Course Change Request

New Course Proposal

Date Submitted: 11/25/19 3:51 pm

Viewing: **GGS 422 : Drone Remote Sensing**

Last edit: 11/25/19 3:51 pm

Changes proposed by: nburtch

Programs referencing this course	SC-BS-GEOG: Geography, BS GIS: Geographic Information Systems Minor

Are you completing this form on someone else's behalf? No

Effective Term:	Fall 2020		
Subject Code:	GGS - Geography & Geoinformation Science	**Course Number:**	422
Bundled Courses:			
Is this course replacing another course?	No		
Equivalent Courses:			
Catalog Title:	Drone Remote Sensing		
Banner Title:	Drone Remote Sensing		
Will section titles vary by semester?	No		
Credits:	3		
Schedule Type:	Lecture		

In Workflow

1. **GGS Chair**
2. **SC Curriculum Committee**
3. SC Associate Dean
4. Assoc Provost-Undergraduate
5. Registrar-Courses
6. Banner

Approval Path

1. 11/25/19 4:15 pm Nathan Burtch (nburtch): Approved for GGS Chair

Hours of Lecture or Seminar per week: 3

Repeatable: May be only taken once for credit, limited to 3 attempts (N3)

Max Allowable Credits: 9

Default Grade Mode: Undergraduate Regular

Recommended Prerequisite(s):

Recommended Corequisite(s):

Required Prerequisite(s) / Corequisite(s) (Updates only): GGS 379 or GGS 416

Registrar's Office Use Only - Required Prerequisite(s)/Corequisite(s):

And/Or	(	Course/Test Code	Min Grade/Score	Academic Level	)	Concurrency?

Registration Restrictions (Updates only):

Registrar's Office Use Only - Registration Restrictions:

Field(s) of Study:

Class(es):

Level(s):

Degree(s):

School(s):

Catalog Description: An advanced remote sensing course that focuses on the fundamentals of collecting and processing drone-based sensor data for various scientific applications. Explores the principles involved in drone-based

photogrammetry, 3D reconstruction, multi-spectral and LiDAR sensing, whilst providing hands-on experience with drone mission planning, data acquisition and data processing

Justification:

With the proliferation of drones and unmanned aerial vehicles (UAV) there are increasing opportunities to use drones for scientific remote sensing data acquisition and applications. Within scientific literature there has been an exponential increase in publications using drones for remote sensing. Drones and their expanding series of new remote sensing sensors have placed the responsibility of producing calibrated, accurate data in the hands of users who have otherwise become used to simply receiving pre-processed, scientific grade satellite imagery. Amidst rapidly evolving technology and market disruption there is a need to educate students on the scientific principles involved of the sensor function and calibration in order to address specific scientific questions and geospatial applications. This advanced course focuses on understanding the fundamentals behind acquiring scientific remote sensing imagery with drone-based cameras (e.g. multi-spectral and thermal) and processing the data for various applications.

What this course is NOT: Students will not be required to acquire their own data as the data will be acquired by the qualified instructors. This course will not lead directly to certification of students for operating a drone. The course is not about flying drones, but about understanding how to acquire and process remote sensing data for scientific purposes.

Does this course cover material which crosses into another department?

No

Learning Outcomes:	Understand how to use drones as a platform to acquire scientific remote sensing data 2. Understand components and functions of a drone system 3. Understand the photogrammetric principles of drone-based image acquisition and processing 4. Participate in application-specific flight planning and data acquisition with a drone 5. Develop insight into regulations and qualifications for safe and legal drone operation. 6. Understand how to operate various drone-based sensors, RGB camera, Multispectral, Thermal, LiDAR 7. Develop the ability to process drone-derived raw data imagery (RGB camera, Multispectral, Thermal, LiDAR) to various products and applications. 8. Gain oversight of the complete mission pipe-line, from planning to final product 9. Learn to present research proposals and complete a project as a team member
Attach Syllabus	DroneRS2019Courseproposal.pdf
Additional Attachments	
Staffing:	This course is being taught as a GGS 470/590 special topics course by Dr. Konrad Wessels and Dr. Paul Houser. Both will be capable of teaching the course on their own in future semesters
Relationship to Existing Programs:	This course will add to the remote sensing curriculum in GGS at the undergraduate and graduate levels. It will be a graduate level elective course for students. At the undergraduate level, this course will be added to the Advanced Techniques courses that BS GEOG students choose from.
Relationship to Existing Courses:	In GGS, this course builds on remote sensing fundamentals taught in GGS 379 and GGS 416 (undergraduate), and GGS 579 at the graduate level. Forensics has a Forensic Drone Photography (FRSC 516) course, but there will be little to no overlap between the courses. FRSC 516 focuses more on the operations of a drone to capture photographs of a

small crime scene, while the proposed course focus on multi-spectral (visible, near-infrared and thermal) and LiDAR remote sensing of large study areas. The FRSC course focus specifically on the skills required to obtain a drone pilot license (FAA Part 107), as well as legal requirements, while the proposed course does not focus on flying drones. The proposed course focus more on classic photogrammetric and remote sensing fundamentals, sensor calibration and data processing to biophicical metrics or orthomosaics, which was traditionally based on satellite or airborne imagery.

