SUR4501C/6502C Foundations of UAS Mapping

1. OVERVIEW
Foundations of UAS Mapping introduces students to the fundamental components of small unmanned aerial systems (sUAS) and how they function together to produce high resolution, spatially accurate planimetric maps and 3D models of the terrain. These components include GPS/GNSS, inertial systems, lidar, and on-board sensors like cameras. We focus primarily on the application of these technologies, but also cover basic theoretical aspects. We deal with establishing ground control for sUAS imagery so that the products can be referenced to specific geodetic reference frameworks and integrated with other geospatial data. This is the first of the three courses required for the Certificate in Mapping with Unmanned Aerial Systems. Students who do not have a geomatics background, such as an introductory surveying class or field experience, are required to get the permission of the instructor before they enroll.

- Spring semester, 3 credits
- Hybrid delivery consisting of mandatory in-person field labs and synchronous, online lectures/discussions
- [https://elearning.ufl.edu/](https://elearning.ufl.edu/)

Course Prerequisites: SUR 3103C Geomatics or instructor consent (non-Geomatics students are encouraged to take this course)

Instructors:

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Recommended textbooks (not required):


Recommended resources (not required):

  [https://www.asprs.org/a/society/committees/standards/Positional_Accuracy_Standards.pdf](https://www.asprs.org/a/society/committees/standards/Positional_Accuracy_Standards.pdf)
  [https://www.pobonline.com/articles/101529-how-to-use-ground-control-in-drone-surveying](https://www.pobonline.com/articles/101529-how-to-use-ground-control-in-drone-surveying)
2. LEARNING OUTCOMES
At the completion of the course, the student should be able to:

- understand the fundamentals of sUAS
- identify the essential hardware components of sUAS
- plan, acquire, and adjust GPS/GNSS and total station measurements, and know their role in ground control for sUAS mapping
- understand the fundamentals of onboard GPS/GNSS and inertial measurements, and know their role in airborne navigation and control for sUAS
- understand the fundamental concepts of photogrammetry and lidar
- articulate the standard sUAS mapping workflow
- analyze and report on the quality of spatial measurements and maps

3. COURSE LOGISTICS
First day of class: 1/11/21. Last day of class: 4/21/21

Method of Instruction:
- This course is based on the concept of experiential learning or “learning by doing.” Where possible, the material is learned primarily through a series of hands-on field projects. The field data collection component of the project is done in small teams (2-4 students).
- Analysis of the data and submission of results, however, must be done independently and individually (not as a team).
- The project deliverables are due at specified dates (deadlines) throughout the semester according to a set schedule. These deadlines are not flexible.

Scheduled Meetings:

**All sections**
**Mon: 8:30am – 9:20am (per. 2) via Zoom or pre-recorded**
- This meeting is used to provide background information on the specific technology and methodology as well as the requirements of the weekly project.
- Links to meeting recordings will be posted in Canvas.

**All sections**
**Wed: 8:20pm – 9:10pm (per E2) via Zoom**
- This meeting is used to do independent data reduction and analysis.
- All meetings are meant to be interactive discussions. Preparation prior to meetings is paramount for course success.
- When applicable, links to meeting recordings will be posted in Canvas.

Scheduled Labs:

**GNV sections**
**Mon: 1145am – 2:45pm (per. 5-7)**
- Flavet field site

**GNV-B sections**
**Mon: 3:00pm – 6:00pm (per. 8-10)**
- Flavet field site

**PCC sections**
**Sat: 8:30am – 2:30pm***
- GCREC/Plant City Campus

**FTL sections**
**Sat: 8:30am – 2:30pm**
- FLREC/Davie West Bldg.

* estimated ending time, may vary weekly depending on lab specifics
- The field data acquisition part of projects occurs during scheduled labs unless equipment constraints
or weather dictate otherwise. All field work is done on campus and students should read the project instructions prior to going to the field.

- Any student who cannot complete their labs in Gainesville, Plant City, or Fort Lauderdale, can only complete this course if they have access to the hardware and software involved.
- This course will be conducted in a hybrid format that includes some face-to-face sessions. During all face-to-face activities, the following public health and safety protocols are required of all students, instructors, and teaching assistants until further notice:

  - Bring and wear a face mask at all times when indoors.
  - Wash hands (>20 sec) before and during class.
  - Maintain at least 6ft of distance from others.
  - If you feel sick or have symptoms, stay home.

