SOE 592 – Advanced Topics in Environmental and Natural Resource Sciences:

Lidar remote sensing for environmental monitoring

Fall 2020

Credits: 3 credits
Class time/place: ONLINE through BlackBoard

Note: Following WSU's COVID policy, this course is offered completely online.

Instructor: Dr. A.J.H. Meddens
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Office hours: By appointment over Zoom (https://wsu.zoom.us/j/2769375914)

Prerequisites: Instructor permission required.

Course description: Lidar remote sensing is a state-of-the-art technology that is becoming widely used in many research applications. This new class will teach you everything you need to know about lidar technology, research, and applications. Learn how to visualize, process lidar point cloud data, build terrain and canopy height models and establish statistical models. We will use open source software including R-statistical language and FUSION/LDV. This class is entirely online and includes a chance to develop your own lidar project with the many datasets available (including terrestrial and drone lidar data). Projects can include: data visualization, biomass estimation, fuel load estimation, species classification, streambed hydrology, and more. Students are encouraged to choose a project that is close to their own interests.

Course objectives and learning outcomes

Learning outcomes: In this lidar course, we will develop skills to process and analyze lidar data. In addition, we will learn about the various applications of lidar. At the end of the course you should:
1) Understand how lidar technology works and in what kind of applications lidar remote sensing is used.
2) Be able to process raw (las/laz) lidar data to digital terrain and canopy height models.
3) Be able to extract various lidar metrics for estimating vegetation structure.
4) Be able to build statistical models for estimating and mapping vegetation parameters.
5) Analyze and evaluate your own lidar dataset using some of the methods described above.

Software & Materials: We will use no textbook for this course. Readings and exercises will be posted to BlackBoard for download. Students must have access to a computer and able to install the following software (see below). In addition, some amount of disk space (>5 Gb) is required to complete the exercises and final project. During the course we will use various software packages including:

• R
• R-Studio
• Notepad ++
• ArcGIS
• FUSION
• FurgoViewer

Learning Management System / BlackBoard
We will use BlackBoard as a Learning Management System (LMS) for providing course materials and communication. See https://learn.wsu.edu or https://online.wsu.edu/currentstudent/blackboard-learn/ for details about using Blackboard, the current LMS used across WSU.

BlackBoard discussion board: We value student's participation and interaction. Therefore, we encourage the students to interact as much as they can through the Discussion Board in BlackBoard. Because many (high-tech) professional organizations have internal help communities; we are interested in setting up our own. We are aware that our course is filled with software installation, computer code, and statistics, that can lead to self-help trouble-shooting. Therefore, we encourage student to post questions, answers, and cool features on the BlackBoard Discussion Board. Student's participation in the discussion board will count towards your grade, either by asking questions or answering questions from your peers. Read the Rposting guide to help you develop your skills in asking good questions: https://www.r-project.org/postingguide.html.

Final paper and presentation: Each student will be responsible for writing a final paper (approximately 8-15 pages, double spaced including figures) and a short 10-minute video presentation for the course. There is considerable flexibility in the topic and format that students choose. If you are currently analyzing lidar data, we recommend that you do a project on this topic. Otherwise choose a project that fits well with your interests/current research. If you do not have your own lidar data to analyze, please look for a project that interests you on BlackBoard. If you have specific ideas for a project, you can also contact one of the instructors to discuss a project. At the end of the fourth week, please submit a 1-page proposal of your project. By the end of the course we will share the videos and provide feedback on your final project paper. **A 1-page proposal of your final project due on Oct 2. The final presentation and final paper are due on Dec 10.**

Final assessment (total: 100%):
   • Participation in the course and Discussion Board: 20%
   • Quizzes (total: 30%):
        • Quiz 1: 10%
        • Quiz 2: 10%
        • Quiz 3: 10%
   • Final project (total: 50%):
        • Proposal: 5%
        • Presentation: 15%
        • Final paper: 30%

Your final grade for the semester will be based on a percentage basis using the following distribution: A (93-100), A- (92-90), B+ (89-87), B (86-83), B- (82-80), C+ (79-77), C (76-73), C- (72-70), D+ (69-67), D (66-63), F (<63). All percentages will be rounded up to the nearest whole number prior to assigning your final grade.

Approximate Course Schedule (self-guided and flexible), please contact the instructor if you get further than a week behind.

