

Special Topics in Geography/Aviation RPAS Knowledge Requirements

Spring 2017

Instructor: Derek T. Robinson, dtrobins@uwaterloo.ca, room EV1-105A
<http://env-emp-vlnx1.uwaterloo.ca/rpas/>
Office hours: Wednesday, 9:00 – 10:30am
Lecture: EV3 4412, 11:30 – 1:20 Tuesdays
Labs: EV3 4412, 1:30 – 2:20 Tuesdays
Course Number: 4760/4763

Course Description

The proliferation of sales and use of unmanned aerial vehicles has fostered innovative applications, novel remote-sensing techniques and data analysis, and simultaneously has created concerns for air-traffic management and privacy. Students in this course will gain substantive knowledge about the requirements and constraints affecting recreational as well as commercial and research remotely piloted aircraft system (RPAS) flights for geomatics applications and research. Theory and conceptual factors affecting flight, remote sensing, and spatial analysis with very-high resolution data will be discussed in lectures. In addition to the science, students will gain knowledge about how to navigate the regulatory requirements and how to link their science and research objectives as well as harness their geomatics skills to mitigate risk and communicate objectives to aid the acquisition of special flight operating certificates or other regulatory RPAS-flight requirements. Finally, assignments will be used to emphasize these aforementioned components and give students experience with applied aspects of flight campaign approval, setup, management, and success.

Learning Objectives

At the end of this course, you should:

- Demonstrate their understanding of and awareness of the requirements for RPAS flight and the successful acquisition of special flight operating certificate or other civil or governmental evaluation and testing requirements for commercial and research RPAS flights.
- Design flight campaigns that integrate aviation restrictions and science objectives by understanding the relationship between flight planning and sampling design with the geomatics tools and software available to manage, manipulate, and analyze data collected from RPAS flights.
- Critically evaluate potential research applications of RPASs to determine if the advantages of RPAS flight and data acquisition are justified, advance science, and can be achieved under current hardware, software, and regulatory constraints.

Required Text

Unmanned: Textbook for UAS Studies, 2017. Aviation Publishers Co. Ltd., Ottawa, Ontario.

Available for purchase at the campus book store (approximately \$65) or at Porter Library 1 day loan.

Available at University of Waterloo Library UW Porter. Book Stacks. 6th-10th Floors. (UG1242.D7 C36x 2017)

Reference Materials

The following references will be used throughout the course and are available on course reserve at the Porter Library, on the LEARN course website, or at <http://env-emp-vlnx1.uwaterloo.ca/rpas/>.

*Advancing Unmanned Systems in Canada, Canadian Centre for Unmanned Vehicle Systems 2007-2010,

Advisory Circular. General Safety Practices – Model Aircraft and Unmanned Vehicle Systems, Document No: AC 600-02, 2014-11-27, Transport Canada.

Advisory Circular. Guidance Material for Operating Unmanned Air Vehicle Systems under an Exemption, Document No: AC 600-004, 2014-11-27, Transport Canada.

Aeronautical Information Manual – AIM 2015-1, Transport Canada.

*Gundlach, Jay, 2014. Designing Unmanned Aircraft Systems: A comprehensive Approach, American Institute of Aeronautics and Astronautics.

Knowledge Requirements to Pilot Unmanned Air Vehicle Systems: RPAS 25 kg or less, Operating within Visual Line of Sight. First Edition, August 2014, Transport Canada.

Staff Instruction (SI) No. 623-001. Review and Processing of an Application for a Special Flight Operations Certificate for the Operation of an Unmanned Air Vehicle (RPAS) System, Transport Canada.

Small Unmanned Air Vehicle (RPAS) Definitions and Best Practices, Unmanned Systems Canada, 2013.

Study Guide for the Restricted Operator Certificate With Aeronautical Qualification, Spectrum Management and Telecommunications, Radiocommunication Information Circular, January 2008, Industry Canada.

The Canadian Council on Geomatics (CCOG), Environmental Scan on the Operational

Use of Remotely Piloted Aircraft Systems (RPAS) for Geomatics Applications in Canada, July 15, 2016.

