Geospatial Field Methods: GPS and Drones

Geography 3170/5170, Fall 2023

Instructor: Dr. Chelsea Ackroyd
Class: Tuesday 12:25 – 1:45 PM, Gardner Commons 3660
Office Hours: Friday 10:00 AM – 12:00 PM via Zoom, or by appointment
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Course Description

This course is designed to be a hands-on introduction to geospatial field methods. Course content will focus on Global Positioning Systems (GPS)/Global Navigation Satellite Systems (GNSS) and uncrewed aerial systems (UAS; commonly referred to as drones), but will also broadly cover the various tools and resources geospatial scientists employ to gather, process/analyze, and visualize/present geospatial field data. Classroom lectures will cover the basics needed to successfully understand field collection and analysis, including projections and coordinate systems, remote sensing, georeferencing, digital surface/elevation models, and basic spatial analysis using Geographic Information Systems (GIS). During field sessions, students will learn safe field practices and will receive guided hands-on experience with geospatial field instrumentation. This includes collecting locations using GNSS, flying UAS, and mapping

surface elevation using imagery and lidar. Students will also design and carry out independent data collection to complete course projects.

Specifically, in terms of GNSS, students will learn: 1) the basic principles of identifying locations using a satellite network, 2) the difference between GNSS systems and associated levels of uncertainty, 3) how to post-process and visualize location data, and 4) how to use location data to georeference field observations, photos, and data for analysis and reports. In terms of UAS, students will learn how to: 1) fly a quadcopter UAS safely after demonstrating an understanding of best practices, 2) collect aerial imagery for different applications, 3) process and georeference imagery by applying GNSS location information, and 4) produce digital surface and orthophoto models using structure-from-motion photogrammetry and lidar.

The objectives of the class are to 1) learn how to collect geospatial data, 2) process and analyze geospatial data while understanding and constraining uncertainties, and 3) display the information in a way that facilitates communication and understanding. We will focus on practical skills and field implementation, and we will also use software that is commonly used by industry professionals. Students will learn and practice skills by first covering theory and completing exercises/labs in class, and then we will apply that knowledge through data collection in the field. Students will complete projects relating to the data collected during each field session and will prepare professional reports summarizing results. There are no prerequisites for the course, but a previous GIS or remote sensing class may provide the student with a better background for some course content.

Learning Outcomes

- Demonstrate understanding of the fundamental concepts and methods for geospatial data collection
- Understand the concept of 'thinking spatially' and determine when geospatial data collection is appropriate and needed
- Understand common approaches to geospatial data analysis, their applications, and sources of uncertainty
- Gain the skills needed to confidently operate field instruments, navigate in outdoor environments, and produce field reports
- Ability to effectively display and visualize geospatial spatial data and implement GIS/cartographic principles

Helpful Details

Students enrolled in 5170 will have higher expectations for quality of work and will have additional tasks to complete for projects.

Don't be shy! Please feel free to ask me as many questions as you can think of during class, in the field, and during my office hours.

I will respond to emails within 24 hours, with the exception of holidays and weekends, over which I will still do my best to respond in a timely fashion. Please email me again if you think your email may have been overlooked.

There are no required textbooks – assigned readings will be posted on Canvas.

Assignments will be distributed and turned in via Canvas.

Late assignments lose 10% per day.

Work must be original! While you will frequently work in groups, each person must turn in their own assignments in their own words. Cheating, copying, plagiarism, or use of AI to complete assignments will automatically result in a zero on the test or assignment.

Student Assessment Activities and Grading

30% Assignments and Labs
20% Field participation, demonstrating safe field methods, field notes
20% Exams (2)

Exams will include multiple choice, short answer, and essay questions that will assess understanding of course content and will be taken through Canvas. The second test will integrate concepts from the full semester.

30%. Projects (3)

Projects will present and visualize geospatial field data collected in the field. Details on the format for the different components of the projects will be provided in class and on Canvas.

