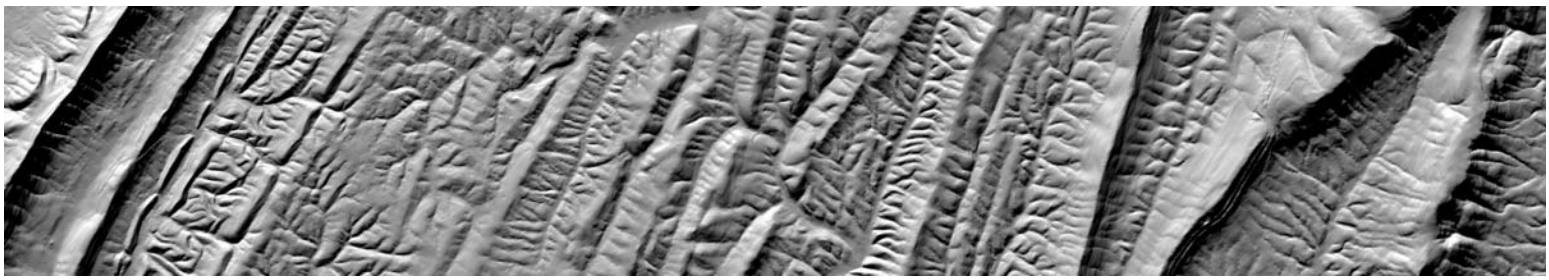

Geog/Geol 755
Advanced Remote Sensing
2010

Instructor: Dr. Tim Warner
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Office: 341 Brooks Hall

Office Hours: Mondays 9:30 to 11:00, or by appointment
Class meets: Mondays: 1:30 – 4:30 pm,
Room: Lectures: Room 304; Labs in 419
Prerequisite: Any one of: Geog 455, Geol 455, or equivalent.
Credit 2 hours lecture, 1 laboratory (3 total)

Course Schedule:

Wk	Date		Subject	Readings*	Laboratory	Assignment
1	Jan	11	Project planning & data selection	J Ch 1 & Ch 4, p101-103, WNF Chap 1 & Warner 2010	Band selection	
2		*18*	*No class – Acc. Assessment*	WNF Chap 21 & J Chap 13		Paper review
		20	*Field trip to Washington DC*			
3		25	Radiometric normalization	J Chap 6	Radiometric normalization	Paper review
4	Feb	1	Spectral transformations	J p274-276,296-322	Ratios + NDVI, MKT, PCA	Paper review, *Project topic*
5		8	Lidar	WNF Chap 14	Lidar - exploration	Paper review
6		15	Change detection	WNF Chap 33 (J Chap 12)	Las Vegas Growth	Paper review
7		22	Spatial analysis 1	J 276-295,322-329	Texture	Proj. progress rpt
8	Mrch	1	**Exam 1**			
9		8	Spatial analysis 2		Ship Counting	Proj. progress rpt
10		15	*Project*			
11		22	Image classification	WNF 19 (J Chap 9 & 10)	Expert System	Proj. progress rpt
		29	**Spring Break**			
12	April	5	Digital orthophotos	EFG Ch 8	Imagine Orthobase	Draft project rpt. 1
13		12	Hyperspectral imagery	J Chap 11 (WNF Chap 12)	ASD field data collection	Draft project rpt. 2
14		19	Radar	WNF Chap 13	Radar/Optical IHS fusion	
15		26	Project presentations			Final project rpt
16	May	6	**Final Exam** (Thursday: 3-5)			

*Readings:
J: Jensen, 2005
EFG: Erdas Field Guide
LKC: Lillesand, Kiefer and Chipman, 2008
WNF: Warner, Nellis and Foody, 2009
Warner 2010: Warner, T.A., 210. Remote sensing analysis: From project design to implementation. Chapter 17 in J.D. Bossler, R.B. McMaster, C. Rizos and J.B. Campbell (ed.), Manual of Geospatial Sciences (2nd Edition). Taylor and Francis, London, UK.

