USC Dornsife
Dana and David Dornsife College of Letters, Arts and Sciences

SSCI 220L (Section 35771R), Spatial Data Collection Using Drones

Syllabus (as of April 1, 2021)

Units: 4

Term — Day — Time: Spring, 2021

Location: Lectures will occur ONLINE on Tues and Thurs from 9:00 - 10:20 AM. Labs will be on Mon from 8:00 – 9:50 AM. The initial plan for this course was to be delivered in a hybrid format. In this, if/when Los Angeles County/USC authorized teaching on campus, a small number of meetings (either the lecture or the lab) would be in person as well as live streamed. All others would be held online. Presently, all meetings will be ONLINE with the Zoom delivery location being posted via Blackboard.

Instructor: COL[R] Steven Fleming, Ph.D
Office: AHF B55
Office Hours: Mon/Wed; 8-9 AM. I plan to open my Zoom room during this time. However, students still need to inform me in advance that they desire to meet during these office hours so that I can allocate time to their specific needs. Additionally, I am available asynchronously via email and synchronously via phone on most days and times *by prior arrangement* via email.
Contact Info: s.fleming@usc.edu**,** 213-740-7144.

Lab Instructor: Dr. Jason Knowles. **Office:** Remote ONLY.
Office Hours: By appointment.
Contact Info: jasonkno@usc.edu.

Library Help: Andy Rutkowski
Office: VKC 36B; **Hours of Service:** Tuesdays, 10 a.m.-12 p.m. and Thursdays 4:30-5:30 p.m. PT
Contact Info: arutkows@usc.edu, 213-740-6390, http://bit.ly/andyhangout

IT Help: Richard Tsung
Office: AHF 145D; **Office Hours:** By appointment
Contact Info: spatial_support@usc.edu, 213-821-4415

Course Scope and Purpose

Geographic Information Systems (GIS) and imagery collected from unmanned/unpersonned aerial systems (UASs) or drones present researchers an unparalleled opportunity to study the earth's built and natural systems and the human impact on these systems in very high detail. The recent advent of stable and maneuverable unmanned/unpersonned aerial systems (e.g. quad and octocopters vs fixed-wing), formal regulations by the FAA (in the United States, and the dramatic reduction in production costs, has enabled the rapid adoption over the past five years of UAS by the consumer market. Under the supervision of faculty that are licensed FAA remote system pilots, students will develop the requisite knowledge and practical skills to conduct remotes sensing operations via sourcing, analyzing, and producing GIS and simulation-based projects with UAS-derived data. As a recurring theme, a number of *Security & Safety for Human Populations* examples will be used throughout the course.

This course is a required course for the B.S. in Human Security and Geospatial Intelligence. It serves as an elective course for the B.S. in GeoDesign, the B.S. in Global GeoDesign, and the B.S. in Environmental Studies. Additionally, it serves as an elective course for the minor in GIS and Sustainability Science, Human Security and Geospatial Intelligence, or Spatial Sciences.

All course materials will be organized through Blackboard. The main theoretical concepts will be provided through course notes and assigned readings. Hands-on practical exercises/projects will use various software products accessible over the Internet. Assignments will give students an opportunity to internalize and apply the concepts and theory learned from readings. Some assignments require student interaction in which all will benefit from it.

Learning Objectives

On completion of this course, students should be able to:

- Specify fitness-for-purpose (i.e. use) criteria and apply them to the evaluation of geospatial data for specific applications;
- Demonstrate an understanding of conceptual foundations of remote sensing, focused primarily on imagery data, with an additional focus on UAS-derived products;
- Describe the methods to collect and process UAS-derived imagery;
- Use GIS and modeling to process, exhibit, and analyze imagery datasets;
- Conduct imagery-based geospatial analysis;
- Discuss the application of GIS in research and the management of natural and manmade environments;
- Present and share analytic results.

Prerequisite(s): None
Co-requisite(s): None
Recommended Preparation: None

Class Conduct

Harassment, sexual misconduct, interpersonal violence, and stalking are not tolerated by the university. All faculty and most staff are considered Responsible Employees by the university and must forward all information they receive about these types of situations to the Title IX Coordinator. The Title IX Coordinator is responsible for assisting students with supportive accommodations, including academic accommodations, as well as investigating these incidents if the reporting student wants an investigation. The Title IX office is also responsible for coordinating supportive measures for transgender and non-binary students such as faculty notifications, and more. If you need supportive accommodations you may contact the Title IX Coordinator directly (titleix@usc.edu or 213-821-8298) without sharing any personal information with me. If you would like to speak with a confidential counselor, Relationship and Sexual Violence Prevention Services (RSVP) provides 24/7 confidential support for students (213-740-9355 (WELL); press 0 after hours).

