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

SSCI 588, Remote Sensing for GIS

Syllabus

Units: 4

Term — Day — Time: Fall, 2015, Online

Location: Online, via Blackboard

Instructor: COL [R] Steven D. Fleming, Ph.D.
Office: AHF B55D
Office Hours: Monday and Wednesdays, 9:00-10:00 am PST, and by appointment at other times. I am always available asynchronously via email. I am also available for synchronous chats via phone or Skype or IM text, audio or video most days and times *by prior arrangement* via email. Or we can meet in my Adobe Connect room. Just get in touch!

Contact Info: stevendf@usc.edu**,** 213-740-7144 **Adobe Connect:** http://usccollege.adobeconnect.com/stevendf
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Library Help: Katharin Peter
Office: VKC B40A
Hours of Service: By appointment
Contact Info: kpeter@usc.edu, 213-740-1700 (office)

IT Help: Richard Tsung
Hours of Service: Monday to Friday, 9:00 am-5:00 pm PST **Contact Info:** ctsung@usc.edu, 213-821-4415

Course Description

This course is an elective course for the Geographic Information Science & Technology (GIST), Geospatial Intelligence, and Geospatial Leadership Graduate Certificates and the GIST M.S. degree programs and explores some of the ways in which remote sensing systems provide geospatial information that is relevant, accurate, timely, accessible, available in an appropriate format, and cost-effective. Recent developments in Earth observation such as imaging radar, LiDAR and hyperspectral sensors are increasing the wealth of information that can be generated from remotely sensed data sources. As a consequence, numerous new GIS applications that rely on advanced remotely sensed data sources have emerged at local, regional and global scales. We will cover several topics:

Remote Sensing Principles – We start by examining the history and modern-day scope of remote sensing and continue with an in-depth review of the full electromagnetic spectrum since the interpretation of remote sensing imagery depends first and foremost, on a sound understanding of electromagnetic radiation and its interaction with surfaces and the atmosphere.

Image Acquisition – Here we examine the fundamentals involved in image acquisition, by examining a variety of topics associated with digital photographic sensor systems, the role and importance of digital data, the typical steps that would be involved in transforming these digital data into information (i.e. image interpretation), the various Earth observation missions launched thus far, the various contributions provided by microwave, LiDAR, and thermal sensor systems, and the role of image resolution in projects integrating remote sensing and GIS.

Image Analysis – We next take up the typical remote sensing for GIS workflow that starts with one or more forms of preprocessing (i.e. feature extraction, radiometric, and geometric corrections), continues with the process of assigning pixels to classes using one or more forms of digital image classification, and typically concludes with the collection and use of field data for model calibration and accuracy assessment. We will also examine hyperspectral remote sensing, which utilizes many of the aforementioned principles and methods, but requires specialized data sets, instruments, field data and software.

GIS / Remote Sensing Applications – We will conclude the course by looking at the various ways in which GIS and remote sensing have been integrated and used to characterize natural as well as human phenomena at a variety of scales ranging from individual humans and land parcels to neighborhoods, cities, regions, continents, hemispheres and nowadays, to the entire globe.

Learning Outcomes

When you have completed this course, you will be able to:

- Explain the principles of remote sensing and the technical characteristics and constraints of Earth Observation missions.

- Design, implement and critically evaluate methods of digital image processing ranging from preprocessing to image classification, field data collection and accuracy assessment.
- Generate geographical information by processing digital remotely sensed data and critically evaluate its use for human security and/or environmental applications.
- Critically evaluate the opportunities and available methods for integrating remote sensing and GIS.

Course Formats

This a graduate level course, so you should expect this class to be both academically robust and intellectually challenging. As graduate students you are expected to engage with the information you are learning and to explore the heady cauldron of ideas, opinion, and analysis that describe our collective effort to thoroughly interrogate the subject at hand. Learning arises from active engagement with the knowledge found in our reading materials and with one another. As in any graduate-level class, the instructor's role is that of a guide who keeps you on this path of discovery and you will find that you will learn much from your fellow classmates. The challenge for us is to replicate such an academic experience within the milieu of "online learning".

