GEOG 490/590

Topic: **Mapping with Drones**

**CRN:** 32358/32374 (4 cr.)
**Class Online Lecture:** Mondays & Wednesdays 4:15pm - 5:45pm
**Instructor:** Mark Fonstad, fonstad@uoregon.edu; **GE:** Eric Levenson, elevens2@uoregon.edu
**Instructor Office Hours:** Wednesdays 3 – 4pm

**Course Objectives**
UAVs (“drones”) represent a new, exciting technology which has already expanded our ability to view, map, and examine our world. This course is designed to give you a basic understanding of what it means to undertake mapping, implement photogrammetry using established “best-practices”, and UAV flight planning and execution. The course will have a strong “applied” approach to mapping and UAVs. We will work to think critically about how to produce mapped information from UAVs, how to think about the quality of mapping, and how to think about the planning of projects and the analysis of their products. Specific topics include: (1) Introduction to mapping and mission-planning, (2) Basics of cameras and photogrammetry, (3) Introduction to photogrammetric software for converting images to 3D data and map-like orthophotographs, (4) Introduction to UAS (unmanned aircraft systems – “drones”), rules of operation, (5) flight training basics and mission flight planning, (6) exercises and a larger project to produce map data from UAS imagery, (7) interpretation and analysis of UAS-produced maps. This course is NOT an FAA Part 107 Commercial UAV Pilot License preparation course, we will discuss some of the topics that are on that exam, but this course is focused on mapping, not on Part 107 certification.

**Course “Materials”**
There is no textbook for this class – the topic is still quite new and there is no good textbook available. Instead, there are some required “materials” you’ll need to participate in the class. If these are going to be a problem for you, please let me know via email as soon as possible as it may affect your ability to participate in the class.

**Required Hardware:**
1. You’re going to need a **personal computer where you can install applications and process your work.** It doesn’t have to be a super-duper computer or anything (I’m using an old laptop and it seems fine for our purposes), but if it is really old and/or slow, you may have problems running the software needed in class.

2. **You’re going to need an imaging drone.** It can be a small mini-drone – that would be perfectly fine. It needs to be able to take pictures remotely that are reasonable clear, and it needs to be reasonably controllable. I recommend the DJI/Ryze Tello mini-drone – we’ve used them in previous years and they’re pretty good for about $100. Some students decide to purchase bigger & better drones. That’s totally fine with me, but having anything more than the mini-drone I have described isn’t required.

**Required Software:** Agisoft Metashape Pro, other free software needed will be discussed as needed.
Grading
Below are the course activities I will use in computing your grades. The undergraduate and graduate sections of the class share most components, but the graduate section also has a term project, and the percentages reflect this difference. The letter grading scheme is as follows: A+: >98; A: 92–98; A–: 90–92; B+: 88–90; B: 82–88; B–: 80–82; C+: 78–80; C: 72–78; C–: 70–72%; D+: 68–70; D: 62–68; D–: 60–62; F: <60.

Undergraduate Students (GEOG 490)
Eight activity reports (7.5% each), Exam #1 (20%), Exam #2 (20%)

Graduate Students (GEOG 590)
Eight activity reports (5% each), Exam #1 (20%), Exam #2 (20%), Individual Term Project (20%)

Course Assignments
Most weeks of the term there will be a short activity you’ll work on by yourself at home or possibly in collaboration with others online. In general, I will describe the activity during the Monday class meeting, and your activity report is due at 11:59pm of the following Monday evening.

I will give you general goals and tasks for each of the activities, but I’ll be encouraging you to play thoughtfully with these tasks, trying things out to see what happens under different conditions. Rather than scoring you on how well your products come out or how “correct” your conclusions might be, I am instead asking you to write up the results of your weekly activities/experiments in an informal self-report – much like an extended journal entry. Describe what you, why you tried the things you tried, what worked and didn’t work (and why that might be), and where you could guess improvements might be made. If you are thoughtful in writing your report, I’ll give you full credit. I expect that these reports are going to be about 1-2 pages long (double-spaced), but I am not going to tie you to a specific length.

Graduate students will work on an additional self-directed, partly-self-designed term project using either existing drone data or data collected by the individual student.

Exams
As we are all operating online this term, exams for this class will be different than in past years. There are two exams during the term. Exam #1 is Wednesday, April 28, 4:15 – 5:45pm, and Exam #2 is Wednesday, June 9th, 2:45pm – 4:45pm. The exams will be (1) Open book, (2) Primarily based on problem-solving rather than memorization of material, and (3) Generally in the form of essay or short-essay type questions that you type out answers in sentence/paragraph format.

Participation
While synchronous attendance at the remote lecture is not mandatory (other than exams), you are strongly encouraged to participate in each online lecture in order to gain the knowledge crucial for understanding the course material and for doing well on the weekly activities and projects.

Contacting me
The fastest way to contact me is via email. I may not be able to be contacted on evenings & weekends.
Tentative Class Schedule (Subject to Change):
Week 1 (March 29 & March 31): Weekly Topics -- Overview, Introduction to Mapping, UAS, Workflow
Week 2 (April 5 & April 7): Weekly Topics – Cameras and Photogrammetry, Agisoft
Week 3 (April 12 & April 14): Weekly Topics – Basic Flying-for-Mapping, UAS Sensors & Data
Week 4 (April 19 & April 21): Weekly Topics – Scale, geodesy, georeferencing
Week 5 (April 26 & 28): Weekly Topics – Intro to Flight Planning, Exam #1 (Wednesday)
Week 6 (May 3 & May 5): Weekly Topics – Product quality, sources of error, quantifying error
Week 7 (May 10 & May 12): Weekly Topics – Image Interpretation, Classification, and Indices
Week 8 (May 17 & May 19): Weekly Topics – UAS/RS applications 1
Week 9 (May 24 & May 26): Weekly Topics -- UAS/RS applications 2, Intro to FAA Part 107
Week 10 (May 31 & June 2): MONDAY NO CLASS (Memorial Day), Weekly Topics -- Intro to FAA Part 107
Exam #2: June 9 (Wednesday), 2:45pm