Weeks	Date	Topic
1 – 3	Aug 24 – Sept 11	**Module 1** • Class introductions • Lesson 1: Introduction to lidar • Lesson 2: Lidar applications • Lesson 3: Select a (final) lidar project • Quiz 1
4 – 6	Sept 14 – Oct 2	**Module 2** • Lesson 1: Software • Lesson 2: Lidar data and visualization • Lesson 3: Lidar data processing • Quiz 2 • Submit 1-page project proposal (Due: Oct 2)
7 - 9	Sept 5 – Oct 23	Module 3 • Lesson 1: Area-based approach for estimating and mapping forest attributes using lidar data • Lesson 2: Individual tree detection from lidar data • Lesson 3: Environmental applications • Quiz 3
10 - 13	Oct 5 – Nov 20	**Module 4** • Work on individual project
14	Nov 23 – 27	THANKSGIVING BREAK
15	Nov 30 – Dec 4	• Work on individual project
16	Dec 7 – 11	Final paper due (Dec. 10)
17	Dec 14 – 18	FINALS WEEK (no final for this course)

COVID-19 Policy
Students are expected to abide by all current COVID-19 related university policies and public health directives, which could include wearing a cloth face covering, physically distancing, self-attestations, and sanitizing common use spaces. All current COVID-19 related university policies and public health directives are located at https://wsu.edu/covid-19/. Students who do not comply with these directives may be required to leave the classroom; in egregious or repetitive cases, students may be referred to the Center for Community Standards for university disciplinary action.

WSU Reasonable Accommodation Statement
Reasonable accommodations are available for students with documented disabilities or chronic medical or psychological conditions. If you have a disability and need accommodations to fully participate in this class, please visit your campus' Access Center/Services website to follow published procedures to request accommodations. Students may also contact their campus offices to schedule an appointment with a Disability Specialist. All disability related accommodations are to be approved through the Access Center/Services on your campus. It is a university expectation that students visit with instructors (via email, Zoom, or in person) to discuss logistics within two weeks after they have officially requested their accommodations.
For more information contact a Disability Specialist on your home campus:

- Pullman, WSU Global Campus, Everett, Bremerton, and Puyallup: 509-335-3417 Access Center (https://www.accesscenter.wsu.edu) or email at access.center@wsu.edu

Reasonable Religious Accommodation
Washington State University reasonably accommodates absences allowing for students to take holidays for reasons of faith or conscience or organized activities conducted under the auspices of a religious denomination, church, or religious organization. Reasonable accommodation requires the student to coordinate with the instructor on scheduling examinations or other activities necessary for course completion. Students requesting accommodation must provide written notification within the first two weeks of the beginning of the course and include specific dates for absences. Approved accommodations for absences will not adversely impact student grades. Absence from classes or examinations for religious reasons does not relieve students from responsibility for any part of the course work required during the period of absence. Students who feel they have been treated unfairly in terms of this accommodation may refer to Academic Regulation 104 – Academic Complaint Procedures.

WSU Academic Integrity Statement
All members of the university community share responsibility for maintaining and promoting the principles of integrity in all activities, including academic integrity and honest scholarship. Students are responsible for understanding the full Academic Integrity Statement found here. Students who violate WSU's Academic Integrity Policy (identified in WAC 504-26-010(3) and -404) will fail the assignment, will not have the option to withdraw from the course pending an appeal, and will be reported to the Office of Student Conduct. If you have any questions about what is and is not allowed in this course, you should ask course instructors.

Classroom Safety Statement
Classroom and campus safety are of paramount importance at Washington State University, and are the shared responsibility of the entire campus population. WSU urges students to follow the "Alert, Assess, Act," protocol for all types of emergencies and the "Run, Hide, Fight" response for an active shooter incident. Remain ALERT (through direct observation or emergency notification), ASSESS your specific situation, and ACT in the most appropriate way to assure your own safety (and the safety of others if you are able).

Please sign up for emergency alerts on your account at MyWSU. For more information on this subject, campus safety, and related topics, please view the FBI's Run, Hide, Fight video and visit the WSU safety portal.

Full details can be found at https://provost.wsu.edu/classroom-safety/

Steffen Center Dog Exclusion Zone
Normally during one of our labs we will visit the Steffen Center to do some outdoor measurements. Please note the following: To reduce exposure of deer to the sight, sounds, or scent of dogs, while still providing access to students assisted by a legally designated service animal, a Dog Exclusion Zone exists within the Steffen Center and the WSU Arboretum that is warranted and legally justifiable under the provisions of the ADA. More information is here: https://environment.wsu.edu/facilities/