GIS-551: DIGITAL IMAGING WITH SUAS (DRONE) SYSTEMS I

Effective Term
Fall 2026

BOT Approval Date
05/15/2025

Discipline
GIS - Geospatial Information Science

Course Number
551

Course Title
Digital Imaging with sUAS (Drone) Systems I

Short Title
Imaging with Drones I

Credit Status (CB 04)
D - Credit - Degree applicable

Units

Lecture Units
2.00

Lab Units
1.00

Total Units
3.00

Hours

Lecture Contact Hours
32-36

Out of Class Hours Lecture
64-72

Lab Contact Hours
48-54

Out of Class Hours Lab
0.00

Total Contact Hours
80 - 90

Total Out of Class Hours
64 - 72

Total Student Learning Hours
144 - 162

Is this an existing Extensive Lab?
Yes

Distance Education

No

Catalog Description

This course introduces students to commercial uses of Small Unmanned Aerial Systems (sUAS), drone facilitated remote sensing theory and implementation. The course focuses on developing foundations for commercial applications of digital imagery used in geospatial information science (GIS). Topics include data acquisition, imagery collection, analysis, and interpretation.

Requisites

Prerequisite(s)

Prerequisite(s) (must be taken before)
GIS-550 (with a grade of C or better)

Codes

TOP Code (CB 03)

2206.10* - *Geographic Information Systems

CIP Code

45.0702 - Geographic Information Science and Cartography.

Repeatability Code

No

Grading Option

Letter grade OR P/NP

Minimum Qualifications

Minimum Qualifications	And/Or
Biological Sciences (Masters Required)	Or
Ecology (Masters Required)	Or
Environmental Technologies	Or
Geography (Masters Required)	Or
Multimedia	Or
Aeronautics	Or
Aviation	Or
Earth Science (Masters Required)	End

Learning Objectives

Learning Objectives

Learning Objective
1. Contrast different types of remote sensing systems used to develop commercially viable products.
2. Evaluate the strengths and limitations of the use of various remote sensing systems for commercial applications.
3. Appraise the process remote sensing acquired images for commercial use.
4. Compare commercially applicable digital models using remote sensing and analysis software.
5. Explore imagery content to represent the commercial considerations of multicultural and individual diversity perspectives.
6. Validate the use of narrative storytelling in the development of remote image data collection for commercial applications.
7. Categorize the effectiveness of various types of drones used in digital media capture.
8. Justify the ethical and privacy concerns about the use of drones in collecting digital data on the distribution and diversity of various human populations.

Learning Outcome Information

Course Learning Outcomes

Learning Outcome
1. The student will develop commercial drone application skills for varied applications with a perspective from the students' own age, ethnic, racial, gender and/or socio-economic background.
2. The student will apply deductive reasoning to the collection of imagery data and the development of geospatial imagery data for commercial applications.
3. The student will analyze the capabilities, limitations, and features of drone collected imagery and other digital data as it is used in commercial applications.
4. The student will exercise reflective thought concerning imagery and data collection for commercial use.

Content

Course Lecture Content

I. Commercial Uses of Drone Collected Digital Media
- A. History of commercial use of digital media
- B. The "Digital Society"
- C. Digital imagery and geospatial information

II. The Use of Drone Collected Digital Media in Commercial Applications
- A. Professional drone configurations
- B. Professional imagery and digital data configurations
- C. Review and analysis of commercial applications

III. Drone Collection of Commercial Digital Imagery
- A. Reading an Image vs. Understanding an Image
- B. Interpretation vs. projection
- C. Point of view

IV. Planning and Narrative Design
- A. Elements of good storytelling
- B. Applications of story in commercial GIS digital spaces
- C. Appreciation and analysis of narrative storytelling
  1. Cultural perspective
  2. Applying bias to storytelling

V. sUAS used in Commercial Imagery Capture
- A. DJI Matrice 300 RTK— facilities inspections
- B. Flyability Elios 2—indoor facilities inspections
- C. DJI Mavic 3—aerial photography/videography
- D. Freefly Alta 8—high-end cinematography.
- E. XAG V40 2021—agriculture.
- F. Parrot ANAFI USA—public safety
- G. WingtraOne Gen II—high end mapping & surveying
- H. DJC Phantom 4 Pro—mapping & surveying
- I. Autel Robotic—facilities inspections, mapping