Technological and Communication Requirements

ArcGIS and other software tools are provided online via the GIST Server; hence, you do not need to install it on your own computer. Instead, every student must have the following technology requirements:

- A computer with a fast Internet connection.
- A functional webcam and a microphone for use whenever a presentation or meeting is scheduled.
- An up-to-date web browser to access the Server

SSI Server and Tech Support – This course utilizes the SSI Server which is a virtual desktop giving access to many different professional software. If you are unable to connect to the server or experience any type of technical issues, send an email using your USC account to SSI Tech Support at spatial_support@usc.edu, making sure to copy (cc) me on the email.

Communications – This is presently taught as a distance learning course, so most of our interactions will be a combination of synchronous and asynchronous (not at the same time). All materials to be handed in will be submitted via Blackboard. It is each student's responsibility to stay informed about what is going on in our course. In addition to email about time-sensitive topics, any important announcements will be posted on the Announcement page in Blackboard. Be sure to check these each time you log onto Blackboard. I will send via email through Blackboard any notices that are time sensitive. Please be sure that you read as soon as possible all email sent from Blackboard or from me. Do not ignore course email until the day before assignments are due. Also double check to be sure that email sent from the USC blackboard account does not go into your junk mail! While I am usually on-line all day and will probably respond to emails from students very quickly, I will endeavor to respond to all email within 24 hours of receipt, aiming for no more than 72 hours delay. In the rare case when I expect to be off-line for more than 72 hours, I will post an announcement on the Blackboard site.

Discussion forums – On the Blackboard site, I will post a series of discussion threads relevant to various sections of the course. Discussions provide a key means for student-to-student discussion and collaboration that can replicate the face-to-face contact you may have experienced in traditional classrooms. Here students can provide support to each other while working on your assignments, sharing hints and helpful tips, as you would in a classroom laboratory. Please post your questions about assignments there, as you would ask them publically in the classroom. I monitor the discussion threads and offer comments when necessary, but more importantly, consider the discussion board a key way to connect with your classmates and share your discoveries.

Course Structure

This is a four-credit course comprised of lectures (two per week) and project/data collection session (one per week). The lecture/learning sessions will discuss various aspects of spatial data collection approaches, remote sensing concepts, UAS platforms, UAS-based sensors, UAS data collection, and the hardware and software systems used to investigate these processes. The weekly project meetings or UAS data collections are designed to introduce the student to the tools of remote sensing inquiry and to provide practical experience in implementing these tools to explore various problems within the framework of the scientific method. The lecture and project sessions are designed to complement each other to provide the student with sound theoretical reasoning and the technical skills to investigate various physical attributes. The project assignments will be graded and returned. It is required that you register for both the lecture and one laboratory session for this course.

Please note that all course materials and correspondence will be posted on the course Blackboard website. As a registered student you will find this course available for you to access on the first day of classes.

Required Readings and Supplementary Materials

The required textbooks for this course are:

- Brown, C. and C. Harder. 2017. ***The ArcGIS Book – 2nd Edition***. Washington, DC: New America. Esri Press, Redlands, CA. ISBN: 9781589484870 (no cost; provided in Bb).
- Brown, C. and C. Harder. 2016. ***The ArcGIS Imagery Book***. Washington, DC: New America. Esri Press, Redlands, CA. ISBN: 9781589484627 (no cost; provided in Bb).
- Canada Centre for Remote Sensing (CCRS). 2000. ***Fundamentals of Remote Sensing*** (no cost; provided in Bb).
- Jensen, John R, 2017. ***Drone Aerial Photography and Videography: Data Collection and Image Interpretation***. Amazon Kindle store or Apple iBooks store. NOTE: The Amazon Kindle store version is recommended as it can be viewed on either the Microsoft Windows or the Apple operating systems.