Additional Comments:

Reviewer Comments

Key: 16612

GGS 422/622 – **Drone-Based Remote Sensing;** Credits: 3

Syllabus

Course description

An advanced remote sensing course that focusses on the fundamentals of collecting and processing drone-based sensor data for various scientific applications. Explores the principles involved in drone-based photogrammetry, 3D reconstruction, multi-spectral and LiDAR sensing, whilst providing hands-on experience with drone mission planning, data acquisition and data processing.

Objectives: To educate students on the use of drones to acquire scientific remote sensing data and process various drone-based sensor data sets for multiple applications. The course will involve hands-on experience with drone vehicles, sensors, imagery software and applications.

With the proliferation of drones there are increasing opportunities to use drones for scientific remote sensing data acquisition and applications. This advanced course focusses on understanding the fundamentals behind acquiring scientific remote sensing imagery with drone-based cameras (e.g. multi-spectral and thermal) and processing the data for various applications. Gain hands-on experience with drone vehicles, sensors, image processing software and applications.

Learning outcomes:

- Understand how to use drones as a platform to acquire scientific remote sensing data
- Understand components and functions of a drone system
- Understand the photogrammetric principles of drone-based image acquisition and processing
- Participate in application-specific flight planning and data acquisition with a drone
- Develop insight into regulations and qualifications for safe and legal drone operation.
- Understand how to operate various drone-based sensors, RGB camera, Multispectral, Thermal, LiDAR
- Develop the ability to process drone-derived raw data imagery (RGB camera, Multispectral, Thermal, LiDAR) to various products and applications.
- Gain oversight of the complete mission pipe-line, from planning to final product
- Learn to present research proposals and complete a project as a team member

Note:

- Students will not be required to acquire their own data as the data will be acquired by the qualified instructors.
- This course will not lead directly to certification of students for operating a drone.
- The course is not about flying drones, but about understanding how to acquire and process remote sensing data for scientific purposes.

Prerequisites: GGS 379 or GGS 416

Recommended text: Small-Format Aerial Photography and UAS Imagery, ISBN: 9780128129425

NOTE: The instructors will provide any required reading, and the book is optional.

Evaluation: All work must be your own.

Homework	25 points (5 per assignment)
Paper Presentation	10 points (Graduate Students Only)
Final Exam	25 points
Pop Quizzes	10 (2 Points per quiz)
Team Project	30 points
TOTAL	100 points (90 points for Undergraduates)

Grades are assigned using a ten percent scale (+/- grades determined at instructor discretion):

Undergraduate:	A= 90 – 100 B = 80 – 90 C= 70 – 80 D= 60 – 70 F= 0 – 60
Graduate:	A= 90 – 100 B = 80 – 90 C= 70 – 80 F= 0 – 70

Team Project: The project will consist of a drone remote sensing data analysis exercise to investigate a well-posed hypothesis or question. Project deliverables will consist of: 1. A brief project proposal presentation; 2. a final project report presentation (20-minute oral). Project teams should consist of 3-5 students, and project complexity should scale with team size. Projects may use already collected drone remote sensing data, or can arrange to collect new drone remote sensing data as part of this course.

Paper Presentation: Each graduate student will be required to present and lead a discussion on a published drone-based remote sensing research paper. The 15 minute presentation should be generally relevant (but not redundant) to the topic covered during that class session. Grading will be based on (1) relevancy and creativity of chosen paper/topic, (2) quality of presentation and visuals, (3) assessment of methods and drone-based sensors used and (4) responses to questions and discussion. ***Any review materials should be sent out to the class by the Friday before the presentation. Please select a date for your paper presentation – preference will be given on a first come first served basis.***

Academic integrity: The following statement is adapted from the Stearns Center for Teaching and Learning. No grade is important enough to justify academic misconduct. The integrity of the University community is affected by the individual choices made by each of us. Mason has an Honor Code, which you can read fully at the Office for Academic Integrity (https://oai.gmu.edu/mason-honor-code/). The Honor Code Pledge reads as follows:

> To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of the George Mason University Community and with the desire for greater academic and personal achievement, we, the student members of the university community, have set for this Honor Code: Student Members of the George Mason University community pledge not to cheat, plagiarize, steal, or lie in matters related to academic work.