VI. Software for GIS Image Manipulation
- A. Site Scan for ArcGIS
- B. Drone2Map
- C. Pix4Dmapper
- D. DroneDeploy

VII. Image Basics
- A. Pixels, resolution, and image size
- B. File Formats, compression, and limitations

C. Raster vs. Vector Images
VIII. Drone Image Capture
A. Still photography
B. Video photography
C. Non-visual spectrum applications
XI. Imagery from the Perspective of Individuals of Differing Human Populations.
A. Considerations of cultural and ethnic differences
B. Gender bias and perspective in collection and analysis of imagery
C. Aspects of age related response to imagery

Course Lab Content

I. Introduction to sUAS collected digital media
A. Types of drones used in digital media capture.
B. Digital media capture devices
II. Still image photography
III. Videography
IV. Specialized digital data
V. Ethical and Privacy Concerns
A. Distribution of Human Populations - Diversity
B. Ethnic and Racial Considerations of digital data gathering
C. Socio-economic Consideration of digital data gathering
D. Gender diversity Consideration of digital data gathering
VI. Remote Sensing Platforms and Sensors
A. Multispectral scanners
B. Hyperspectral scanners
C. Infrared and thermal scanners
VII. Digital Imaging
A. Survey potential capture devices
B. Checklist
C. Flight operation and camera operation
D. First Person View systems
E. Flight Parameters
F. Flight times & wireless transmission
G. Limitations
H. Way finding
VIII. Pre and Post Processing and Delivery
A. Stabilize video
B. Panoramic photos
C. Remove lens distortion
D. Sharing images
IX. Documenting distribution of Human Populations
A. Ethnic and Racial Considerations of video photography
B. Socio-economic, gender, and privacy considerations
C. Ethnic and Racial Considerations of video photography
D. Socio-economic, gender, and privacy considerations
X. Electromagnetic Radiation Principles
A. Insolation
B. Radiation
C. Electromagnetic spectrum
D. Emitted vs. natural electromagnetic radiation

XI. Spectral signatures differentiation
XII. Spatial and Spectral Enhancement
XIII. Land use Classification
  A. Supervised classification
  B. Unsupervised classification
XIV. Navigation and Maintenance
  A. Pre-flight planning
  B .Latitude and longitude
  C. Time zones
  D. Determining altitude
  E. Pre-flight briefing and inspection
  F. Post-flight debriefing and inspection
  G. Right of way
  H. Maintenance
XV. Aviation Weather
  A. Atmosphere and air pressure
  B. Heat and temperature
  C. Wind
  D. Precipitation
  E .Micrometeorology in urban settings
  F. Aviation weather services
XVI. Weight and Balance
  A .Terminology
  B .Weight and balance control
  C. Calculating weight and balance
XVII. Crew Resource Management
  A. Risk management
  B. Risk assessment
  C. Rick factors
  D. Mitigating risk
  E. Hazardous attitudes
  F. Decision making process
  G. Situational awareness
XVIII.Change Detection
  A. Image differencing
  B. Multi-date visual change detection

Methods of Instruction

Method

Individualized Instruction

Integration

Individualized instruction is used to develop students' ability to operate and program a drone, equipped with a variety of sensors including GPS, video and/or still photography for commercial applications. Students work individually with the instructor to prepare and present commercial portfolios of drone collected digital imagery.

Method

Observation and Demonstration

Integration

Observations and demonstrations are used to develop students' ability to participate in the collection and evaluation of drone collected digital information as it is used in commercial GIS data recovery applications. These demonstrations guide students through data collection processes, uploading, analysis and applications using sUAS for commercial imagery and spatial analysis. Demonstrations and observation focus on real-world scenarios of drone applications in the collection of digital data, problem-solving methods, and decision-making techniques in commercial imagery endeavors. These observation and demonstration activities help students define and evaluate problems associated with acquisition and accuracy of drone collected imagery and digital data used in commercial applications.

Method

Discussion

Integration

Discussion are used to assess students' understanding of digital imagery collection and analysis for use in commercial applications. Students participate in a discussion of various aspects of commercial uses of drone data collection and analysis as to how it relates to subsets of human diversity. Discussions include aspects of how members of different social, cultural, racial, ethnic, gender, age characteristics of human population respond to and are affected by the presentation of commercial drone digital data collection and analysis.

Method

Lab Activities

Integration

Laboratory activities are used to develop students' hands-on skills and knowledge for commercial applications of drone collected imagery and other forms of digital data. Students participate in laboratory groups to operate and program drones equipped with a variety of sensors including GPS, video and/or still photography for the development of commercial applications. Students work as a team of two or more individuals with one person operating the camera and one operating the drone flight.