Supplemental Readings – Some (not all) of the following journal articles and readings will be used in course as directed or posted to Blackboard. Additional readings may be added:

- Aber, James S., Marzolff, I, Ries, J.B., and Aber, S. 2019, Principles of Photogrammetry (Chapter 3). Small-Format Aerial Photography and UAS Imagery. Elsevier B.V. https://doi.org/10.1016/B978-0-12-812942-5.00003-3
- Candiago, S., Remondino, F., De Giglio, M., Dubbini, M., & Gattelli, M. 2015. Evaluating multispectral images and vegetation indices for precision farming applications from UAV images. *Remote Sensing*. 7(4): 4026-4047.
- Clark, R. 2020. *Geospatial Intelligence – Origins and Evolution (Selected Chapters).* Georgetown Washington, DC: University Press.
- Colomina, I., & Molina, P. 2014. Unmanned aerial systems for photogrammetry and remote sensing: A review. *ISPRS journal of photogrammetry and remote sensing*. 92: 79-97, https://www.sciencedirect.com/science/article/pii/S0924271614000501.
- Colorado, J., Mondragon, I., Rodriguez, J., & Castiblanco, C. 2015. Geo-mapping and visual stitching to support landmine detection using a low-cost UAV. *International Journal of Advanced Robotic Systems*. 12(9), 125.
- Dall'Asta, E., G. Forlani, R. Roncella, M. Santise, F. Diotri, U. Morra di Cella, 2017. Unmanned Aerial Systems and DSM matching for rock glacier monitoring, ISPRS Journal of Photogrammetry and Remote Sensing, 127:102-114, http://dx.doi.org/10.1016/j.isprsjprs.2016.10.003.
- DeMario, A., P. Lopez, E. Plewka, R. Wix, H. Xia, E. Zamora, D. Gessler, A.P. Yalin, 2017. Water plume temperature measurements by an unmanned aerial system (UAS). Sensors; 17(2):306, http://doi:10.3390/s17020306
- Eisenbeiss, H. 2004. A mini unmanned aerial vehicle (UAV): system overview and image acquisition. *International Archives of Photogrammetry. Remote Sensing and Spatial Information Sciences*. 36(5/W1): 1-7.
- Erenoglu, R.C., O. Akcay, O. Erenoglu, 2017. An UAS-assisted multi-sensor approach for 3D modeling and reconstruction of cultural heritage site, Journal of Cultural Heritage. 26:79-90, http://dx.doi.org/10.1016/j.culher.2017.02.007
- Gillan, J.K., K. Jason, A. Elaksher, M.C. Duniway, 2017. Fine-resolution repeat topographic surveying of dryland landscapes using UAS-based structure-from-motion photogrammetry, Remote Sensing, 9, 437; http://doi:10.3390/rs9050437
- Greenwood, F. 2015. How to make maps with drones. In *Drones and Aerial Observation: New Technology for Property Rights, Human Rights, and Global Development, A Primer*, edited by K. Kakaes. 35-47. Washington, DC: New America.
- Jones IV, P., L. G. Pearlstine, H. F. Percival, 2007. An assessment of small unmanned aerial vehicles for wildlife research, Wildlife Society Bulletin, 34(3): 750-758, http://www.jstor.org.pallas2.tcl.sc.edu/stable/3784704

- Kachhwaha, T. S. 1983. Spectral signatures obtained from Landsat digital data for forest vegetation and land-use mapping in India. *Photogrammetric Engineering and Remote Sensing*. 49(5): 685-689.
- Khorram S., Koch F.H., van der Wiele C.F., Nelson S.A.C. 2012. Remote Sensing. Springer Briefs in Space Development. Boston, MA: Springer.
- Mesas-Carrascosa, F.J., M. D. Notario García, J.M. Meroño de Larriva and A. García-Ferrer, 2016. An analysis of the influence of flight parameters in the generation of unmanned aerial vehicle (UAV) orthomosaicks to survey archaeological areas, Sensors, http://doi:10.3390/s16111838
- Mulero-Pázmány, M., S. Jenni-Eiermann, N. Strebel, T. Sattler, J.J. Negro, Z. Tablado, 2017, Unmanned aircraft systems as a new source of disturbance for wildlife: A systematic review. PLOS ONE, 12(6), e0178448. https://doi.org/10.1371/journal.pone.0178448
- Pajares, G., 2015. Overview and Current Status of Remote Sensing Applications Based on Unmanned Aerial Vehicles (UAVs), Photogrammetric Engineering and Remote Sensing. 81(4): 281-329.
- Remondino, F., 2003. From point cloud to surface: the modeling and visualization problem. International Archives of photogrammetry. *Remote Sensing and Spatial Information Sciences*. 34.
- Vas, E., A. Lescroe, O. Duriez, G. Boguszewski, D. Gremillet, 2015. Approaching birds with drones: first experiments and ethical guidelines, Biological Letters, 11(2): DOI: 10.1098/rsbl.2014.0754
- Whitehead, K., and C. H. Hugenholtz., 2014. Remote sensing of the environment with small unmanned aircraft systems (UASs), Part 1: A review of progress and challenges. *Journal of Unmanned Vehicle Systems.* 2: 69-85.
- Zhang, C., J.M. Kovacs, 2012. The application of small unmanned aerial systems for precision agriculture: a review, Precision Agriculture, 13(6): https://link.springer.com/article/10.1007/s11119-012-9274-5

Description and Assessment of Assignments

There are several different kinds of assignment with at least one due weekly. These are described in the Weekly Folders on Blackboard. Careful planning and a serious, consistent commitment will be required for a student to successfully navigate the various deliverables in this course throughout the semester. Due dates are shown in the course schedule below.