Plus other readings as may be assigned from week to week.

Method of Instruction:

Class meetings will vary in format between formal lectures, seminars and laboratory exercises.

Expected learning outcomes

After completing this course, you will be expected to be able to:

1. Critically evaluate current research and applied issues in remote sensing.
2. Understand and use advanced remote sensing analysis techniques, including radiometric normalization, enhancement, and classification.
3. Search and critically evaluate the remote sensing literature.
4. Design and implement a remote sensing research project.

Texts:

Recommended (not required) texts – available from library and other locations.

Jensen, J. R., 2005. *Digital Image Processing.* Third Edition. Prentice Hall, Upper Saddle River, NJ, 526 pp.

Lillesand, T. W., R. W. Kiefer, and J. W. Chipman, 2008. *Remote Sensing and Image Interpretation*, Sixth Edition. John Wiley and Sons, New York, 756pp.

Leica Geosystems, 2008. *ERDAS Field Guide*. Leica Geosystems, Atlanta. Georgia. (2 Volumes.)

Warner, T. A., M. D. Nellis and G. Foody (eds), 2009. *The Handbook of Remote Sensing*. SAGE, UK.

Grading scale:

A	**90%+**
B	**80-89%**
C	**70-79%**
D	**60-69%**
F	**<60%**

Grading:

Exam 1		25%
Exam 2 (Comprehensive)		25%
Project and presentation		30%
Topic	1%	
Progress Report 1	1%	
Progress Report 2	1%	
Draft Report	2%	
Final Report	20%	
Oral Presentations	5%	
Laboratory exercises		15%
Paper reviews		5%
Total		**100%**
Bonus - *All material handed in on time*		**2%**

Note: Any plagiarism in will result in a grade of 0. Additional penalties may apply.

Grading Rubrics

1. Paper Reviews (10 points maximum)

Grade	Citation	Description of article	Personal evaluation section of report	Grammar & Spelling
10	Follows correct format. Has all information required. Punctuation correct.	Comprehensive summary, all key points described, shows insight and depth of understanding	Student has grappled with article, and made connections to other material (in the course or outside).	Correct, with good, *technical English style.* No typographical mistakes (i.e. was proof-read carefully).
9	**Follows correct format.**	**Comprehensive summary**, key points described	**Comments are correct and indicate thought.**	**Correct grammar and spelling, very few mistakes.**
8	Does not follow correct format, has most of the information required.	Relatively comprehensive summary; some sections skipped or not discussed.	Comments are correct, and show a basic understanding	Mostly correct grammar and spelling, but minor mistakes and or **colloquial language**
7	Incomplete	Brief summary; **limited understanding**, major sections skipped	Perfuctory or shallow comments	Does not use technical language (e.g. **uses colloquial language**), pervasive mistakes
6	Missing	Summary is perfunctory, no understanding shown	Weak	Language is not easily understandable
5 and less	Missing	Weak or missing	Missing	Language is not understandable