Method

Lecture

Integration

Lectures explore the professional understandings of the components, equipment, and technology used to set-up and operate a working drone for the collection of digital imagery including aspects of the legal and ethical responsibilities of collection of digital imagery as it is used in commercial applications. Lectures help students compare and contrast conventional photographic and video technology to drone application technology. Lectures support the development of an appreciation of the knowledge and skills necessary to participate in commercial drone imagery applications.

Methods of Evaluation

Method

Homework

Integration

Homework exercises focus on drone and imagery hardware and software techniques, flight skills, imagery production applications, concepts and terms as used in commercial applications. In particular students explore, define and evaluate problems associated with acquisition and accuracy of sUAS collected digital data used to formulate and interpret imagery for commercial use. Using rubrics designed for each assignment, homework is evaluated for its completeness, clarity, accuracy, details, correctness and applicability to the topics presented in the assignment details.

Method

Capstone Project

Integration

The Capstone project is designed to evaluate an understanding of drone imagery collection in real-world scenarios. Students prepare and present a commercial drone imagery collection and interpretation project. With this project, students develop commercial drone application skills, apply deductive reasoning to the development of geospatial imagery data for commercial applications, using a variety of sensors including GPS, video and/or still photography. They analyze the capabilities, limitations, and features of drone collected imagery as it is used in commercial applications. This project is designed to incorporate each of the course's learning objectives and includes not only written dialog on the commercial use of a digital imagery product; but, on the potential of diverse human responses to various aspects of the project. Projects are evaluated on the design, research, drone platform(s) used, photographic methods used, artistic and accuracy of data presentation as well as appropriate topic relating to a commercial use of the project. Evaluation is accomplished using a three-part rubric including the performance criteria, rating scale and performance indicators used to evaluate the project. The rubric defines the level of completion of the required tasks, assessment of the thesis statement, writing style and organization of the project, a definition and analytic rating scale describing levels of completion and evaluation of each criterion represented by the project.

Method

Presentations

Integration

Students give demonstrations of drone flight plans designed to collect digital data for commercial applications. The presentations include pre and post drone flight information and representations of data collected during the commercial flights. Students are evaluated on completeness, clarity, accuracy, details, correctness of the flight plan and on the application of hands-on-skills in flying the drone and collecting digital imagery according to the proposed flight plan.

Method

Portfolios

Integration

Students develop commercial portfolios of drone collected digital imagery and other digital data. Students are required to initiate the development of their commercial "portfolios" represented by digital data collected using drones. The portfolio represents the use of a number of different formats, sUAS platforms, cameras, and analytical and presentation tools. Portfolios are evaluated on the quality and quantity of digital images included, the completeness, clarity, accuracy, and details presented to demonstrate commercial use value of the images presented.

Method

Class Participation

Integration

Students demonstrate a mastery of course objectives through their ability to discuss complex drone flight, imagery and digital data collection spatial analysis knowledge and skills necessary to develop commercially viable products. Students are required to propose flight digital data collection hypotheses, suggest appropriate data collection methods and analytical tools, and evaluate the accuracy of their results. Student participation in these activities are graded with a rubric representing various levels of assimilation and understanding of course content.

Method

Exams/Tests

Integration

Exams/tests include a variety of question formats that evaluate student comprehension of lectures, assigned readings and exercises. These examinations include knowledge necessary to collect, analyze and present drone collected digital imagery and other forms of digital information and applications related to the course learning outcomes as well as technical processes and procedures and historical and current context information related to collection of digital imagery. Examinations are evaluated using rubrics designed specifically for the course objectives being evaluated. Answers are evaluated on accuracy and student understanding of concepts and information presented in lecture and laboratory instruction.

Assignments

Assignment Type
Writing

In-class and/or outside of class
In-class
Outside of class

Formative or Summative
Formative

Assignment
Produce written documentation of a sUAS flight plan for the remote collection of commercially viable digital imagery. Include the specific hardware and software used and the geospatial information to be collected.

Assignment Type
Reading

In-class and/or outside of class
Outside of class

Formative or Summative
Formative

Assignment
Research and evaluate, using the Internet, library, textbook, or other professional/academic resources, commercial uses of sUAS collected imagery data. Read and summarize at least five (5) commercial imagery products from different sources.

Assignment Type
Other

In-class and/or outside of class
In-class

Formative or Summative
Formative

Assignment
Demonstrate your ability to use a sUAS, to gather archive and analyze, remotely collected GPS, video and/or still photography. Include a demonstration of uploading the data from the sUAS into a software program for archiving and analysis. Be sure to include the kind of digital imagery collected and the specific software application you use.

