GIS-552: DIGITAL IMAGING WITH SUAS (DRONE) SYSTEMS II

Effective Term
Fall 2026

BOT Approval Date
05/15/2025

Discipline
GIS - Geospatial Information Science

Course Number
552

Course Title
Digital Imaging with sUAS (Drone) Systems II

Short Title
Imaging with Drones II

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 provides advanced instruction in Small Unmanned Aerial Systems (sUAS), drone facilitated remote sensing theory and implementation focusing on commercial applications of digital imagery used in geospatial information science (GIS). Topics include satellite imageries, data acquisition, and image interpretation. The hands-on applications of the course cover high resolution video, aerial imaging, intelligent mission planning, multi-spectrum image capture, and the use of sUAS, drones, for collection, editing, mapping and commercially related uses of remotely collected digital imagery.

Requisites

Prerequisite(s)

Prerequisite(s) (must be taken before)
GIS-551 (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
Earth Science (Masters Required)	Or
Aeronautics	Or
Aviation	End

Learning Objectives

Learning Objectives

Learning Objective
1. Distinguish between different types of specialized uses of remote sensing systems used in agricultural, engineering, land development or safety services drone applications.
2. Contrast strengths and weaknesses of manual, intelligent and automated flight mission modes for the collection of commercially applicable digital imagery.
3. Collect and process images and relevant data for agriculture, safety services, disaster service, business, government of other commercially applicable uses.
4. Critique image definition, camera optimization and geo-referencing information needed to develop GIS Capstone product.
5. Contrast characteristics of drone image capture flight for a safety services and transportation of materials application.
6. Compare and contrast advanced camera 2D vs 3D operations for still image photography and videography.

7. Assess various conditions that require the use of visual spectrum and non-visual spectrum digital media capture devices.
8. Design an application for the use of Lidar imagery for digital data collection.
9. Differentiate between the applications using thermal imaging versus Lidar imaging.
10. Evaluate the effects of global climate change, targeting a specific class of human diversity, e.g. gender, racial, ethnic, age, socio-economic.

Learning Outcome Information

Course Learning Outcomes

Learning Outcome
1. Students will explore and develop diverse commercial drone imagery content from multicultural and individual diversity perspectives.
2. Students will integrate spatial thinking with drone imagery and GIS analysis technology to develop, construct, and analyze commercial use patterns represented in drone collected digital data.
3. Students will question and think independently about the knowledge and skills required to collect and process commercially viable, drone acquired digital imagery and data with a variety of sensors.
4. Students will construct and operationalize an advanced sUAS flight plan for the collection of digital imagery.
5. Students will create and execute a commercially viable videographic remote imagery product.
6. Students will evaluate remotely accessed digital media for use in two or more commercial applications.

Content

Course Lecture Content

I. Advanced Digital Media Collection and Processing
- A. Specialized Commercial Use of Digital Media
- B. New Era in Geospatial Data Collection
- C. Aerial and Satellite Photography
- D. Thermal Infrared Imaging
- E. Radar, Sonar and Lidar Technologies

II. Digital Media Processing Environments
- A. Entertainment
- B. Advertising
- C. Emergency Response
- D. Agriculture
- E. Engineering
- F. Land Development
- G. Logistics
- H. Security
- I. Transportation of Materials
- H. Health Care
- J. Catastrophe and Disaster Management

III. Advanced Digital Imagery Information Extraction
- A. Aerial Elevation Data
- B. Data Analytics Global DEMs
- C. Delivery Action Image Enhancement

IV. Drone Platform Data Acquisition
- A. Intelligent mission planning modes
- B. Automated flight path planning
- C. Content creation - Sensor platforms
  - 1). Cinematography
  - 2). Videography

3). Photography
4). Non-visual imagery
D. UAV imaging for Aerial Mapping
V. Flight Planning and Imagery Output Design
A. Operational Flight Path
B. Safety and Planning Accuracy
C. 2D and 3 D Output
1. Measurement track changes
2. Export formats
D. Publishing Results
VI. Advanced Concerns of sUAS used in Commercial Imagery Capture
A. Environmental Concerns
B. Cost-effectiveness
C. Access rights
VII. Advanced Image Manipulation Commercial Software Applications
A. Pix4Dmapper
B. DroneDeploy
C. Pix4field
D. ESRI Site Scan
VIII. Camera Optimization and Geo-referencing
A. Key-points per image
B. Initial and optimized camera parameters
C. Calibrated image data
IX. Advanced Image Capture Flight Environments
X. Post-Processing
A. Editing UAV generated images and video
B. Generating images and data for GIS related uses
C. Processing imagery for 3D export
D. Non-linear editing
E. Media-sharing
XI. Geospatial Image Documentation of the Diversity and Ethnic Distribution of Human Populations
A. World distribution of religious affiliations
B. Historical look at African slave trade
C. Homelessness in America
D. Geospatial Imagery of the #MeToo movement
E. Documenting Pandemics.
F. Global Climate Change
XII. Emerging Uses of Remote Digital Imagery