- Any individuals who are unable or unwilling to meet these requirements cannot participate in face-to-face activities and may be subject to progressive discipline. If you are experiencing COVID-19 symptoms, please use the UF Health screening system and follow the instructions on whether you are able to attend class. Course materials will be provided to you with an excused absence, and you will be given a reasonable amount of time to make up work.

**Office hours:**

*All sections*  
**Fri: 4:00pm – 5:00pm via Zoom**

- If needed, appointments can be made in advance for availability until 6PM on Fridays. For alternate office hour times, the instructors can be best reached via the conversation tool in Canvas. Please note that responding to Canvas messages through UF email may remove attachments and that message delivery may be slightly delayed. Students are also welcomed to call by phone or arrange a video conference meeting in Zoom.

**Communication:**

- The course is managed through the UF’s e-Learning system (Canvas - https://elearning.ufl.edu/). All communication and submission of project reports and results should be done through the facilities in that system.
- Questions and suggestions to the whole class can also be posted under the Discussions tab.
- Any short-term changes concerning meetings, labs, or other course components will be announced through Canvas.
- Students are also welcome to arrange a video conference meeting to go over any questions.
Technology Requirements:
- A computer or mobile device with high-speed internet connection to view lectures.
- A headset and/or microphone and speakers
- For Zoom: A supported web browser on a supported operating system (Windows, Mac OS, Linux); and minimum bandwidth. More details can be found here.
- For software and hardware requirements, a mandatory quiz will be conducted during the beginning of the term to determine the computational needs of students for software used throughout the semester.

Using Zoom:
- Live lectures and office hour meetings (including individual student requests) will be conducted with the Zoom conferencing software. Sessions can be joined by clicking a link posted by the instructor on Canvas.
- Synchronous online sessions will be recorded. By sharing your video, screen, or audio during any synchronous online class sessions, you are consenting to being recorded for the benefit of students who cannot attend live as well as for class review during the current semester. If you have special circumstances or concerns about privacy, it is your responsibility to discuss it with your instructor.
Grades:

- Grading is based on project deliverables, online quizzes, a final project presentation, and participation. Grading is distributed as follows for undergraduates (UG) and graduates (G):

<table>
<thead>
<tr>
<th>Item</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Timeliness and completeness of project reports and assignments</td>
<td>70% (UG), 60% (G)</td>
</tr>
<tr>
<td>Attendance and participation (field labs, discussions, etc.)</td>
<td>10% (UG), 5% (G)</td>
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<tr>
<td>Peer review</td>
<td>3%</td>
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<tr>
<td>Final project presentation</td>
<td>7%</td>
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<tr>
<td>Term paper</td>
<td>NA (UG), 20% (G)</td>
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<tr>
<td>Final quiz (cumulative)</td>
<td>10% (UG), 5% (G)</td>
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<tr>
<td>Total</td>
<td>100%</td>
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Grading scale:

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<tr>
<th>Grade</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>A</td>
<td>95.0-100.0</td>
<td>C+</td>
<td>77.0-79.9</td>
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<tr>
<td>A-</td>
<td>90.0-94.9</td>
<td>C</td>
<td>73.0-76.9</td>
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<tr>
<td>B+</td>
<td>87.0-89.9</td>
<td>C-</td>
<td>70.0-72.9</td>
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<tr>
<td>B</td>
<td>83.0-86.9</td>
<td>D</td>
<td>60.0-69.9</td>
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<tr>
<td>B-</td>
<td>80.0-82.9</td>
<td>E</td>
<td>0-59.9</td>
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- For information on current UF policies for assigning grade points, see https://catalog.ufl.edu/ugrad/current/regulations/info/grades.aspx

Project Reports:

Project reports are required for the following projects:

- P01: UAS mission planning
- P02: Observe, process, and evaluate GPS/GNSS static baselines using CORS/OPUS
- P03: Observe and evaluate GPS/GNSS static network
- P04: Establish ground control points using total stations
- P05: Establish ground control points using levels
- P06: Establish ground control points and survey flight lines using RTK GNSS
- P07: Evaluate inertial navigation system (INS) measurements
- P08: Process UAS RGB imagery
- P09: Process and analyze multispectral UAS imagery
- P10: Process and ground truth UAS lidar
- P11: Measure forest parameters using UAS lidar
- P12: Evaluate spatial quality of Google Earth

Attendance and Participation:

- Students are expected to attend all field lab and Wednesday evening discussion sessions. Ten percent (graduate students 5%) of the grade is dedicated to attendance of field labs and discussions. More than two unexcused absences will result in a deduction of the student final grade.
Group members will be periodically polled on the participation of their peers in lab activities.