Assignment Type
Writing

In-class and/or outside of class
Outside of class

Formative or Summative
Summative

Assignment

Prepare a proposal to produce a commercially relevant photographic, video, or other drone collected digital data product, targeting a specific class(es) of human diversity, e.g. gender, racial, ethnic, age, socio-economic. The proposal must clearly state the purpose or intent use of the digital imagery and the drone application and data to be collected. Provide details about how you will acquire, prepare, build, and analyze data for the project. Identify the type of sUAS equipment to be used; the flight plan, digital camera or other data collection devices, mapping parameters, and potential report or combination of deliverables. Prepare a diagram of the workflow procedures and iterative steps taken to determine successful completion of the product.

Assignment Type

Reading

In-class and/or outside of class

Outside of class

Formative or Summative

Formative

Assignment

Research a method, model, or application that describes the commercial use of drone gathered imagery/data. Prepare a summary that describes how the application is used in three different commercial use situations. Be sure to include the kind of drone used, the imagery/data to be analyzed and how the data is used for commercial purposes.

Assignment Type

Reading

In-class and/or outside of class

Outside of class

Formative or Summative

Summative

Assignment

Read the article, "Drone imagery to create a common understanding of landscapes, Landscape and Urban Planning, Volume 228, December 2022". https://www.sciencedirect.com/science/article/pii/S0169204622002201
Assess the interpretability of different types of drone collected imagery by various stakeholders.

Course Materials

Textbooks

Remote Sensing: Principles, Interpretation, and Applications, Fourth Edition 4th Edition
by Floyd F. Sabins Jr., James M. Ellis, 2020, ISBN-13: 978-1478637103
ISBN-10: 1478637102

Other Resources

Aerial Photography and Videography Using Drones, 1st Edition, by Eric Cheng, 2015, ISBN-10: 0-13-412277-1 ISBN-13: 978-0-13-412277-9

Open Educational Resources

Data Use in an Undergraduate Remote Sensing Course, https://www.oercommons.org/courses/data-use-in-an-undergraduate-remote-sensing-course.

Geography Remote Sensing Class Activities, 2021, https://drive.google.com/file/d/1O1446k3W2BZgmm9smfiUP31s3dyR6gSy/view.

Nature of Geographic Information Systems: An Open Geospatial Textbook, David DiBiase, 2020, https://www.oercommons.org/courses/nature-of-geographic-information-an-open-geospatial-textbook.

Class Size Information

Class Size

32

Class Size Category

G - Large lab 32

Diversity and Inclusion

Course Design and Materials: Course will incorporate diverse perspectives, authors, and examples that reflect a variety of cultures, identities, and lived experiences. Instructional materials will be reviewed regularly to ensure representation, inclusivity, and alignment with equity-minded practices across disciplines.

Inclusive Learning Environment: Instructors will establish classroom norms and policies that promote respect, civil discourse, and belonging in both online and face-to-face classes. Clear expectations for communication and engagement will support a learning space where all students feel valued and heard.

Accessible Instruction: Course content will be delivered using accessible design. Materials will follow accessibility guidelines within the CMS, including captioned media, readable document formats, and multiple means of engagement to support diverse learning.

Equitable Teaching Practices: Instructors will use transparent and grading criteria, varied assessment methods, and timely feedback to promote fairness and student success. Opportunities for revision, reflection, and multiple demonstrations of learning may be incorporated when appropriate to the discipline.

Culturally Responsive Pedagogies: Instructional strategies will encourage critical thinking about diverse perspectives and systems of power relevant to the course content. Faculty will foster opportunities for students to connect course material to real-world contexts.

Ongoing Reflection and Improvement: Faculty will engage in continuous professional development related to IDEAA principles and reflect on course practices using metacognition to identify opportunities for increased equity, inclusion, and accessibility.

Explain how diversity and inclusion(e.g., gender, culture/race, sexuality, etc.) is infused into the course.