Course Lab Content

I. Sources of Digital Imagery and Media
A. Visual imagery
B. Non-visual, multi-spectrum imagery
C. 2D vs 3D
II. Commercial drone platforms used in digital media capture.
A. Fixed wing aircraft
B. Quadcopter
C. Other commercial platforms
III. Visual Spectrum and non-visual digital media capture devices
A. DJI Zenmuse X5 and X7

B. Enterprise Mavic 2 Advanced
C. Enterprise Mavic 2 Dual Infrared
D. Z Cam 4K Lidar

IV. Advance Camera operations for Still image photography
A. DJI Air 2
B. DJI Phantom 4 Pro
C. DJI Mavic 2 Enterprise Dual

V. Inspection concern and techniques
A. Point source inspection
B. Restricted air space
C. Inspection with people present (OOP, operations over people)
D. Inspection hazards

VI. Urban areas
A. Privacy concerns
B. Air traffic
C. FAA regulations
D. Specific drone equipment requirements
E. Building density and height considerations
F. Flying over moving vehicles
G. Night operations
H. Piloting from moving vehicles

VII. Flying over people (OOP)
A. FAA regulations
B. Human health hazards and risks
C. Notifications
D. Considerations of different concerns of various populations of human diversity such as gender, racial, age, socio-economic, and ethnic origin.

VIII. Advanced Camera operations for Videography
A. Gimbal control
B. Resolution, image size
C. Pixel definition altitude concerns

IX. Commercial applications
A. Requirements of drone and imagery collection devices
B. Inspection parameters
C. Location analysis
D. Service sector issues
E. Retail locations
F. Emerging E-commerce applications

X. Visual line of sight (VLOS) vs Beyond visual line of sight (BVLOS)
A. FAA regulations
B. Pilot and visual observer operations
C. Emerging BVLOS applications

XI. Emerging Digital Imagery and Digital Data Commercial Uses
A. Multi-platform camera operations
B. Laser (LIDAR) applications
C. Non-spectral (visual) applications

XII. Applications of Commercial Drone Use
A. Safety Services Emergency Response
B. Environmental/Agriculture
C. Engineering- Construction

D. Transportation of Materials
E. Health Care
F. Climate Change

XIII. Drone Flight Plans for Digital Imagery Capture
A. Logbook information
B. Drone maintenance concerns
C. Camera maintenance concerns
D. Weather and temporal concerns
E. Intelligent mission planning modes - Site Scan for ArcGIS and Drone2Map
F. Automated flight path planning - Using DroneDeploy

XIV. Portfolio Design
A. Choosing a commercial application
B. Defining industry standards for specific application
C. Aesthetic considerations

XV. Drone Flights with digital imagery capture for portfolio development (minimum 3 hours of flight time)
A. Manual flight
B. Programmed flight

XVI. Post-Processing
A. Still imaging
B. Video imaging
C. Downloading
D. Editing and Formatting
E. Editing images for special applications, eg. construction, agriculture, safety services.
F. Processing images for export

Methods of Instruction

Method

Lecture

Integration

Lectures develop a professional understandings of the use of visual spectrum and non-visual digital media capture devices, advanced camera, DJI Zenmuse X5 and X7, operations for still image photography, and spatial analysis knowledge and skills such as the analysis of remote sensing acquired images with Site Scan for ArcGIS with respect to commercial product development. Lectures are used to specify the strengths and limitations of remote sensing software systems such as DRone2Map and DroneDeploy as well as the characteristics of drone image capture flight using platforms such as DJI Mavic 2 Enterprise Dual and DJI Phantom 4 Pro. Particular emphasis is placed on digital media processing and presentation for specialized commercial uses, such as Entertainment, Emergency Response and Agriculture, of drone collected digital media. Lectures cover digital media processing environments such as ESRI Site Scan, for editing of UAV generated imaging, 3D digital imagery export and non-linear editing.