2. Term Project (Based on 100 maximum points– will be scaled to the appropriate percentage in grading scheme)

Grade	Content	Structure	Introduction	Body	Conclusion	References	Grammar & Spelling
100	Comprehensive report. **Shows insight. Innovative methods.**	Structure is logical, ideas developed systematically, excellent transitions.	Desribes theme of paper and places in context	Develops ideas, goes well-beyond mere summary	**Makes connections between papers, draws common themes**	Comprehensive and extensive reference list. Follows correct format.	Correct, with good, *technical English style.* No typographical mistakes (i.e. was proof-read carefully).
90	Comprehensive report. Excellent choice of methods	Structure is logical and well-thought out	Describes themes of paper	Develops ideas, goes well beyond mere summary	Summarizes major content, makes connections, draws contrasts	Comprehensive and extensive reference list. Follows correct format.	**Correct grammar and spelling, only occasional mistakes.**
80	Relatively comprehensive report, appropriate methods	Structure is good	Describes themes of paper	Develops ideas, summarizes major ideas clearly	Summarizes major content	Moderate reference list, mostly follows correct format.	Mostly correct grammar and spelling, but minor mistakes and r **colloquial language**
70	Topic ismostly covered, some material poorly developed or not covered. **Simple methods**.	Structure is confused in places, transitions not well developed	Introduction is limited or poorly connected to the paper's themes	Ideas introducted by poorly developed, does not capture range of the topic	Summarizes major content	Limited reference list; Inconsistent or incorrect reference format	Does not use technical language (e.g. uses colloquial language), pervasive mistakes
60	Perfunctory report. Methods have major flaws.	Confused structure	Introduction has limited connection to the main themes of the paper	Limited understanding of the ideas, limted development	Perfunctory, or not connected to the paper body	Missing	Language is not easily understandable
Less than 60	Weak content, limited or no understanding	No structure	Limited or confused introduction	Major themes not developed, or significant	Perfunctory or not connected to the paper	Missing	Languate is not understandable

	of methods.			errors	body		

Policies

1. All material is to be handed in before class on the due date. There is a 10% per day late penalty, unless you make prior arrangements with me.
2. ***Attendance is required***. Please contact me before class if you cannot make a class meeting. If you are unable to make it to a telephone or email before class, please contact me as soon as possible thereafter.

Laboratory:

The laboratory assignments will mostly comprise digital image analysis using ERDAS *Imagine,* which is available in the teaching laboratory. You should make use of the ERDAS resources to help learn this software: there is on-line help (though, it is not very useful), and also the ERDAS Field Guide (a practical remote sensing text), and the ERDAS Tour Guide (a tutorial). All are available in the Erdas help directory:
C:\Program Files\ERDAS\Geospatial Imaging 9.3\help\hardcopy

Course philosophy:

This course is designed to give you an overview of the current state of remote sensing. It assumes a basic knowledge of remote sensing from an introductory course. At the end of the course you should have the knowledge to pursue the remote sensing literature or a project of your interest independently. The course schedule as listed here will be reviewed at the first class meeting, and adapted to meet the needs of the students enrolled in the class.

Ideas will be introduced through lectures and readings. The laboratory exercises will be an opportunity to investigate concepts in greater depth. Each student will also pursue an individualized project, based on some aspect of remote sensing which the student finds interesting. This project is important, because it facilitates a better understanding of the material, and also provides a mechanism to ensure the greatest relevancy of the course for each student.

Social Justice Statement

West Virginia University is committed to social justice. I support that commitment and expect to maintain a positive learning environment based upon open communication, mutual respect, and non-discrimination. Our University does not discriminate on the basis of race, sex, age, disability, veteran status, religion, sexual orientation, color or national origin. Any suggestions as to how to further such a positive and open environment in this class will be appreciated and given serious consideration.

If you are a person with a disability and anticipate needing any type of accommodation in order to participate in this class, please advise me and make appropriate arrangements with Disability Services (293-6700).

Days of Special Concern

WVU recognizes the diversity of its students and the needs of those who absent themselves from class during Days of Special Concern, which are listed in the Schedule of Courses. Students should notify the instructor **by the end of the second week of classes or prior to the first Day of Special Concern**, whichever is earlier, regarding Day of Special Concern observances that will affect their attendance. As the instructor of this course, I will make reasonable accommodation for tests or field trips that a student misses as a result of observing a Day of Special Concern, so long as I am notified in advance as specified above.

Class cancellation for weather or emergencies

If the University decides to close, cancel, or delay classes, an announcement is posted immediately on various websites, including www.wvu.edu and MIX.

If you are unable to attend class due to locally hazardous conditions, please contact me immediately you have access to a telephone and/or email.

Paper reviews

There are two types of paper reviews for this class. Sometimes I will hand out papers that I would like you to review by the following week. I will also sometimes assign one student to lead a short discussion of the paper.

In addition, for weeks 2-6, I would like you to turn in a review of a paper you have chosen yourself. The papers that you choose must focus on remote sensing, and must be a peer-reviewed journal article.