Project Assignments – 5 worth a total of 35 points. For a portion of the classes, students will be doing project work based on GNSS data, UAS imagery data, or data collected from another source (such as satellite imagery). Students may talk with each other in class to complete these exercises & tutorials, but will need to do the projects on their own and submit independent work.

Midterm – 1 worth 15 points. There will be one midterm administered in class which will cover information presented this far as well as assigned readings.

Reading Responses – 5 worth a total of 20 points. During most weeks, each student will completed assigned readings and post a responses on Blackboard. The posting should be under 200 words and informally discuss the readings, it may include what the student agrees/disagrees with, what critiques the student may have or links to other relevant materials (websites, videos, etc.).

Online Discussions – Various worth a total of 5 points. There will be a number of online discussions on Blackboard. The purpose of the Blackboard discussions is to foster a dialogue on current and sometimes contentious topics related to UAS use such as 'Drones and Privacy'. In each discussion every student will make one short post in response to the instructor's prompt and then make at least two prompts responding to other students or further prompts from the instructor.

Project Participation – Various worth a total of 5 points. Student participation and involvement is critical for the success of this course. Each student must actively participate in class discussions and projects, especially those project discussions involving drones. You will be evaluated on the quality and usefulness of your contributions and insights. Your comments should:

- Demonstrate that you have read and understood the assigned texts and articles
- Help move the class conversation forward by offering your unique/relevant perspective
- Take an active role in field-based work.

Final Exam – 1 worth 20 points. There will be one final exam administered in class which will cover information presented throughout the course. The exam will be administered during exam week.

Grading Breakdown

Careful planning and a serious, consistent commitment will be required for you to successfully navigate the various deliverables in this and other SSI courses. The table below summarizes the SSCI 220L course assignments and their point distribution.

Assignments	Number	Points Each	Total Points
Project Assignments	5	7	35
Midterm	1	15	15
Reading Responses	5	4	20
Online Discussion	~ 5	Variable	5
Class Participation	5	1	5
Final Exam	1	20	20
Totals	~ 22	-	100

Assignment Submission Policy

All assignments are due at the start of the designated class and must be uploaded to Blackboard. Work submitted after the deadline will be accepted with a penalty. Additionally, no written work will be accepted for grading after 5 p.m. PT on the last day of classes.

Course Schedule: A Weekly Breakdown

	Topic	Assignments and Readings	Deliverables/Due Dates
Week 1 **(4 Day Week)** 1/18 Monday, 1/18 is a USC holiday	Intro to GIS and Spatial Data	Review Course Syllabus Read Brown (2016) Chap. 1 Read Brown (2017) Chap. 1 Read Jensen (2017) Chap. 1 Read CCRS (2000) ToC	No deliverables
Week 2 **(5 Day Week)** 1/25	Intro to Spatial Data Collection and Remote Sensing	Read Brown (2016) Chap. 2 Read Brown (2017) Chap. 2 Read CCRS (2000) Chap. 1	No deliverables
Week 3 **(5 Day Week)** 2/1	Defining Imagery and Intro to sUAS	Read Brown (2016) Chap. 3 Read Jensen (2017) Chap. 2	Reading Response 1 ***Due 2 Feb***
Week 4 **(5 Day Week)** 2/8	GNSS Coordinates and Coordinate-Based Referencing	Read Clark (2020) Chaps. 4 and 7 Read Selected Supplemental Reading: *Is RTK the Future of Drone Mapping?*	Project 1 ***Due 9 Feb***
Week 5 **(4 Day Week)** 2/16 Monday, 2/15 is a USC holiday	Photogrammetry, UAS Flight Basics (Part I), and Flight Planning	Read Jensen (2017) Chap. 3 Read Selected Supplemental Reading: *Principles of Photogrammetry* Watch: *Introduction to Photogrammetry* video by Stachniss.	Reading Response 2 ***Due 16 Feb***
Week 6 **(5 Day Week)** 2/22	UAS Flight Basics (Part II), Pilot Licensing, and Air Space Considerations	Read Jensen (2017) Chap. 7 Read Jansen (2017) Chap. 4, Sections 7-8	Project 2 ***Due 23 Feb***
Week 7 **(5 Day Week)** 3/1	Perceiving the Imperceptible (Sensors - Part I)	Read Brown (2016) Chap. 4 Read Jensen (2017) Chap. 4, Sections 1-6 and Section 11	Reading Response 3 ***Due 2 Mar***
Week 8 **(4 Day Week)** 3/8 Friday, 3/12 is a Wellness Day	Perceiving the Imperceptible (Sensors - Part II)	Read CCRS (2000) Chap 2 Scan CCRS (2000) Chap 3	Midterm ***11 Mar (during class)***