Specialized drone platforms for data acquisition such as thermal infrared, radar, sonar and Lidar technologies are presented. Intelligent mission, automated flight path and flight planning and output design are presented as well as image manipulation software applications and post processing, as well as geospatial image documentation of human populations. Class participation focuses on knowledge and skills in course content such as aerial data collection, data acquisition, intelligent mission planning modes and automated flight path planning.

Method

Lab Activities

Integration

Lab activities are used to help students develop the ability to participate in professional environments related to the collection, processing and evaluation of digital imagery. Lab activities present opportunities for students with various learning styles, to distinguish between different types of specialized uses of remote sensing systems used in agricultural, engineering, land development or safety services drone applications. Students work as "commercial development" teams of two or more individuals to develop hands-on skills and application knowledge for the processing, analysis and preparation of commercial uses of drone

collected imagery and other forms of digital data. These skills and knowledge applications include sources of digital imagery and media such as visual and non-visual, multi-spectrum imagery as well as 2D and 3D sources of digital imagery. Commercial drone platforms used for digital media capture include both fixed wing and quadcopter aircraft. Special concerns of drone inspections include point source inspection, flying in restricted air space and inspections with people present (OOP0 in populated urban and sub-urban areas.

Method

Discussion

Integration

Discussions are used to help students contextualize information present in both the lecture and laboratory portions of the course. Students participate in discussions of various advanced aspects of commercial drone data processing and analysis. Discussions include such topics as UAV imaging for Aerial Mapping, Flight Planning and Imagery Output Design, . Operational Flight Path and Safety and Planning Accuracy. Discussions include a focus on how these concepts relate to various aspects of human diversity as represented in a variety of human endeavors such as; entertainment, advertising, emergency response, agriculture, engineering, land development (real estate), logistics, security, transportation of materials, health care, catastrophe and disaster management, and other geospatial aspects of human socio-economic structures.

Method

Observation and Demonstration

Integration

Demonstrations and observation focus on problem-solving methods, analysis, processing and decision-making techniques in commercial imagery endeavors. Topics include issues such as the critique of image definition, camera optimization and geo-referencing information needed to develop GIS Capstone product. Students participate in the observation of topics such as gimbal control, resolution, image size, pixel definition and altitude concerns. Commercial endeavors include the requirements of drone and imagery collection devices, inspection parameters, location analysis, service sector issues, retail locations and emerging E-commerce applications. Observations and demonstrations are used to engage students with a variety of learning styles incorporating new and previous experiences with the information. Students are required to process and evaluate drone collected digital information as it is used in commercial geospatial data applications. These demonstrations guide students through the analysis and applications using drone collected commercial imagery and spatial analysis software.

Method

Discussion

Integration

Class discussion of how digital imagery of various aspects of human diversity, such as gender definition, race, ethnic distribution, etc. is represented in space and time and how this data gives a better understanding of human diversity and equity in social, political, and economic decision making.

Methods of Evaluation

Method

Exams/Tests

Integration

Exams/tests include a variety of question formats that evaluate student comprehension of lectures, assigned readings and exercises. They are designed to evaluate the students ability to integrate spatial thinking with drone imagery and GIS analysis technology to develop, construct, and analyze commercial use patterns represented in drone collected digital data. Topics include knowledge and application of advanced technical processes and procedures related to Entertainment, Advertising, Emergency Response, Agriculture, Engineering, Land Development, Logistics, Security and other human interests. Examinations include skills and knowledge necessary to demonstrate a student's ability to analyze and present drone collected digital imagery and other forms of digital information and applications related to advance digital imagery collection and processing. Students are evaluated on their ability to question and

think independently about the knowledge and skills required to process and present commercially viable, drone acquired digital imagery and data with a variety of sensors. Examinations are evaluated using criteria designed specifically for the course objectives being evaluated, such as contrasting strengths and weaknesses of manual, intelligent and automated flight mission modes for the collection of commercially applicable digital imagery. Answers are evaluated on accuracy and student understanding of concepts and information presented in lecture and laboratory instruction.

Method

Class Participation

Integration

Class participation is used for students to demonstrate the use of visual spectrum and non-visual digital media capture devices, advanced camera operations for still image photography, and spatial analysis knowledge and skills. Class participation focuses on knowledge and skills in course content such as aerial data collection, data acquisition, intelligent mission planning modes and automated flight path planning. As part of the class participation students are required to not only propose, but also demonstrate, flight digital data collection, flight hypotheses development, appropriate data collection methods and analytical tools, and the accuracy of their results. Student participation in these activities is graded using criteria representing various levels of completeness, clarity, accuracy, details, and correctness of the assimilation of course content.