The course operates with a foundational intention of diversity and inclusion. Included in the objectives, is the necessity of teaching diverse content from multicultural and interpersonal perspectives across all aspects of the course content. Emphasis is placed on the articulation of how drone technology imagery data collection and analysis contributions to the commercial applications of the discipline of geospatial science. The course offers students' opportunities to foster empathy, expose variant interpretations, and exhibit diverse societal concerns represented by the geographic distribution of humans around the globe. The course content is designed to align objectives with and to create opportunities for students from a variety of backgrounds to hone new skills while acknowledging and honoring their diverse, existing knowledge base. The course emphasizes the need to present commercial imagery documenting not only geophysical aspects of human geospatial distribution, but as well, the socio-cultural perspective as it pertains to race, gender identity, sexual orientation, and cultural differences. Students are expected to use GIS imagery which considers cultural, economic, political, and gender-based positioning in developing commercial use assignments affecting the geospatial imagery of human activities. Assignments are formatted to allow students to reflect on their cultural frame of reference and to investigate their personal perspectives as to the geospatial imagery of the communities to which they associate. Students are encouraged to consider factors representing their personal cultural, economic, political, and gender-based positioning in developing assignments affecting the imagery representations of the geospatial distribution of human activities. Students are urged to consider not only how photographic and video imagery have affected their own geographic distribution but how they are used in a "historical context" to capture the deeper connections between socio-historical forces and the geospatial distribution of humans.

Describe how assignments, instruction, evaluation, course content, and interactions are contextualized for diverse learners promoting an equitable course.

To better support diverse learners, formative and summative active learning strategies and included in-class and out-of-class assignments are incorporated that explored content material through the lens of equity and diversity. Discussions, class activities and assignments are designed to allow students to bring in their own cultural experiences through the collection and analysis of digital imagery. The methods of evaluation feature the necessity of formative and summative assessments that align with the revised course objectives and content. Discussions, group activities, and lectures support the infusion of student feedback and interaction with the instructor. The course materials include an OER option. The course emphasizes the aspects that diverse learners bring to the use drone technologies to investigate not only the geophysical aspects of the imagery collected using sUAS; but as well, the socio-cultural perspective, as it pertains to their individual ethnic, race, gender identity, sexual orientation, and cultural differences. Students

are expected to call on their own educational and life learning experiences to contextualize how digital imagery data collection and analysis are studing in the lens of their own learning styles and history. Students explore how their own learning styles and methodologies of inquiry, contribute to the collection and analysis of drone imagery data.

Interactions

Explain how the course will incorporate student-to-student interaction.

Students are encouraged to work together to solve geospatial imagery problems both in lecture and laboratory situations. Student are required to participate in weekly student to student discussion sessions on topics related to the collection and processing of digital imagery with an sUAS (drone). Students are organized into laboratory work groups to simulate commercial working conditions in the collection, analysis and production of drone collected imagery. Drone flight imagery collection specifically involves student to student interaction between the drone pilot and the camera operator. As an example, one of the assignment requirements is that; with one or more lab partners, students work as a team to program and operate a drone equipped with a sensor, GPS, video and/or still photography, for digital data collection.

Explain how the course will incorporate instructor-to-student interaction.

The instructor facilitates instructor to student interactions by encouraging and requiring students to reflect on course topics and articulate an understanding of the material to the instructor and other students. Laboratory instruction is designed to include extensive instructor/student one-on-one instruction in the use of the professional drone image data collection applications and software. To better support a diverse range of learners, instructors are encouraged to work individually with students to assess and implement a variety of learning styles incorporating formative and summative active learning strategies in the both the lecture and laboratory assignments. Students are encouraged to ask questions and get clarification of concepts and skills development examples from the instructor.

Explain how the course will incorporate student-to-content interaction.

Student to content interaction is incorporated in both lecture and laboratory presentations and assignments as well as the semester "Capstone" project. Students are required to apply lecture content and operationalize applications of instruction in laboratory assignments. Students are introduced to content in the lecture portion of the class and interact with the content in many ways including researching relevant information, summarizing lecture presentations, taking quizzes and examinations, participating in discussions, project development and development of the semester Capstone project. Laboratory assignments require students to produce drone acquired digital output using information discussed and developed in lecture. This output represents a variety of data presentations all of which include imagery collection and analysis of specific geospatially related questions; what resources are being explored; who (the diversity of populations) are impacted by the resources; where the resources are congregated and the historical data influencing the commercial application of the images representing the geospatial distributions.

Explain how the course will incorporate student-to-self interaction (metacognitive).

The goal is to support students in connecting their personal experiences with the concepts and skills of sUAS imagery collection and analysis presented in the course. Assignments are designed to validate the student's life experience by seeing themselves in the design and presentation of commercially appropriate drone collected imagery. Class activities, reading, lecture, discussions and student development of technical commercial projects encourage and allow students to explore various personal interpretations and understandings of their individual relationships to the commercial use of geospatial imagery related to their own diversity, socio-economic status, gender, ethic-racial background and other aspects of their own identity and history.

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