Meaningful posting of questions and project troubleshooting on discussion boards is incorporated into the participation grade. Students are expected to participate to provide meaningful posts in at least 6 out of the 12 project discussion boards.

For unexcused absences from field lab activities, the corresponding project report grade will receive a 50% reduction.

**Final Presentation & Peer Review:**

- **Final Presentations:**
  - The presentation needs to include an executive summary of the objective, methodology, data processing, analysis, results, and conclusion(s) reached.
  - Students will be given detailed instructions on how to pre-record their presentations and share the recording on Canvas with the class.
  - Undergraduates:
    - Each student is given 3 minutes to present a summary of one of the topics or projects completed during the semester.
  - Graduates:
    - Each student is given 8-10 minutes to present a summary of one’s Term Paper (see below).

- **Peer Review:**
  - Students will be grouped. Each student is required to peer review the presentations of all other group members according to a specific rubric.

**Term Paper (Graduate Students only):**

- Graduate students are required to write a journal length paper on a topic related to the class. This should include analysis beyond what was done in the assigned project (such as comparisons of different methods from different projects) and should show a thorough understanding of the technology and techniques involved. This manuscript should follow the typical format used in peer-reviewed journals (e.g., MDPI journal *Drones* - [https://www.mdpi.com/journal/drones/instructions](https://www.mdpi.com/journal/drones/instructions)). More detailed instructions will be provided in Canvas.

**Final Quiz:**

- A final 50-minute quiz will be given on the last Wednesday meeting of the semester (4/21/21) from 8:20 pm to 9:10 pm (per. E2). The quiz will be delivered through Canvas using Honorlock, which requires a high-speed internet connection and a webcam. This quiz covers the concepts and principles associated with the topics covered during the semester. This date and time are firm. Any exceptions must be arranged with the instructors at least 2 weeks in advance.
4. COURSE SCHEDULE
Please note that bad weather and/or other unpredictable factors may cause this schedule to change during the semester.

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<th>Monday</th>
<th>Tuesday</th>
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<td>1/14</td>
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<td>1/16</td>
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<tr>
<td>ALL-WEB: Overview, UAS Mapping</td>
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<td>Holiday - MLK</td>
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<td>P1 UAS Mission Planning</td>
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<td>1/28</td>
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<td>1/31</td>
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<tr>
<td>ALL-WEB: P2 OPUS</td>
<td>ALL-WEB: P2/P3 (Field)</td>
<td>ALL-Q/A: P1</td>
<td>ALL-OH</td>
<td>FTL: P2/P3 (Field)</td>
<td>PCC: P2/P3 (Field)</td>
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<tr>
<td>ALL-WEB: P3 GNSS Network</td>
<td>GNV-A: P3 (OH 2-4PM)</td>
<td>GNV-B: P3 (OH 2-4PM)</td>
<td>ALL-OH</td>
<td>FTL: P4/P5 (Field)</td>
<td>PCC: P4/P5 (Field)</td>
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<td>2/8</td>
<td>2/9</td>
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<td>2/13</td>
<td>2/14</td>
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<tr>
<td>ALL-WEB: P4 Total Station</td>
<td>GNV-A: P4 (Field)</td>
<td>GNV-B: P4 (Field)</td>
<td>ALL-OH</td>
<td>P4 Report Due</td>
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<td>2/15</td>
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<td>2/21</td>
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<tr>
<td>ALL-WEB: P5 Digital Level</td>
<td>GNV-A: P5 (Field)</td>
<td>GNV-B: P5 (Field)</td>
<td>ALL-OH</td>
<td>FTL: P6 (Field)</td>
<td>PCC: P6 (Field)</td>
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<td>2/22</td>
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<td>2/28</td>
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<tr>
<td>ALL-WEB: P6 RTK</td>
<td>GNV-A: P6 (Field)</td>
<td>GNV-B: P6 (Field)</td>
<td>UF Recharge Day</td>
<td>ALL-OH</td>
<td>GRAD: Project Proposal due 2/28 (No Grace Period)</td>
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<td>3/7</td>
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<td>ALL-WEB: P7 INS</td>
<td>GNV-A: P3 (OH 2-4PM)</td>
<td>GNV-B: P3 (OH 2-4PM)</td>
<td>ALL-OH</td>
<td>P7 Report Due</td>
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<tr>
<td>ALL-WEB: P8 UAS RGB</td>
<td>GNV-A: P3 (OH 2-4PM)</td>
<td>GNV-B: P3 (OH 2-4PM)</td>
<td>ALL-OH</td>
<td>P8 Report Due</td>
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<tr>
<td>ALL-WEB: P9 UAS multispectral</td>
<td>GNV-A: P3 (P10 Lidar Flights 2-4PM)</td>
<td>GNV-B: P3 (P10 Lidar Flights 2-4PM)</td>
<td>ALL-OH</td>
<td>GRAD: Refined Project Proposal due 3/21 (No Grace Period)</td>
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<tr>
<td>ALL-WEB: P10 Lidar - Ground Truth</td>
<td>GNV-A: P10 (Field)</td>
<td>GNV-B: P10 (Field)</td>
<td>UF Recharge Day</td>
<td>ALL-OH</td>
<td>FTL: P11 (Field)</td>
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</tbody>
</table>

