

CGN 6905: Special Problems
Nondestructive Testing and Geophysical Methods
Class Periods: Tuesday and Thursday| Periods 8&9 (3:00 – 4:15 PM)
Location: Tuesday: WEIM 1094 and Thursday: MCCA 2196
Academic Term: Fall 2023

Instructor:

Dr. Khiem Tran

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Office Hours: Tue and Thu: 1:55-2:45 PM or appointment.

Course Description

Covers nondestructive and geophysical methods, and their engineering related applications. It includes (i) the principles of elastic waves and associated computational method (e.g., finite difference); (ii) the fundamentals on inverse theory and signal processing; (iii) inversion methods (e.g., global and deterministic optimizations); and (iv) real-world applications. The applications include geotechnical site characterization (soil/rock and sinkhole) and evaluation of concrete structural components (bridge deck/slab).

Course Pre-Requisites / Co-Requisites

Understanding of fundamentals of soil mechanics and geotechnical engineering.

Course Objectives

Students will be able to understand the principles of elastic waves and inversion methods, deploy test equipment and collect seismic/ultrasonic data for geotechnical/structural applications, perform analyses of collected data and interpret test results. They will be able to assess advantages and limitations of seismic/ultrasonic methods commonly used for material imaging in civil engineering.

Required Textbooks and Software

- Title: Surface Wave Methods for Near-Surface Site Characterization
- Authors: Sebastiano Foti, Carlo G. Lai, Glenn J. Rix, and Claudio Strobbia,
- Publication date: March 29, 2017, and edition: 01
- ISBN number: 9781138077737

Software licenses will be provided for SurfSeis, SeisImager, and Full-waveform tomography.

Course Schedule

Week 1: Introduction to NDT and Geophysical methods; Seismic wave propagation

Week 2: Surface wave methods; Spectral Analysis of Surface Waves (SASW); Multi-channel Analysis of Surface Waves (MASW)

Week 3: Transducers and Data Acquisition; Field seismic experiment (*Newberry test site*)

Week 4: MASW data processing and inversion, MASW Surfseis software

Week 5: Refraction Tomography: Overview, principles, and schematic; Horizontal/dipping layers

Week 6: Refraction tomography: Travel time picking and inversion, 2D-SeisImager software

Week 7: Elastic waves: 2D and 3D Waveform propagation and modeling; **Exam I**

Week 8: Full Waveform Tomography: Deterministic inversion; 2D FWI GUI software

Week 9: Ambient noise tomography, Electrical Resistivity: Principles, Schematic, and Inversion

Week 10: Electrical Resistivity: field experiment and data processing (*Newberry test site*)

Week 11: Review of NDT Methods; Impact-Echo method; Ultrasonic surface-wave method

Week 12: Ground penetrating radar (GPR): principles and data processing

Week 13: 2D Ultrasonic body-wave methods; NDT experiment with ultrasonic MIRA system on bridge deck (*structure lab*)

Week 14: Synthetic Aperture Focusing Technique (SAFT): Overview, Principles, Schematics, Software

Week 15: Ultrasonic SH-waveform tomography, Project presentation (Final Project due)

Evaluation of Grades

Assignment	Total Points	Percentage of Final Grade
Homework sets (5)	20 each	40%
Exam I	100	30%
Final Project	100	20%
Project Presentation	100	10%
		100%

Final Project

A four-week long project will be assigned to students on geotechnical subsurface investigation using seismic testing. In-situ seismic experiments will be conducted at a test site near UF campus. Students will participate in all steps of the experiments including equipment deployment (geophones, signal analyzer), wave excitation (drop-weight), and data acquisition and analysis. Students will analyze collected data by three seismic software packages including Multi-channel Analysis of Surface Waves (MASW), Refraction tomography (SeisImager2D), and full-waveform tomography (FWT). Results will be compared to assess advantages and limitations of these seismic methods. A project report and presentation are required for each student.

Grading Policy

Percent	Grade	Grade Points
90.0 - 100.0	A	4.00
87.0 - 89.9	A-	3.67
84.0 - 86.9	B+	3.33
81.0 - 83.9	B	3.00
78.0 - 80.9	B-	2.67
75.0 - 79.9	C+	2.33
72.0 - 74.9	C	2.00
69.0 - 71.9	C-	1.67
66.0 - 68.9	D+	1.33
63.0 - 65.9	D	1.00
60.0 - 62.9	D-	0.67
0 - 59.9	E	0.00

More information on UF grading policy may be found at:

[UF Graduate Catalog](#)
[Grades and Grading Policies](#)

Students Requiring Accommodations

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting <https://disability.ufl.edu/students/get-started/>. It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Course Evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at <https://gatorevals.aa.ufl.edu/students/>. Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via <https://ufl.bluera.com/ufl/>. Summaries of course evaluation results are available to students at <https://gatorevals.aa.ufl.edu/public-results/>.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A “class lecture” is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To “publish” means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.