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 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, all will benefit from it.

Technological Proficiency and Hardware/Software Required

We have several technologies that will facilitate our course work and our interactions, despite our dispersed locations. These include:

Blackboard – All course materials and correspondence will be posted on the course Blackboard site. As a registered student, you will find this course will show up in your available classes no later than 12:00 noon, PST on the first day of classes. It is here that the day-to-day flow of the course will be recorded.

Discussion boards – On the Blackboard site, we will post a number of discussion threads related to various course topics. These threads are very important in terms of providing support to each other while working on class exercises to share hints and helpful tips, as you would do in a classroom setting. I will check the discussion threads periodically and offer occasional comments. Please send your course instructor an email directly if you have a question or concern that requires my immediate attention.

Live meetings and presentations – We will use a browser-based service called Adobe
Connect to create synchronous, interactive sessions. With voice and webcam capabilities, Adobe Connect can be used to share presentations and even our desktops between two or more people.

Individual meetings – While Adobe Connect can be used for one-on-one meetings, we generally find it easier to use the free VOIP and chat technology, Skype (http://www.skype.com/) for individual chats.

GIST server and tech support – This course will utilize the GIST Servers to provide you with your own virtual desktop. You can access the GIST Server at: https://gistonline.usc.edu. If you are unable to connect to the server or experience any type of technical issues, send an email to GIST Tech Support at gistsupport@dornsife.usc.edu and make sure to copy (cc) me on the email. GIST Tech Support is available Monday through Friday, 9:00 a.m.to 5:00 p.m. PST. A variety of geospatial software platforms (ArcGIS, e-Cognition, Idrisi, etc.) are provided online via the GIST Server; hence, you do not need to install it on your own computer. Instead, every student must satisfy the following technology requirements: (1) a computer with a fast Internet connection; (2) a functional webcam and a microphone for use whenever a presentation or meeting is scheduled; and (3) a modern web browser, Firefox recommended, to access the GIST Server (in the event you want or need to).

Required Readings and Supplementary Materials

Textbooks – There are two required texts for this course. The first book by Campbell can be purchased from the USC Bookstore or online outlets such as Amazon and the second book by Warner and Campagna can be purchased from either the USC Bookstore or Clark Labs (http://www.clarklabs.org/). We will need the Campbell book from the first day of classes and the second book by Warner and Campagna very soon thereafter.

- Campbell, James B., 2011. *Introduction to Remote Sensing,* 5th edition. New York, Guilford Press.

- Warner, Timothy A. and Campagna, David J., 2014. *Remote Sensing with IDRISI® Selva: A Beginner's Guide.* Hong Kong, GeoCarto International.

Readings – To be posted to Blackboard under Course Documents:

1. Boyd, D.S. and Danson, F.M. (2005) Satellite remote sensing of forest resources: Three decades of research development. *Progress in Physical Geography* 29: 1-26.

2. Gilliespie, T.W., Chu, J., Frankenberg, E., and Thomas, D. (2007) Assessment and prediction of natural hazards from satellite imagery. *Progress in Physical Geography* 31: 459470.

3. Strahler, A.H., Woodcock, C.E., and Smith, J.A. (1986) On the nature of models in remote sensing. *Remote Sensing of Environment* 20: 121-139.

4. Price, J.C. (1994) How unique are spectral signatures? *Remote Sensing of Environment* 49: 181-186.

5. Townshend, J.R.G., Huang, C., Kalluri, S.N.V., DeFries, R.S., and Liang, S. (2000) Beware of per-pixel characterization of land cover. *International Journal of Remote Sensing* 21: 839-843.

6. Lees, B. (2008) Remote sensing. In Wilson, J.P. and Fotheringham, A.S. (eds) *Handbook of Geographic Information Science.* Oxford, Blackwell Publishing: 49-60.

7. Rashed, T., Weeks, J.R., and Gadalla, M.S. (2001) Revealing the anatomy of cities through spectral mixture analysis of multispectral satellite imagery: A case study of the Greater Cairo region, Egypt. *Geocarto Intnernational* 16: 5-16.