* items not yet included in the schedule below

Schedule

The course comprises a 2-hour lecture followed by a dedicated lab. Attendance will be recorded and will be included in the evaluated grade. The lecture will be used to introduce the theory and concepts behind RPAS flight, meteorology, airspace, and regulations among other content. The lab session will be used to provide hands on experience developing skills related to navigating the regulatory requirements to gain legal approval for RPAS flight as well as setting up flight plans using geographical information systems, RPAS flight planning software, and spatial analysis of flight data. Significant additional time will be required for independent study to complete assignments and develop necessary skills (e.g., acquire Radio Operators Certification). The schedule of course content and labs are subject to change. If a change is made an updated version of the schedule or due date will be posted on the course website and students will be notified via the course website and in class.

Week	Contents	Reference Material
1	Introduction to Unmanned Aircraft Systems	Unmanned – Chapter 1; Small RPAS Definitions and Best Practices
2	Flight Mechanics and Theory of Flight	Unmanned – Chapter 2, 3; Knowledge Requirements to Pilot RPASS pages 19-34
3	Aerodromes, Airspace, and Air law	Unmanned – Chapter 4; AIM-2015-1 pages 190-200; Knowledge Requirements to Pilot RPASS pages 1-9;
4	Aviation Weather	Unmanned – Chapter 5; Knowledge Requirements to Pilot RPASS pages 14-18;
5	Air Navigation, Navigation Aids, and NOTAM	Unmanned – Chapter 6; AIM-2015-1 pages 377-378, 380-384; Knowledge Requirements to Pilot RPASS pages 10-13;
6	Radiocommunications	Unmanned – Chapter 7; Study Guide for the Restricted Operator Certificate With Aeronautical Qualification; AIM-2015-1 pages 95-101
7	Minimizing Risk, Reporting Occurrences, and Emergencies	AIM-2015-1 pages 1-49, pages 369-375
8	Transport Canada Regulations and SFOCs	AC 600-02; AC 600-004; SI No. 623-001;

9	Best Practices for flight and Geomatics	CCOG 2016
10	Sampling and Flight Design	
11	Getting RPAS data into GIS	
12	Final Test	Applicants shall have obtained a minimum of 60% on a written examination of these subjects to meet Transport Canada standards.

Topics and weeks of content delivery are subject to change. Other topics incorporated may include control, detection, and monitoring;

Method of Evaluation

Item	Format / Topic	Contribution
Assignment 1	Development of SFOC (groups of 2)	12.5%
Assignment 2	RPAS application proposal	12.5%
Test	Radio Operators Test	5%
Labs		40%
In-class test	Final Course test	25%
Attendance		5%

Labs

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1	5%	METAR and Weather Data – When to and not to fly and why
2	5%	Reading Flight Charts
3	5%	Flight Skills – Hands on RPAS Flying
4	7.5%	Sampling and Flight Design
5	7.5%	Georeferencing RPAS Imagery
6	5%	Is it legal to fly? Case study of companies on campus?
7	5%	Managing Security and Accident Risk Reduction (live scenarios)
8		Intro to Proposal Development

Late submissions: Assignments will be subjected to a 10% reduction for each day that they are late up to 5 days and then a value of zero will be assigned for the entire assignment.

Computer Labs

You can use the ENV lab(s) for practical work in this course when they are not booked for other courses. Flight planning software specific to the course will be installed in the

Geddes lab. Access codes are available at the Mapping Analysis and Design helpdesk in EV2.

NOTE: No food or drink is allowed in the labs. Failure to abide by this rule may result in your computer accounts being suspended.

Course Website

A course website has been created on the new learning platform “Learn” (Desire2Learn). Students registered in the course can access the course website after the first day of class by going to the LEARN website (<http://learn.uwaterloo.ca>) and logging in using your WatIAM/Quest username and password. Once logged in, you will see the course listed under “My Courses and Communities”. Click on GEOG or AVIA 374 to see the course content.

The course website provides access to lecture presentations, course notes, and other relevant information. Online material in LEARN can be opened or downloaded by clicking on the appropriate link. In addition, the course website supports announcements, discussion groups and e-mail. Assignments will be handed in via the LEARN course website and students should become familiar with the website and submission process early so as not to receive a late submission.