Week 9 **(5 Day Week)** 3/15	Turning Imagery into Information (Part I)	Read Brown (2016) Chap. 5 Read Jensen (2017) Chap. 5, Sections 1- 5	Project 3 ***Due 16 Mar***
Week 10 **(4 Day Week)** 3/22 Tuesday, 3/23 is a Wellness Day	Turning Imagery into Information (Part II)	Read Jenson (2017) Chap. 5, Sections 6-13	Reading (Watching) Response 4 ***Due 22 Mar***
Week 11 **(5 Day Week)** 3/29	Creating Mirror Worlds – 3D Imagery	Read Brown (2016) Chap. 6 Read Jensen (2017) Chap. 6, Sections 1-6 Read CCRS (2000) Chap 4, Sections 4.1-4.5	No deliverables
Week 12 **(4 Day Week)** 4/5 Wednesday, 4/7 is a Wellness Day	Imagery in the 4th Dimension – Temporal Applications and Change Mapping	Read Brown (2016) Chap. 7 Read Jensen (2017) Chap. 6, Sections 7-15 Read CCRS (2000) Chap 4, Sections 4.6-4.9	Project 4 ***6 Apr***
Week 13 **(5 Day Week)** 4/12	The Big Data Challenge – Managing Imagery and Distribution	Read Brown (2016) Chap. 8 Read Jensen (2017) Chap 4, Sections 9-10 Read Selected Supplemental Reading(s) on Modeling & Simulation (VR Demo) (TBP)	Reading Response 5 ***Due 13 Apr***
Week 14 **(4 Day Week)** 4/19 Thursday, 4/22 is a Wellness Day	The Future Is Now – Converging Technologies (Modeling, Simulation, and Interaction)	Read Jensen (2017) Chap. 8 and 9 Read Selected Supplemental Reading(s) (TBP)	Project 5 ***Due 20 Apr***
Week 15 **(4 Day Week)** 4/26 Friday, 4/30 is a Wellness Day, 4/29 is the last day of class	Summary of Imagery Applications and Products	Read Brown (2016) Chap. 9 Read Selected Supplemental Reading(s) (TBP)	No deliverables
Exam Week 5/5 – 5/12	Final Exam		***11 May, 8-10 AM***

Statement on Academic Conduct and Support Systems

Academic Conduct

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in *SCampus* in Part B, Section 11, "Behavior Violating University Standards" policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in *SCampus* and university policies on scientific misconduct, http://policy.usc.edu/scientific-misconduct.

Support Systems

Counseling and Mental Health– (213) 740-9355 – 24/7 on call
engemannshc.usc.edu/counseling
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline – 1 (800) 273-8255 – 24/7 on call
www.suicidepreventionlifeline.org
Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) – (213) 740-9355(WELL), press "0" after hours – 24/7 on call
studenthealth.usc.edu/sexual-assault
Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) – (213) 740-5086 |Title IX Compliance – (213) 821-8298
equity.usc.edu, titleix.usc.edu
Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment– (213) 740-5086 or (213) 821-8298
usc-advocate.symplicity.com/care_report
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity | Title IX for appropriate investigation, supportive measures, and response.

The Office of Disability Services and Programs – (213) 740-0776
dsp.usc.edu
Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Campus Support and Intervention – (213) 821-4710
uscsa.usc.edu
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity at USC – (213) 740-2101
diversity.usc.edu
Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call
dps.usc.edu, emergency.usc.edu
Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety – - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call
dps.usc.edu
Non-emergency assistance or information.

Resources for Online Students

The Course Blackboard page and the GIST Community Blackboard page have many resources available for distance students enrolled in our graduate programs. In addition, all registered students can access electronic library resources through the link https://libraries.usc.edu/. Also, the USC Libraries have many important resources available for distance students through the link: https://libraries.usc.edu/faculty-students/distance-learners. These include instructional videos, remote access to university resources, and other key contact information for distance students.