GRAD: Project Proposal due 2/28 (No Grace Period)
GRAD: Refined Project Proposal due 3/21 (No Grace Period)
5. POLICIES AND REQUIREMENTS

This syllabus represents current plans and objectives for this course. As the semester progresses, changes may need to be made to accommodate timing, logistics, or to enhance learning. Such changes, communicated clearly, are not unusual and should be expected.

**Late submissions and make-up requests:**

It is the responsibility of the student to access online lectures, readings, and quizzes to maintain satisfactory progress in the course.

- A 10% penalty per day will be applied to late project reports turned in after the grace period. A submission is assessed a 10% penalty starting 1 minute after the grace period ends.
- Questions about projects should be brought to the attention of the instructors by the end of office hours on Friday. Questions asked outside of business hours may not be answered immediately, which is not an excuse for late submission.
- Project reports will not be accepted for credit if handed in more than ten days after the original due date.
- Quizzes cannot be taken past the deadline. There is no grace period for quizzes.
• Exceptions to the late policy are only allowed per university policy, and it is the responsibility of the student to make instructors aware of such extenuating circumstances within 1 week of the due date.

Computer or other hardware failures, except failure of the UF e-Learning system, will not excuse students for missing assignments. Any late submissions due to technical issues MUST be accompanied by the ticket number received from the Helpdesk when the problem was reported to them. The ticket number will document the time and date of the problem. You MUST e-mail your instructor within 24 hours of the technical difficulty if you wish to request consideration.

For computer, software compatibility, or access problems call the HELP DESK phone number—352-392-HELP = 352-392-4357 (option 2).

Requirements for class attendance and make-up exams, assignments and other work are consistent with university policies that can be found at:

Semester Evaluation Process:
Student assessment of instruction is an important part of efforts to improve teaching and learning.

At approximately the mid-point of the semester, the School of Forest Resources & Conservation will request anonymous feedback on student satisfaction on various aspects of this course. These surveys will be sent out through Canvas and are not required but encouraged. This is not the UF Faculty Evaluation!

At the end of the semester, students are expected to provide UF with feedback on the quality of instruction in this course using a standard set of university and college criteria (UF Faculty Evaluations). These evaluations are conducted online at https://evaluations.ufl.edu. Evaluations are typically open for students to complete during the last two or three weeks of the semester; students will be notified of the specific times when they are open. Summary results of these assessments are available to students at https://evaluations.ufl.edu/results.

