmospheric monitoring	Chapter 6	Quiz 2
Week 14	Thanksgiving Holiday		
Week 15	Guest lecture: applications of SAR images (Dec 2) Final presentations (Dec 3)		Project presentations

6. POLICIES AND REQUIREMENTS

This syllabus represents the current plans and objectives for this course. As the semester progresses, changes may need to be made to accommodate timing, and logistics, or to enhance learning.

Guidelines for preparing homework assignments:

a) You may work together and discuss the assignments, but you must prepare your own report, which includes your own discussions, your own derivations of equations, and your own graphical illustrations.
b) The lab report must be type-written. Good English needs to be practiced.
c) Label and define everything. Symbols that you use in your text must be properly defined. Axes in plots need to be properly labeled. Units must be denoted for all numerical values, including plotted values.
d) Graphical illustrations (plots) need to be legible. Spend time to make your plots meaningful and informative. Use appropriate ranges on the abscissa and ordinate axes to show the important parts of what should be plotted.

Late submissions and make-up requests:
It is the responsibility of the student to access online materials (lectures, readings, quizzes, assignments, discussions, exams) to maintain satisfactory progress in the course.

- A **10% penalty** will be applied to unexcused late assignments.
- Assignments will not be accepted if handed in more than **seven days** after the due date.
- Exams can only be taken during the designated times.
- Exceptions to the late policy are only allowed per university policy.
- Any late submission due to technical issues Must be accompanied by the ticket number received from the Helpdesk when the problem was reported to them. The ticket number should document the time and date of the problem. You must email your instructor within 24 hours of the technical difficulty if you request consideration.

For computer, software compatibility, or access problems call the HELP DESK phone number—352-392-HELP = 352- 392-4357.

Requirements for class **attendance** and make-up exams, assignments and other work are consistent with university policies that can be found at:
https://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/

Academic Policies and Helping Resources

Academic policies for this course are consistent with university policies. See
https://syllabus.ufl.edu/syllabus-policy/uf-syllabus-policy-links/

Campus Health and Wellness Resources

Visit https://one.uf.edu/whole-gator/topics for resources that are designed to help you thrive physically, mentally, and emotionally at UF.
Please contact UMatterWeCare for additional and immediate support.

Software Use

All faculty, staff and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

Privacy and Accessibility Policies / Data Privacy / E-Learning Course Technologies:

UF Resources: **Privacy** | **Accessibility**
Microsoft **Privacy** | **Accessibility**
Zoom **Privacy Statement** | **Accessibility**
Mediasite **Privacy Statement** | **Accessibility.**
Instructure (Canvas) **Privacy Statement** | **Accessibility**
Honorlock **Privacy Statement** | **Accessibility**
YouTube: **Privacy**