Method

Portfolios

Integration

The portfolio addresses the course learning outcome of assessing characteristics of a variety of drones use for the collection of remote imagery for commercial applications. Portfolios representing a student's advanced understanding of the development of professional digital imagery for commercial applications. Students are required to develop individual "portfolios" represented by digital data collected using drones from at least one of the following areas: Commercial Use of Digital Media, Digital Imagery and Geospatial Information, Digital Media in Commercial Applications, Entertainment, Advertising, Emergency Response, Agriculture, Engineering, Land Development, Logistics, Security, Transportation of Materials, Health Care, Catastrophe and Disaster Management or other area specifically approved by the instructor.The portfolio represents the advanced use of a number of different formats, sUAS platforms, cameras, and analytical and presentation tools representing not only commercial applications, but industry standards, and aesthetic considerations. Portfolios are evaluated according to a rubric representing the completeness, clarity, accuracy, details, appropriateness and correctness of digital imagery for use in commercial applications.

Method

Presentations

Integration

Presentation cover a variety of topics including the evaluation of remotely accessed digital media used in commercial applications. Presentations are used to evaluate a student's understanding of the development and execution of advanced drone flight plans designed to collect commercially applicable digital imagery data. The presentations include pre and post drone flight information and representations of data collected during the flight. Students demonstrate knowledge of pre and post-processing of still and video imaging as well as non-visual data. Presentations are evaluated on the completeness, clarity, accuracy, details, and correctness as to the commercial viability of the products presented. Students are also required to demonstrate a minimum of 3 hours of drone flight time which includes the capture of digital imagery.

Method

Capstone Project

Integration

The Capstone project specifically addresses the course learning outcome to create and execute a commercially viable videographic remote imagery product. The project is evaluated as to its efficacy as a representation of a semester summative assignment of the knowledge and information about advanced sUAS, drone, collected digital imagery developed by a student in the class. From in-class lectures, demonstrations and laboratory activities involving real-world scenarios, students prepare and present a unique collection and interpretation project, including a "GIS Story Map", representing a specific industry, scientific, social or other human interest application of drone collected geospatial imagery. The Capstone project must include the use of at least one specific analysis

software tool for advance GIS image manipulation: Site Scan for ArcGIS, Drone2Map, Pix4Dmapper, DroneDeploy, or Pix4field. The project must also demonstrate advanced image definition with camera optimization and geo-referencing techniques including: pixels, resolution, and image size key-points per image data; file formats, compression, and computer memory limitations; initial and optimized camera parameters; and raster and/or vector images. Portfolios should represent calibrated image data. Students are evaluated on the design, research, drone platform, photographic methods used, artistic and accuracy of data presentation as well as appropriate topic relating to a commercial use of the project.

Method

Research Projects

Integration

From in-class discussions and outside readings evaluate how digital imagery data about gender definitions, racial and ethnic aspects of human populations can provide valuable information related to diversity, equity and inclusion.

Assignments

Assignment Type

Writing

In-class and/or outside of class

In-class
Outside of class

Formative or Summative

Summative

Assignment

With other members of your "commercial development team" prepare a proposal, using relevant drone collected digital data, to evaluate the effects of global climate change, targeting a specific class of human diversity, e.g. gender, racial, ethnic, age, socio-economic. Provide details about how you decide on what population or specific target group will be evaluated in your presentation. Describe 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 detailed diagram of the workflow procedures and iterative steps taken to determine successful completion of the product.

Assignment Type

Writing

In-class and/or outside of class

In-class
Outside of class

Formative or Summative

Formative

Assignment

Research and evaluate a drone, digitally collected, data project used to evaluate a specific construction or agriculturally related endeavor. Include what aspect of the endeavor are to be evaluated by the data collected. Identify the audience for which the project is proposed, collected and presented. Identify and explain why a specific type(s) of drone is used and the specific camera or other non-image device used to collect the data. Identify a "real-life"" geographic area in which the data will be collected. Identify any relevant temporal and meteorological conditions which impact data collection relevant to the project. Present your findings to the class as if you are making a presentation to a client.

Assignment Type

Reading

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

Formative or Summative
Formative

Assignment
Using the Internet, library, textbook, or other professional/academic resources, research and evaluate the establishment of a restaurant or retail establishment in a specific geographical location of your choice. Identify what sUAS collected imagery data was used, including digital maps, geographic data, downloadable geographic and descriptive imagery data, socio-economic, cultural, gender, and other pertinent imagery data to reflect interest and diversity of individuals and populations represented in the geospatial environment. Read and summarize at least five (5) imagery products used to evaluate the location chosen. Present your findings to your work group members.