8. Burnett, C. and Blaschke, T. (2003) A multi-scale segmentation/object relationship modeling methodology for landscape analysis. *Ecological Modelling* 168: 233-249.

9. To be announced.

10. To be announced.

Technology – ArcGIS and IDRISI® Selva are provided online via the GIST Server. In addition, you must satisfy the following technology requirements:

Every student MUST have a computer with a fast Internet connection.

Every student MUST have a functional webcam and a microphone for use whenever a presentation or meeting is scheduled

Description and Assessment of Assignments

Your grade in this course will be determined on the basis of several different assessment tools:

- **Resume Assignment – 1 for a total of 2 points.** We require all current students to post and maintain a public resume, short biography and recent photo on our shared GIST Student Community Blackboard site. With your permission, your photo and resume will be posted to the Spatial Sciences Institute website and your resume will be included in the GIST Resume Book. The latter is compiled annually and along with our web presence used to promote our programs and more importantly, your skills, experience, and professional aspirations.
- **Reading Assignments – 7 for a total of 21 points.** Each student is required to complete seven reading assignments for this class. The reading assignments will focus on the theory portion of the course as presented in the weekly readings. The objective of the reading is to help you evaluate and integrate the information you have acquired from the course readings. Some of these will involve discussions and collaborative work and some will be individual efforts. In the event you complete more than seven reading assignments, I will use your seven highest scores to calculate your course grade.
- **IDRISI® Selva Tutorials – 9 for a total of 27 points.** These will be scheduled throughout the semester and will require you to work through individual chapters of the Warner and Campagna (2014) workbook during the weeks they are assigned. To demonstrate that you have completed each chapter, you will turn in a quick copy of some digital output or brief text answers from the final part of the exercise such as a .jpg of the map produced at the final step.
- **Exercises – 2 for a total of 10 points.** To demonstrate your understanding of the basic concepts and skills learned in the class, you will complete two exercises that will integrate key concepts and ideas and take some independent thought. .
- **Presentation – 1 for a total of 10 points.** This assignment will require some independent thought and synthesis and allow you to explore a case study of your choice. The results will be presented over the Web in Week 12 with the help of a PowerPoint slideshow.
- **Research Reports – 2 for a total of 30 points.** The first report (10 points) will provide you with an opportunity to describe the data capture options and challenges for a project of your choice from a list of projects spanning a variety of application domains. The second report (20 points) will take one or other of two forms depending on your student status. Students enrolled in the GIST M.S. Program will have the option to prepare a prospectus for a thesis project and outline some of the methods and geospatial data sources that could be used in such a project. The remainder of the students (and any GIST M.S. students choosing not to select this option) would be afforded the opportunity to integrate all that they have learned in the semester in a specific application that I will designate when the guidelines for the final reports are distributed.

Careful planning and a serious, consistent commitment will be required for you to successfully navigate the various deliverables in this and other GIST courses. The table below summarizes the *SSCI 588* course assignments and their point distribution.

Assignments	Number	Points Per Assignment	Total Points
Exercises	2	5	10
IDRISI Tutorials	9	3	27
Presentation	1	10	10
Reading Assignments	7	3	21
Resume Assignment	1	2	2
Research Reports:			
First Report	1	10	10
Second Report	1	20	20
Totals	**22**	**-**	**100**

Grades in this and other GIST courses will use the standard USC grading criteria, as follows:

A	≥ 93 points	B-	80-82 points	D+	67-69 points
A-	90-93 points	C+	77-79 points	D	63-66 points
B+	87-89 points	C	73-76 points	D-	60-62 points
B	83-86 points	C-	70-72 points	F	< 60 points

And finally, it is important to note from the outset that: (1) you are expected to attend and participate in every class session and to complete and upload all assignments before the deadlines detailed in the Course Schedule; (2) late postings and assignments will be docked one grade and no grade will be given for postings or assignments turned in more than one week late; and (3) no written work will be accepted for grading after 5:00 p.m. PT on the last day of classes.

Assignment Submission Policy

Assignments will be submitted for grading via Blackboard using the due dates specified in the Course Schedule below.

