ASEN 6092 GNSS For Remote Sensing

Spring 2025
Instructors: Jade Morton

Office: Class Time: MW 10-11:15AM
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Overview:
This course covers technologies that rely on GNSS signals for remote sensing applications. GNSS receiver signal processing techniques and GNSS signal propagation effects due to interactions with ionosphere, atmosphere, and Earth surface are addressed. Students will learn techniques to process GNSS measurements and to infer ionosphere, atmosphere, and Earth surface properties from real GNSS measurements collected at ground monitoring stations and on LEO satellites. Guest lecturers will be invited to give lectures on relevant topics throughout the semester.

Prerequisites & Eligibility
ASEN 5090 Introduction to GNSS or instructor permission.

Required Textbook:
There is no required textbook for this course. Reading materials will be provided during the semester.

Subject Outline
1. Review of GNSS signals, measurement models, error sources, receiver basics (2 week)
2. GNSS receiver signal tracking: closed loop (2 weeks)
3. GNSS receiver signal tracking: open loop (2 weeks)
4. Tropospheric effects, models, and measurements (2 week)
5. Ionospheric effects, models, and measurements (2 weeks)
6. GNSS radio occultation (2 week)
7. GNSS reflectometry (2 weeks)
8. Other relevant topics (1 week)

Assignments
There will be 8 assignments, each is associated with one of the above topics. Students can form 2 person teams. Students are encouraged to switch partners from one assignment to another to learn how to work with others who have different background, interest, and skills. All assignments involve software/algorithm development. Deliverables are well-documented and well-organized reports. The software can be developed in Matlab or Python. The report should include information on data sources, flow charts, and plots showing sample results. Reports are graded based on technical merits of the methodologies, results, and material presentation clarity.

Final Exam
We do not have a written final exam. Instead, the last project will serve as a final project and students will present their project results/findings to the class.

Grading Policy
Grades on individual assignments. Each assignment is worth 12-15 points. For the overall course, grades are set based on the following criteria:

A:	Demonstrates superior understanding of the material beyond the course requirements, excellent technical work.
A-/B+:	Demonstrates comprehensive understanding of the material, strong technical work.
B/B-:	Demonstrates adequate understanding of the material, complete technical work.
C:	Demonstrates barely adequate understanding of the material and minimally sufficient technical work
D:	Poor technical work
F:	Unsatisfactory performance

Grade Calculation

Each project report is worth 12 points while the last project presentation worth 4 points.

Project reports (8 reports, 12 pts each)	96
Final presentation	4
Total	100

University Policy for Spring 2025

Honor Code
All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the Honor Code may include but are not limited to: plagiarism (including use of paper writing services or technology [such as essay bots]), cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. Understanding the course's syllabus is a vital part in adhering to the Honor Code.

All incidents of academic misconduct will be reported to Student Conduct & Conflict Resolution: StudentConduct@colorado.edu. Students found responsible for violating the Honor Code will be assigned resolution outcomes from the Student Conduct & Conflict Resolution as well as be subject to academic sanctions from the faculty member. Visit Honor Code for more information on the academic integrity policy.

Accommodation for Disabilities, Temporary Medical Conditions, and Medical Isolation
If you qualify for accommodations because of a disability, please submit your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. *Students should expect to receive accommodations for a timed assessment (e.g., exam) only if their faculty instructor(s) receive the student's accommodations letter at least 5 business days before the assessment, as a departmental policy, in order to facilitate administering the assessment.* Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the Disability Services website. Contact Disability Services at 303-492-8671 or DSinfo@colorado.edu for further assistance. If you have a temporary medical condition, see Temporary Medical Conditions on the Disability Services website.
If you have a temporary illness, injury or required medical isolation for which you require adjustment, please notify your instructor as soon as possible so that actions can be taken to make the adjustment.

Accommodation for Religious Obligations
Campus policy requires faculty to provide reasonable accommodations for students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. Please

communicate the need for a religious accommodation in a timely manner. See the campus policy regarding religious observances for full details.

Preferred Student Names and Pronouns
CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name.

Classroom Behavior
Students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote, or online. Failure to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, marital status, political affiliation, or political philosophy. For more information, see the classroom behavior policy, the Student Code of Conduct, and the Office of Institutional Equity and Compliance.

Sexual Misconduct, Discrimination, Harassment and/or Related Retaliation
CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. University policy prohibits protected-class discrimination and harassment, sexual misconduct (harassment, exploitation, and assault), intimate partner abuse (dating or domestic violence), stalking, and related retaliation by or against members of our community on- and off-campus. The Office of Institutional Equity and Compliance (OIEC) addresses these concerns, and individuals who have been subjected to misconduct can contact OIEC at 303-492-2127 or email CUreport@colorado.edu. Information about university policies, reporting options, and OIEC support resources including confidential services can be found on the OIEC website.
Please know that faculty and graduate instructors are required to inform OIEC when they are made aware of incidents related to these concerns regardless of when or where something occurred. This is to ensure that individuals impacted receive outreach from OIEC about their options and support resources. To learn more about reporting and support for a variety of concerns, visit the Don't Ignore It page.