Assignment Type
Reading

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

Formative or Summative
Formative

Assignment
Gather information to develop a drone flight application to collect digital imagery or other digital data to evaluate the daily traffic patterns of a major roadway of your choice. Read to identify and develop a road use temporal hypothesis. Take into account the limitations of flying over people and vehicles. Explore multiple digital imagery/data to be analyzed; determine which imagery will be used; and how it will be used to evaluate your hypothesis. Review the steps taken to do the analysis and develop potential concerns and outcomes of the flight plan. Research a method, model or application to enhance the use of the project in identify traffic congestion concerns. Present your findings to members of your work group.

Assignment Type
Reading

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

Formative or Summative
Formative

Assignment
Read the article, "Citizen visions of drone uses and impacts in 2057: Far-future insights for policy decision-makers", Technological Forecasting and Social Change, Volume 204, July 2024, https://www.sciencedirect.com/science/article/pii/S0040162524002348 Appraise this article in respect to how the use of drone digital data may be viewed by populations representing the wide diversity of humans.

Course Materials

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

Other Resources
ESRI Site Scan and Drone to Map simulations

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

http://www.agisoft.com/downloads/user-manuals/
http://www.dji.com/product/inspire-1/download
http://www.dji.com/product/spreading-wings-s900/download

Agisoft PhotoScan Lessons and Tutorials:
http://www.agisoft.com/support/tutorials/beginner-level/

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.

DronEgenuity: Comprehensive List of Commercial Drone Uses. https://www.dronegenuity.com/commercial-drone-use-cases-comprehensive-list/

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.

This course provides a framework for how advanced aspects of digital data collection with the use of sUAS (drones) provides geospatial information with a focus on how humans interact with their positional environment both regionally and globally. Assignments invite students to explore diversity and inclusion issues that affect gender, culture, sexuality, age and other diversity issues especially as they affect marginalized communities both domestically and abroad. Considerations of diversity issues are integrated into the content and students are invited to explore the ways in which the effects of geospatial positioning impact cultures

and genders in diverse and unequal ways. The course emphasizes aspects of how commercial imagery represents the socio-cultural perspective of human distribution as it pertains to race, gender identity, sexual orientation, and cultural differences.

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

The course centers on the use of non-spectral, and LiDAR imagery in the development of commercial use digital information as it represents diverse cultures, voices, and lived experiences. Students are urged to consider how photographic and non-spectral imagery represent aspects of the environment that have affected their own geographic distribution. 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. Instruction is focused on eliminating diversity and inclusion barriers in the development of commercially successful digital imagery products. Students are expected to interact with one another in discussions focused on contemporary issues in drone facilitated digital imagery collection and application to commercial products. Students are encouraged to share their perspectives and personal experiences while exploring and adhering to norms of inclusivity. Students are encouraged to challenge their own expectations of what it means to engage with geospatial information science research and are provided with the tools to be active in the scientific endeavor of geospatial data collection regardless of their chosen major or career path. The use of different types of instruction and interactions; lecture, film, group discussions, laboratory student to student interaction, and student to self interaction, provide different styles of learners an opportunity to interact with the material in ways that are meaningful to them.

Interactions

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

Students are encouraged to work together to design, carry-out and interpret geospatial imagery problems in commercial applications. Students participate in student to student interactions in "career work groups" to simulate an employment environment. Career work groups simulate commercial working conditions to develop, carryout and analyze drone flights for the collection of a variety of digital imagery.

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. Instructors encourage students to ask questions and get clarification of concepts and skills development. The instructor participates with each student in a one on one evaluation of the course "Portfolio" project to evaluate its applicability to a real-life commercial scenario. The portfolio addresses the course learning outcome of assessing characteristics of a variety of drones use for the collection of remote imagery for commercial applications. The instructor works with individual students to develop portfolios representing the student's advanced understanding of the development of professional digital imagery for commercial applications.

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 "Portfolio" project. 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 portfolio project. Laboratory assignments are designed to introduce students real life commercial applications of drone acquired digital output. These commercial applications represent a variety of data presentations all of which include imagery collection and analysis of specific geospatially related questions.

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

Assignments are designed to support students in validating their life experience by seeing themselves in the design, application and presentation of commercially appropriate drone collected imagery. Class activities encourage 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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