Additional Policies

Communications – This is a distance learning course, so most of our interactions will be asynchronous (not at the same time). All materials to be handed in will be submitted via the Blackboard Assessment link. I will also create multiple Blackboard discussion forums throughout the semester that we will use for the aforementioned assignments and so we can discuss issues and comments on the course assignments, exercises and projects as the need arises.

In addition, I will send via e-mail through Blackboard any notices that are time sensitive. Please be sure that you read as soon as possible all e-mail sent from Blackboard or from me. Check now to make sure that mail sent from both the USC blackboard accounts and my private domain (stevendf@usc.edu) does not go into your junk mail!

While I am usually online and will probably respond to e-mails from students relatively quickly, I will endeavor to respond to all e-mail within 24 hours of receipt, aiming for no more than 48 hours delay. In the rare case when I expect to be offline for more than 60 hours, I will post an announcement on the Blackboard site.

That said, it is each student's responsibility to stay informed about what is going on in our course. In addition to e-mail 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.

Workload – This is a four credit, one semester course. Students should expect to spend 12-15 hours per week completing the work in this course.

Course Schedule: A Weekly Breakdown

Tentative Schedule

Week #	Week Begins	Theme	Week's Readings	Assignments Due Monday Following		
			Reading	Reading Assign.	IDRISI Tutorials .	Exercises and Reports
1	8/24	Remote Sensing Principles	Campbell 1, 2			Resume
2	8/31	Image Acquisition – Passive Sensors	Campbell 3, 4, 5, 6	R1	1	
3	9/7	Image Acquisition – Active Sensors	Campbell 7, 8, 9	R2	2	

	4	9/14	Image Resolution	Campbell 10	R3	3	
	5	9/21	Image Resolution, Part II	Campbell 10	R4		Exercise 1
	6	9/28	Analysis – Preprocessing	Campbell 11	R5	4	
	7	10/5	Image Classification	Campbell 12	R6	5	
	8	10/12	Image Classification, Part II	Campbell 12	R7		Report 1
	9	10/19	Field Data & Accuracy Assessment	Campbell 13, 14	R8	6	
	10	10/26	Hyperspectral Remote Sensing	Campbell 15	R9	7	
	11	11/2	Integrating GIS and Remote Sensing	Notes		8	Presentation
	12	11/9	Integrating GIS and Remote Sensing, Part II	Notes	R10		
	13	11/16	Gallery of Applications	Campbell 17, 18		9	Exercise 2
	14	11/23	Gallery of Applications	Campbell 19, 20			
	15	11/30	Gallery of Applications	Campbell 21			Report 2
		12/4	End of Semester; All of your work must be submitted by 5:00 p.m. on this date				

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 Section 11, *Behavior Violating University Standards* https://scampus.usc.edu/1100-behavior-violatinguniversity-standards-and-appropriate-sanctions. 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.

Discrimination, sexual assault, and harassment are not tolerated by the university. You are encouraged to report any incidents to the *Office of Equity and Diversity* http://equity.usc.edu or to the *Department of Public Safety* http://capsnet.usc.edu/department/department-public-safety/online-forms/contactus. This is important for the safety of the whole USC community. Another member of the university community – such as a friend, classmate, advisor, or faculty member – can help initiate the report, or can initiate the report on behalf of another person. *The Center for*

Women and Men http://www.usc.edu/student-affairs/cwm/ provides 24/7 confidential support, and the sexual assault resource center webpage http://sarc.usc.edu describes reporting options and other resources.

Support Systems

A number of USC's schools provide support for students who need help with scholarly writing. Check with your advisor or program staff to find out more. Students whose primary language is not English should check with the *American Language Institute* http://dornsife.usc.edu/ali, which sponsors courses and workshops specifically for international graduate students. *The Office of Disability Services and Programs* http://sait.usc.edu/academicsupport/centerprograms/dsp/home_index.html provides certification for students with disabilities and helps arrange the relevant accommodations. If an officially declared emergency makes travel to campus infeasible, *USC Emergency Information* http://emergency.usc.edu will provide safety and other updates, including ways in which instruction will be continued by means of blackboard, teleconferencing, and other technology.