The Mason Honor Code defines cheating, plagiarism, stealing, and lying. It is expected that you understand these definitions. If you have any doubts about what constitutes cheating, plagiarism, stealing, or lying in the academic context, please see your professor. Acts of academic dishonesty in this course may be penalized with failure of either the work in question or the entire course.

While collaboration and group learning is encouraged in this course, each student absolutely must turn in their own work, from their own computer, and any discussion must be theirs alone, and not attributable to another person or group, except where noted (for example, quoting authors as a small portion of your scholarly work). This also applies to online sources; you cannot copy the words of anyone else for any graded part of this course. It is not enough to exchange a few synonyms within a sentence! You must write, summarize, and analyze with your own words and ideas.

Disability statement: This course is in compliance with Mason policies for students with disabilities. Students with disabilities are encouraged to register with Disability Services (DS). DS can be contacted by phone at (703) 993-2474, or in person at SUB I Suite 2500, or online by the link at the end of this section. Students who suspect that they have a disability, temporary or permanent, but do not have documentation are encouraged to contact DS for advice on how to obtain appropriate evaluation. A memo from DS authorizing your accommodation is needed before any accommodation can be made. The memo should be furnished to the professor preferably within the first two weeks of class or as soon as an accommodation is made. Please visit https://ds.gmu.edu/ for more information.

Mason diversity statement: From https://stearnscenter.gmu.edu/professional-development/mason-diversity-statement

> George Mason University promotes a living and learning environment for outstanding growth and productivity among its students, faculty and staff. Through its curriculum, programs, policies, procedures, services and resources, Mason strives to maintain a quality environment for work, study and personal growth.
>
> An emphasis upon diversity and inclusion throughout the campus community is essential to achieve these goals. Diversity is broadly defined to include such characteristics as, but not limited to, race, ethnicity, gender, religion, age, disability, and sexual orientation. Diversity also entails different viewpoints, philosophies, and perspectives. Attention to these aspects of diversity will help promote a culture of inclusion and belonging, and an environment where diverse opinions, backgrounds and practices have the opportunity to be voiced, heard and respected.

Mason policy on sexual harassment, sexual misconduct, and interpersonal violence: As a faculty member and designated "Responsible Employee," I am required to report all disclosures of sexual assault, interpersonal violence, and stalking to Mason's Title IX Coordinator per university policy 1412. If you wish to speak with someone confidentially, please contact the Student Support and Advocacy Center (703-380-1434), Counseling and Psychological Services (703-993-2380), Student Health Services, or Mason's Title IX Coordinator (703-993-8730; cde@gmu.edu).

Use of electronic devices: Your professor encourages the use of devices that both aid your learning ability and do not distract from the learning of others. With the exception of mobile phones and audio/video recorders, you are free to use any electronic device that fulfills both of those conditions. All

electronic devices should be muted or silenced. Please be respectful of the class and avoid use of social media during class which can distract both you and your classmates. You are expected to adhere to Mason's student code of conduct; disruptive behavior will result in classroom removal. Audio/video recording requires the consent of the professor.

Course Outline

Date	Topic
Aug 26	Introduction: Course Requirements, Basic Drone Remote Sensing Concepts -Course syllabus and expectations -Drone, UAV, UAS definitions and history -Introduction to GGS's drone platforms (hands on) -Overview of drone remote sensing applications
Sept 9	Drone System Components, regulations and requirements (FAA Part 107))
Sept 16	Mission Planning 1 Overview of Drone data processing software and AWS
Sept 23	Drone Photogrammetry 1
Sept 30	Drone Photogrammetry 2 Processing drone imagery to point cloud and 3D mesh
Oct 7	Team Project Proposal Presentations
Oct 15	Drone deployment (software and procedures) Practical Flight demonstration Mission Planning 2
Oct 21	Multi-spectral sensing with UAV's Collection and Processing multi-spectral imagery
Oct 28	Drone Remote Sensing Analysis-Science and application questions
Nov 4	Drone-based LiDAR data collection and processing
Nov 11	Drone Remote Sensing Applications 1 - science and applications Guest Lecture(s) by professionals from industry / agencies Team project mentoring by instructors
Nov 18	Drone Remote Sensing Applications 2 - case studies Possible Guest Lecture(s)
Dec 2	Team Project Presentations