Netiquette: Communication Courtesy Semester Evaluation Process:
All members of the class are expected to follow rules of common courtesy in all email messages, threaded discussions and chats. Failure to do so may result in loss of participation points and/or referral to the Dean of Students’ Office. http://teach.ufl.edu/docs/NetiquetteGuideforOnlineCourses.pdf

Academic Honesty Policy:
As a student at the University of Florida, you have committed yourself to uphold the Honor Code, which includes the following pledge: “We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.”

You are expected to exhibit behavior consistent with this commitment to the UF academic community, and on all work submitted for credit at the University of Florida, the following pledge is either required or
implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment."

It is assumed that you will complete all work independently in each course unless their instructor provides explicit permission for you to collaborate on course tasks (e.g. assignments, papers, quizzes, exams). Furthermore, as part of your obligation to uphold the Honor Code, you should report any condition that facilitates academic misconduct or appropriate personnel. It is your individual responsibility to know and comply with all university policies and procedures regarding academic integrity and the Student Honor Code. Violations of the Honor Code at the University of Florida will not be tolerated.

Violations will be reported to the Dean of Students Office for consideration of disciplinary action. For more information regarding the Student Honor Code, please see: http://www.dso.ufl.edu/sscr/process/student-conduct-honor-code

Inclusive Learning Environment
This course embraces the University of Florida’s Non-Discrimination Policy, which reads,

The University shall actively promote equal opportunity policies and practices conforming to laws against discrimination. The University is committed to non-discrimination with respect to race, creed, color, religion, age, disability, sex, sexual orientation, gender identity and expression, marital status, national origin, political opinions or affiliations, genetic information and veteran status as protected under the Vietnam Era Veterans’ Readjustment Assistance Act.

If you have questions or concerns about your rights and responsibilities for inclusive learning environment, please see the instructor or refer to the Office of Multicultural & Diversity Affairs website: http://multicultural.ufl.edu.

University Policy on Accommodating Students with Disabilities:
Students requesting accommodation for disabilities must first register with the Dean of Students Office (http://www.dso.ufl.edu/drc/). The Dean of Students Office will provide documentation to the student who must then provide this documentation to the instructor when requesting accommodation. You must submit this documentation prior to submitting assignments or taking the quizzes or exams. Accommodations are not retroactive; therefore, students should contact the office as soon as possible in the term for which they are seeking accommodations.

Software use:
All faculty, staff and students of the university are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against university policies and rules, disciplinary action will be taken as appropriate.

6. CAMPUS RESOURCES
Student Life, Wellness, and Counseling Help:
- U Matter, We Care: If you or someone you know is in distress, please contact umatter@ufl.edu, 352-392-1575, or visit U Matter, We Care website to refer or report a concern and a team member will
reach out to the student in distress.

- **Counseling and Wellness Center:** Visit the Counseling and Wellness Center website or call 352-392-1575 for information on crisis services as well as non-crisis services.
- **Student Health Care Center:** Call 352-392-1161 for 24/7 information to help you find the care you need, or visit the Student Health Care Center website.
- **University Police Department:** Visit UF Police Department website or call 352-392-1111 (or 9-1-1 for emergencies).
- **UF Health Shands Emergency Room / Trauma Center:** For immediate medical care call 352-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32608; Visit the UF Health Emergency Room and Trauma Center website.

**Academic Resources:**

- For issues with technical difficulties for e-learning in Canvas, please post your question to the Technical Help Discussion in your course, or contact the UF Help Desk at: Learning-support@ufl.edu | (352) 392-HELP - select option 2 | http://elearning.ufl.edu
- Library Help Desk support http://cms.uflib.ufl.edu/ask
- SFRC Academic Hub https://ufl.instructure.com/courses/303721

**Student Complaint Process:**
The School of Forest Resources & Conservation cares about your experience and we will make every effort to address course concerns. We request that all our online students complete a course satisfaction survey each semester, which is a time for you to voice your thoughts on how your course is being delivered. If you have a more urgent concern, your first point of contact should be the SFRC Academic Coordinator or the Graduate/Undergraduate Coordinator for the program offering the course. You may also submit a complaint directly to UF administration:

- **Student Complaints On-Campus:** Visit the Student Honor Code and Student Conduct Code webpage for more information
- **On-Line Students Complaints:** View the Distance Learning Student Complaint Process.

**Other Requirements:**
Cellular phones must be turned off during class. They may be used in field sessions for field work communication pertaining to this course work only.