Getting Help

Students are expected to get into the habit of using the on-line help files as the **first** source of help. The TA and instructor will be available during scheduled help sessions and office hours to answer questions related to the assignments. Additional help is available from the MAD help desk.

Email

Please include the course shortcode and your family name in the subject of your email (e.g. Robinson GEOG/AVIA 374). We will try to respond to emails within 24hrs excluding weekends (i.e. Friday 5pm to Monday 8am). We will respond to emails regarding course content or logistics, while questions or concerns regarding evaluation will be reserved for discussion during office hours. Because the course is co-instructed, it is your responsibility to contact the appropriate instructor for the course materials that you are requesting assistance with.

Email and online discussions are governed by the same rules of academic conduct as your behaviour in class. Please use common courtesy, be polite, and, of course, avoid sending or forwarding aggressive, sexist, racially discriminatory, obscene, offensive, libellous, or defamatory comments of any kind. If I do not respond to your email within 24 hours please send me another email or see me in person as it may have been deleted by a spam filter or a server may have been down when the email was sent. Email can be a benefit to both the student and instructor objectives; however, email is not a substitute for one-on-one discussion and therefore I prefer to meet with you during office hours.

Academic Integrity: In order to maintain a culture of academic integrity, members of the University of Waterloo community are expected to promote honesty, trust, fairness, respect and responsibility. www.uwaterloo.ca/academicintegrity/. Students who are

unsure what constitutes an academic offence are requested to visit the on-line tutorial at: <http://www.lib.uwaterloo.ca/ait/>

Research Ethics: Please also note that the 'University of Waterloo requires all research conducted by its students, staff, and faculty which involves humans as participants to undergo prior ethics review and clearance through the Director, Office of Human Research and Animal Care (Office). The ethics review and clearance processes are intended to ensure that projects comply with the Office's Guidelines for Research with Human Participants (Guidelines) as well as those of provincial and federal agencies, and that the safety, rights and welfare of participants are adequately protected. The Guidelines inform researchers about ethical issues and procedures which are of concern when conducting research with humans (e.g. confidentiality, risks and benefits, informed consent process, etc.).

If the development of your research proposal consists of research that involves humans as participants, the please contact the course instructor for guidance and see: www.research.uwaterloo.ca/ethics/human/

Note for students with disabilities: The Office for Persons with Disabilities (OPD), located in Needles Hall, Room 1132, collaborates with all academic departments to arrange appropriate accommodations for students with disabilities without compromising the academic integrity of the curriculum. If you require academic accommodations to lessen the impact of your disability, please register with the OPD at the beginning of each academic term.

Religious Observances: Please inform the instructor at the beginning of term if special accommodation needs to be made for religious observances that are not otherwise accounted for in the scheduling of classes and assignments.

Grievance: A student who believes that a decision affecting some aspect of his/her university life has been unfair or unreasonable may have grounds for initiating a grievance. Read Policy 70 - Student Petitions and Grievances, Section 4, www.adm.uwaterloo.ca/infosec/Policies/policy70.htm. When in doubt, please contact your Undergraduate Advisor for details.

Discipline: A student is expected to know what constitutes academic integrity, to avoid committing academic offence, and to take responsibility for his/her actions. A student who is unsure whether an action constitutes an offense, or who needs help in learning how to avoid offenses (e.g., plagiarism, cheating) or about "rules" for group work/collaboration should seek guidance from the course professor, academic advisor, or the Undergraduate Associate Dean. For information on categories of offences and types of penalties, students should refer to Policy 71, Student Discipline, www.adm.uwaterloo.ca/infosec/Policies/policy71.htm. For typical penalties, check Guidelines for Assessment of Penalties, www.adm.uwaterloo.ca/infosec/guidelines/penaltyguidelines.htm

Appeals: A decision made or penalty imposed under Policy 70 - Student Petitions and Grievances (other than a petition) or Policy 71 – (Student Discipline) may be appealed if there is a ground. A student who believes he/she has a ground for an appeal should refer to Policy 72 (Student Appeals). See:

www.adm.uwaterloo.ca/infosec/Policies/policy72.htm

Consequences of Academic Offences: ENV students are strongly encouraged to review the material provided by the university's Academic Integrity office (see:

<http://uwaterloo.ca/academicintegrity/Students/index.html>).