ABOUT THIS COURSE

DESCRIPTION

This course will study Unmanned Aircraft Systems (UAS) or drones. UAS have provided us with new ways to map, monitor, and measure our changing landscape. UAS are relatively inexpensive, easy to operate, and can deploy rapidly. Advances in digital image processing allow one to go from flying a drone to working with accurate maps and 3D models in a matter of hours. These factors make UAS ideal for many applications in which speed, accuracy, resolution, cost, and timeliness are key factors. In this course, you will learn how to operate UAS and process UAS data to support environmental mapping and monitoring. Example case studies will be used. The course covers five main topics: safety, flight operations, data processing, analytics, and dissemination. The goals for this course are to provide students with an in-depth understanding of drone technology and how it can be applied for environmental assessment. The course is technical in nature but it is designed to be accessible to anyone who has an interest in drones and the environment. Technologies students will be exposed to include: drone platforms, drone sensors, flight planning software, image processing software, desktop Geographic Information Systems (GIS), and web mapping. Students will work closely with members of the University of Vermont UAS Team, one of the most experienced drone groups in the United States.

LEARNING OBJECTIVES

- State the regulations that govern recreational and commercial use of UAS
- Develop safety procedures for UAS flight operations
- Implement a UAS pre-flight checklist
- Understand the capabilities and limitations of UAS in the context of environmental mapping
- Categorize the different types of UAS
- Recognize the various sensors that can be mounted on a UAS
- Plan a UAS mission
- Operate fixed-wing and multi-rotor UAS
- Complete Manual and Automated Flights
- Process UAS imagery to generate geospatial data products
- Evaluate the quality of UAS data products
- Integrate UAS data with other types of geospatial products
- Produce web apps and other decision support products from UAS data.

PREREQUISITES

There are no formal prerequisites for this course. Students should have a strong interest in the environment and natural resources along with an awareness of drone technology. A high level of comfort using desktop and mobile computing is recommended.

FORMAT

This course consists of two weeks of resident instruction on the UVM campus and two weeks of coursework off campus. Much of the time will be spent outdoors flying drones.

GRADES

There are 15 graded activities in this course. The total number of points is 100. The distribution of those points, by graded activity, is presented below.

<table>
<thead>
<tr>
<th>Activity</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participation</td>
<td>8</td>
</tr>
<tr>
<td>Short essay: UAS uses</td>
<td>2</td>
</tr>
<tr>
<td>Quiz: UAS regulations</td>
<td>2</td>
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<tr>
<td>Flight checklist</td>
<td>5</td>
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<tr>
<td>Flight practical application</td>
<td>10</td>
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<tr>
<td>Data collection practical application</td>
<td>10</td>
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<tr>
<td>Short essay: challenges</td>
<td>2</td>
</tr>
<tr>
<td>Lab: data processing</td>
<td>10</td>
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<tr>
<td>Lab: geospatial applications</td>
<td>10</td>
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<tr>
<td>Lab: web apps</td>
<td>10</td>
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<tr>
<td>Peer review: web apps</td>
<td>2</td>
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<tr>
<td>Essay: UAS applications</td>
<td>5</td>
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<tr>
<td>Peer review: essay</td>
<td>2</td>
</tr>
<tr>
<td>Project: story map</td>
<td>20</td>
</tr>
<tr>
<td>Peer review: story map</td>
<td>2</td>
</tr>
</tbody>
</table>

COURSE MATERIALS

E-LEARNING PLATFORM

This course will use UVM’s e-learning platform, Blackboard.

TEXTBOOK
There is no textbook requirement for this course.

REQUIREMENTS

For the off-campus portion of this course students will need access to a computer with a broadband internet connection. Students will receive a 1-year Pix4D license as part of this course. The Pix4D software can be run on a computer with the Windows operating system or in the cloud using any modern web browser. Students will receive both UVM network accounts and ArcGIS accounts.

SCHEDULE

MODULE 0: INTRODUCTION

ABOUT

Students will be welcomed into the program

WHEN

Week 1: Day 1

TOPICS & ACTIVITIES

- Program overview
- Introductions
- Understanding geospatial technology
- UAS platform overview
- UAS flight demo

ASSIGNMENT

- Short essay. Give an example of an environmental problem that drones could assist with.

MODULE 1: SAFETY & REGULATIONS

ABOUT

An overview of the regulations surrounding UAS operations along with safety procedures that should be implemented for each flight.

WHEN

Week 1: Day 2

TOPICS & ACTIVITIES

- FAA regulations
- UAS safety
- Mission checklists
- Flight checklists
- Roles and responsibilities of personnel involved in flight operations
ASSIGNMENT

• Quiz. UAS regulations.
• **UAS Flight Checklist.** Students will split into groups and develop their own flight checklist

MODULE 2: FLIGHT SCHOOL

ABOUT

Students will demonstrate proficiency in carrying out flight operations to capture data using both multi-rotor and fixed-wing UAS platforms.

WHEN

Week 1: Days 3-4

TOPICS & ACTIVITIES

• Flight planning
• Multi-rotor flight operations
• Fixed-wing flight operations

ASSIGNMENT

• **Practical application.** Demonstrate that you can effectively plan and execute a UAS flight operation.