Important dates:

Last day to add classes without a permission code – Friday, August 25
Last day to add, drop (delete), elect CR/NC, or audit classes – Friday, September 1
Last day to withdraw from classes – Friday, October 20
Classes End – Thursday, December 7
Final Exam Period – Mon-Fri, Dec 11-15

Course Schedule

DATE	LECTURE TOPIC	ASSIGNMENT
AUG 22	Syllabus and Course Introduction, Determining Location	Reading: GNSS
AUG 29	GPS/GNSS, Uncertainty in GNSS	Lab 1: Global Positioning and Accuracy
SEP 5	Projections and Coordinate Systems	Lab 2: Post-processing Raw GPS Data
SEP 12	Field Exercise: Collecting GNSS Locations	Work on Project 1: GNSS
SEP 19	Imagery and Photogrammetry; Structure from Motion (SfM)	Reading: SfM; Lab 3: Close-range Photogrammetry
SEP 26	Connecting GNSS and Photogrammetry: Georeferencing	Lab 4: Aerial Photogrammetry
OCT 3	Exam 1	Project 1 due
OCT 10	Fall Break	
OCT 17	Creating, Editing, Analyzing Spatial Field Data (Raster), SfM Applications	Lab 5: Georeferencing Aerial Photogrammetry
OCT 24	UAS Flight Planning and Ground Control Placement	Flight Plan for Project 2

OCT 31	Field Exercise: Flying UAS	Work on Project 2: SfM Photogrammetry
NOV 7	Introduction to Lidar	Reading: Lidar
NOV 14	Field Exercise: UAS Lidar Mapping	Lab 6: Lidar Point Clouds
NOV 21	Work on Project 3: Lidar	Project 2 due
NOV 28	Lidar Surface Elevation Models	Work on Project 3: Lidar
DEC 5	Exam 2	Project 3 due 12/11

Additional Information

Scheduling Conflicts: Please speak with the instructor within the first two weeks of class regarding any known conflicts you may have with the course schedule.

Academic Integrity: The University of Utah is committed to nurturing academic excellence, truth, honesty, and personal integrity. The faculty expects all students to maintain high ethical standards. Academic misconduct will not be tolerated. Penalties will include failure of an assignment, or possibly the entire course, and the filing of formal charges with appropriate university authorities. Academic misconduct includes, but is not limited to, cheating, misrepresenting one's work, and plagiarism:

- Cheating involves the unauthorized possession or use of information in an academic exercise, including unauthorized communication with another person during an exercise such as an examination.
- Misrepresenting one's work includes, but is not limited to, representing material prepared by another as one's own work or submitting the same work in more than one course without prior permission of all instructors.

- Plagiarism means the intentional unacknowledged use or incorporation of any other person's work in one's own work offered for academic consideration or public presentation.

Faculty and Student Responsibilities: The class will follow accepted University of Utah policies and procedures. Please refer to the University of Utah Faculty Handbook (http://www.admin.utah.edu/fhb/) and Student Code (http://www.admin.utah.edu/ppmanual/8/8-10.html).

Specifically: All students are expected to maintain professional behavior in the classroom setting, according to the Student Code, spelled out in the Student Handbook. Students have specific rights in the classroom as detailed in the Code. The Code also specifies proscribed conduct that involves cheating on tests, plagiarism, and/or collusion, as well as fraud, theft, etc. Students should read the Code carefully and know they are responsible for the content. According to Faculty Rules and Regulations, it is the faculty's responsibility to enforce responsible classroom behaviors, beginning with verbal warnings and progressing to dismissal from class and a failing grade. Students have the right to appeal such action to the Student Behavior Committee.

Disability Accommodation: The University of Utah seeks to provide equal access to its programs, services and activities for people with disabilities. If you will need accommodations in the class, reasonable prior notice needs to be given to the Center for Disability Services, 162 Olpin Union Building, 581-5020 (V/TDD). CDS will work with you and the instructor to make arrangements for accommodations. All written information in this course can be made available in alternative format with prior notification to the Center for Disability Services.

Harassment: Title IX makes it clear that violence and harassment based on sex and gender (which includes sexual orientation and gender identity/expression) is a Civil Rights offense subject to the same kinds of accountability and the same kinds of support applied to offenses against other protected categories such as race, national origin, color, religion, age, status as a person with a disability, veteran's status or genetic information. If you or someone you know has been harassed or assaulted, you are encouraged to report it to the Title IX Coordinator in the Office of Equal Opportunity and Affirmative Action, 135 Park Building, 801-581-8365, or the Office of the Dean of Students, 270 Union Building, 801-581-7066. For support and confidential consultation, contact the Center for Student Wellness, 426 SSB, 801-581-7776. To report to the police, contact the Department of Public Safety, 801-585-2677(COPS).

Note: The syllabus is not a binding legal contract. It may be modified by the instructor when the student is given reasonable notice of the modification, particularly when the modification is done to rectify an error that would disadvantage the student.