Weekly Take-Home Activities (Subject to Change):
Week 1: None (Get your UAVs and software set up if you haven’t already)
Week 2: By-Hand Imaging & 3D Model-Making
Week 3: Flight Practice & Imaging
Week 4: Flight Imaging, Georeferencing, Modeling, and Orthophotos
Week 5: Image Interpretation and Classification Keys
Week 6: MF John Day Image Classification
Week 7: Your Home Turf Image Classification
Week 8: Change Detection
Week 9: Air Space Map Interpretation
Week 10: None

Academic Dishonesty
I will not tolerate cheating or academic misconduct/dishonesty in my courses; examples of these behaviors include (but are not limited to):

• Plagiarism (passing off the work of another as that of your own)
• Copying answers from your neighbors during exams/activities
• Any other actions that might give you an unfair advantage over your classmates.

All cases of academic dishonesty/misconduct will be referred immediately to the Student Judicial Affairs Office. The penalties for engaging in academic dishonesty and/or misconduct can range from a grade of “F” for an assignment to an automatic failure of the course. Please consult the university policy at https://dos.uoregon.edu/social-misconduct

Late/Make-Up Work
Late weekly activity reports are deducted 25% of total possible after the deadline, +25% deducted for each additional week late. No make-up tests will be given unless you provide documentation in advance and for a reason that is valid in the instructor’s judgment, or you provide a medical excuse signed by a physician within a week after the test.
**Disability Services Notice**

I work hard to ensure a quality learning experience for all students. If you need specific accommodations to get the most out of this class, please let me know by (1) informing me of your particular needs, and (2) providing the appropriate documentation from the university’s AEC office. I will make every effort to accommodate your needs, but you must notify me by the end of the first week of class if you need special arrangements.

**Note:** I consider this syllabus a contract between myself and the students in this course. In writing this syllabus, I have obligated myself to follow the policies and procedures contained herein. You are responsible for understanding and following these policies as well. I reserve the right to make changes to this syllabus. You will receive verbal and written notification of major changes to course policies, procedures and content.
<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Day</th>
<th>Class Topic</th>
<th>Weekly Activity</th>
<th>Turn In by Friday (11:59pm)</th>
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<tbody>
<tr>
<td>1</td>
<td>March 30</td>
<td>Monday</td>
<td>Class overview, Introduction to mapping, RS &amp; UAS</td>
<td>Order personal UAV, Download Software</td>
<td>None</td>
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<td></td>
<td>April 1</td>
<td>Wednesday</td>
<td>UAS types, regs, pros &amp; cons, basic UAS mapping workflow</td>
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<td>2</td>
<td>April 6</td>
<td>Monday</td>
<td>Cameras and photogrammetry 1, Agisoft 1</td>
<td>By-Hand Imaging &amp; 3D model-making</td>
<td>Activity Report</td>
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<td>April 8</td>
<td>Wednesday</td>
<td>Cameras and photogrammetry 2, Agisoft 2</td>
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<td>3</td>
<td>April 13</td>
<td>Monday</td>
<td>Introduction to Tellos, Phantoms, and Flying</td>
<td>Flight Practice &amp; Imaging</td>
<td>Activity Report</td>
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<td></td>
<td>April 15</td>
<td>Wednesday</td>
<td>UAS sensors, data types &amp; management</td>
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<td>4</td>
<td>April 20</td>
<td>Monday</td>
<td>Scala, geodesy, georeferencing, Agisoft 3</td>
<td>Mini-Project 1</td>
<td>Activity Report</td>
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<td>April 22</td>
<td>Wednesday</td>
<td>EXAM #1</td>
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<td>5</td>
<td>April 27</td>
<td>Monday</td>
<td>Flight planning, Flight-based sources of error</td>
<td>Mini-Project 2</td>
<td>Activity Report</td>
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<td></td>
<td>April 29</td>
<td>Wednesday</td>
<td>Model quality, sources of error, and quantifying error</td>
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<td>6</td>
<td>May 4</td>
<td>Monday</td>
<td>Introduction to term project</td>
<td>Term project planning</td>
<td>Term Project Flight Plan</td>
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<td>May 6</td>
<td>Wednesday</td>
<td>UAS/RS applications 1</td>
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<td>7</td>
<td>May 11</td>
<td>Monday</td>
<td>Image interpretation</td>
<td>MF John Day Image Classification</td>
<td>Activity Report</td>
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<td>May 13</td>
<td>Wednesday</td>
<td>Intro to image classification &amp; indices</td>
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<td>8</td>
<td>May 18</td>
<td>Monday</td>
<td>UAS/RS applications 2</td>
<td>Your Home Turf Image Classification</td>
<td>Activity Report</td>
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<td>May 20</td>
<td>Wednesday</td>
<td>EXAM #2</td>
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<td>9</td>
<td>May 25</td>
<td>Monday</td>
<td><strong>Memorial Day holiday; classes are not in session</strong></td>
<td>None</td>
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<td>May 27</td>
<td>Wednesday</td>
<td>Graduate Student Project Presentations</td>
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<td>10</td>
<td>June 1</td>
<td>Monday</td>
<td>Introduction to FAA Part 107 Certification Part 1</td>
<td>Air Space Map Interpretation</td>
<td>Activity Report &amp; Final Project Report</td>
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<td>June 3</td>
<td>Wednesday</td>
<td>Introduction to FAA Part 107 Certification Part 2</td>
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