MODULE 3: DATA COLLECTION

ABOUT

Students will participate in a number of UAS missions focused on collecting data for environmental assessment.

WHEN

Week 1: Day 5
Week 2: Day 1-2

TOPICS & ACTIVITIES

• Flight planning for Manual and Automated Flights
• Flight operations for Manual and Automated Flights
• Data collection
• Post processing

ASSIGNMENT

• **Practical application.** Participate in the planning and execution of flight operations.
• **Short essay.** What are the main challenges you witnessed with respect to using UAS for environmental mapping?

MODULE 4: DATA PROCESSING
ABOUT
Students will learn how to process UAS imagery to generate 2D and 3D geospatial products.

WHEN
Week 2: Day 3

TOPICS & ACTIVITIES
- Pix4D processing
- View point clouds in QT Modeler
- View raster surface models and orthophoto mosaics in ArcGIS

ASSIGNMENT
- Lab. Complete the data processing lab.

MODULE 5: DATA INTEGRATION

ABOUT
Students will use geospatial software to carry out 2D and 3D analyses of UAS

WHEN
Week 2: Day 4

TOPICS & ACTIVITIES
- Perform 3D analyses from UAS data including volumetric measurements, line of sight, and cross sections.
- Integrate UAS data with publicly available geospatial datasets for environmental assessment.

ASSIGNMENT
- Lab. Complete the geospatial applications lab.

MODULE 6: WEB APPS

ABOUT
Students will use geospatial software to develop web applications using their UAS data.

WHEN
Week 2: Day 5
Week 3: Days 1-2

TOPICS & ACTIVITIES
- Publish UAS data to the web.
- Create a web app using UAS data.
ASSIGNMENT

- **Lab.** Complete the web app lab.
- **Peer review.** Provide feedback on one of your peer’s web apps.

**MODULE 7: ENVIRONMENTAL PROBLEM**

**ABOUT**

Students will research an environmental issue and discuss the role in which UAS-based mapping has or could play in addressing the issue.

**WHEN**

Week 3: Days 3-5

**TOPICS & ACTIVITIES**

- Literature review.
- Essay

**ASSIGNMENT**

- **Essay.** Submit the essay.
- **Peer review.** Provide feedback on one of your peer’s essays.

**MODULE 8: STORY MAP**

**ABOUT**

Students will integrate what they have learned from this class, bringing together the data, analyses, and research to discuss and environmental issue and show how UAS-based mapping can be used to address the issue. Student will integrate multimedia materials they have located on the web, the information from their essay, their web apps, and other relevant information.

**WHEN**

Week 4: Days 1-5

**TOPICS & ACTIVITIES**

- Refine web app
- Process additional data as necessary
- Story map

**ASSIGNMENT**

- **Story Map.** Submit the story map.
- **Peer review.** Provide feedback on one of your peer’s story maps.

Please note that due to weather it is possible for the day an activity occurs to change.
POLICIES

OUR COMMON GROUND

The University of Vermont is an educationally purposeful community seeking to prepare students to live in a diverse and changing world. We who work, live, study, teach, do research, conduct business, or participate in the University of Vermont are members of this community. As members, we believe in the transforming power of education and agree to help create and foster an environment where we can discover and reach our true potential.

We aspire to be a community that values:

RESPECT. We respect each other. We listen to each other, encourage each other and care about each other. We are strengthened by our diverse perspectives.

INTEGRITY. We value fairness, straightforward conduct, adherence to the facts, and sincerity. We acknowledge when things have not turned out the way we had hoped. As stewards of the University of Vermont, we are honest and ethical in all responsibilities entrusted to us.

INNOVATION. We want to be at the forefront of change and believe that the best way to lead is to learn from our successes and mistakes and continue to grow. We are forward-looking and break new ground in addressing important community and societal needs.

OPENNESS. We encourage the open exchange of information and ideas from all quarters of the community. We believe that through collaboration and participation, each of us has an important role in determining the direction and well-being of our community.

JUSTICE. As a just community, we unite against all forms of injustice, including, but not limited to, racism. We reject bigotry, oppression, degradation, and harassment, and we challenge injustice toward any member of our community.

RESPONSIBILITY. We are personally and collectively responsible for our words and deeds. We stand together to uphold our common ground.

INSTRUCTOR ROLES & RESPONSIBILITIES

Your instructors will oversee all aspects of the course. You should expect them to be knowledgeable, professional, approachable, and take an interest in your performance in this course.

STUDENT ROLES & RESPONSIBILITIES

Student should be guided by UVM’s “Our Common Ground” principals throughout this course. This is a college-level course and students, although they may still be in high school, will be treated the same as any other UVM student. Students are expected to come prepared and show up promptly for all sessions. UVM’s academic integrity policy (https://www.uvm.edu/policies/student/acadintegrity.pdf) will be strongly enforced. Students are encouraged to take advantage of the multitude of resources UVM offers to ensure student success ranging from the ACCESS office to the Center for Health and Wellbeing. Students requiring any accommodations for this course should notify the instructors at the start of class.