University Honesty Policy

UF students are bound by The Honor Pledge which states, “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: “On my honor, I have neither given nor received unauthorized aid in doing this assignment.” The Honor Code (<https://sccr.dso.ufl.edu/process/student-conduct-code/>) specifies a number of behaviors that are in violation of this code and the possible sanctions. Furthermore, you are obligated to report any condition that facilitates academic misconduct to appropriate personnel. If you have any questions or concerns, please consult with the instructor or TAs in this class.

Commitment to a Safe and Inclusive Learning Environment

The Herbert Wertheim College of Engineering values broad diversity within our community and is committed to individual and group empowerment, inclusion, and the elimination of discrimination. It is expected that every person in this class will treat one another with dignity and respect regardless of gender, sexuality, disability, age, socioeconomic status, ethnicity, race, and culture.

If you feel like your performance in class is being impacted by discrimination or harassment of any kind, please contact your instructor or any of the following:

- Your academic advisor or Graduate Program Coordinator
- Jennifer Nappo, Director of Human Resources, 352-392-0904, jpennacc@ufl.edu
- Curtis Taylor, Associate Dean of Student Affairs, 352-392-2177, taylor@eng.ufl.edu
- Toshikazu Nishida, Associate Dean of Academic Affairs, 352-392-0943, nishida@eng.ufl.edu

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. We, the members of the University of Florida community, pledge to uphold ourselves and our peers to the highest standards of honesty and integrity.

Student Privacy

There are federal laws protecting your privacy with regards to grades earned in courses and on individual assignments. For more information, please see: <https://registrar.ufl.edu/ferpa.html>

Campus Resources:

Health and Wellness

U Matter, We Care:

Your well-being is important to the University of Florida. The U Matter, We Care initiative is committed to creating a culture of care on our campus by encouraging members of our community to look out for one another and to reach out for help if a member of our community is in need. If you or a friend is in distress, please contact umatter@ufl.edu so that the U Matter, We Care Team can reach out to the student in distress. A nighttime and weekend crisis counselor is available by phone at 352-392-1575. The U Matter, We Care Team can help connect students to the many other helping resources available including, but not limited to, Victim Advocates, Housing staff, and the Counseling and Wellness Center. Please remember that asking for help is a sign of strength. In case of emergency, call 9-1-1.

Counseling and Wellness Center: <https://counseling.ufl.edu>, and 392-1575; and the University Police Department: 392-1111 or 9-1-1 for emergencies.

Sexual Discrimination, Harassment, Assault, or Violence

If you or a friend has been subjected to sexual discrimination, sexual harassment, sexual assault, or violence contact the **Office of Title IX Compliance**, located at Yon Hall Room 427, 1908 Stadium Road, (352) 273-1094, title-ix@ufl.edu

Sexual Assault Recovery Services (SARS)

Student Health Care Center, 392-1161.

University Police Department at 392-1111 (or 9-1-1 for emergencies), or <http://www.police.ufl.edu/>.

Academic Resources

E-learning technical support, 352-392-4357 (select option 2) or e-mail to Learning-support@ufl.edu.
<https://lss.at.ufl.edu/help.shtml>.

Career Connections Center, Reitz Union, 392-1601. Career assistance and counseling; <https://career.ufl.edu>.

Library Support, <http://cms.uflib.ufl.edu/ask>. Various ways to receive assistance with respect to using the libraries or finding resources.

Teaching Center, Broward Hall, 392-2010 or 392-6420. General study skills and tutoring.
<https://teachingcenter.ufl.edu/>.

Writing Studio, 302 Tigert Hall, 846-1138. Help brainstorming, formatting, and writing papers.
<https://writing.ufl.edu/writing-studio/>.

Student Complaints Campus: <https://sccr.dso.ufl.edu/policies/student-honor-code-student-conduct-code/>;<https://care.dso.ufl.edu>.

On-Line Students Complaints: <https://distance.ufl.edu/state-authorization-status/#student-complaint>.