Your review should have the following components (lengths are based on single-spaced reviews; if you double space your review, then double the lengths):

1. **Please provide me with a copy of the abstract.**
2. Start your review with a correct journal-style citation at the top. (Be sure to list all authors names, and give the journal name in full).
3. Then give a three-quarter-page overview of the paper contents, and
4. Conclude with a short, more personal evaluation at the end, in which discuss your personal reaction to the paper. (For example, you could explain why you chose the paper, and to what extent you found it useful for your interests).

See me if you need more guidance.

WVU Remote Sensing Journals

Journal Name	***WVU Library***	***Available Electronically****	***Call Number***
Photogrammetric Engineering and Remote Sensing	**Evansdale**	**Yes (1996 to 2 years ago)** www.asprs.org	**T1.P567**
Geocarto International	**Downtown Library**	**Yes (1999 to present)**	**G70.4 .G447**
International Journal of Remote Sensing	Downtown Library	Yes (1997 to present)	G70.4 .I56
Remote Sensing of the Environment	Downtown Library	Yes (1995 to present)	QE33 .R44
Canadian Journal of Remote Sensing	Downtown Library	Yes (2002 to present)	G70.4 .C24
IEEE Transactions on Geoscience and Remote Sensing	Evansdale	Yes (1980 to present)	T1.IN73T GE
IEEE Transactions on Geoscience and Remote Sensing - Letters		Yes (2004 to present)	
Journal of Terrestrial Observation		Yes (2008 to present)	
IEEE Transactions on Geoscience and Remote Sensing (Letters)		Yes (2004-to present)	
The Photogrammetric Record		Yes (2003 to 1 year ago)	

* To find WVU Electronic resources, go to http://www.libraries.wvu.edu/, then click on *electronic journals*, and do a search on remote sensing

Term Project Guidelines

Each student is required to undertake an independent short project, which is written up in the format of a "letter" (brief scientific article).

Overview

The term project is designed to:

1. Give you hands on experience in designing and implementing a remote sensing project.
2. Allow you to explore in a formal mannter some aspect of remote sensing that interests you.
3. Give you experience in writing a technical report, with a focus on following the conventions of a journal article with respect to:
    a. Structure
    b. Language
    c. References and citations
    d. Figures & Tables
4. Give you experience in scientific verbal communication.

Important issues for the report write up

1. The presentation of the report must be of a high standard, following the format and style of a journal article submitted to *Remote Sensing Letters*.
2. Please follow the format in every way expected of a letter published in *Remote Sensing Letters*: http://www.tandf.co.uk/journals/TRSL
    a. On the RSL website, you will find a link to "instructions to authors." Please study that material carefully.
    b. Note that RSL articles are limited to 10 journal pages, including figures.
3. Images used in your paper must be constructed using the ArcMap (or the Imagine Map Composer), unless there is a specific reason for doing a screen capture (e.g. to illustrate the use of an Imagine program).
4. Every Image or figure must have a figure number, and title, and be referenced in the text. The source data, date, band combinations, etc must be clearly given. E.g. "Figure 1. Landsat ETM+ false color image of Morgantown (Bands 4,3,2 as RGB, respectively), acquired 12 September 1999."
5. You must provide a standard reference list, and cite your references in the appropriate way.
6. Be sure to describe the source of your data in your report.

You should chose the project based on the feasibility of carrying out the work in one semester. It would be ideal if part or the entire project could feed into your thesis.

Topics

You are responsible for picking the topic, and for finding the resources to carry out the project. I shall help you in any way I can, but the project remains your responsibility. The topics can range from manual air-photo interpretation, image analysis with Imagine, or developing new image processing algorithms. It is up to you.

Some previous topics

- A comparison of classification methods applied to Morgantown Landsat imagery
- An automatic lineament finder program
- An integrated study of subsurface, digital elevation and lineament data.
- A comparison of standard and fuzzy error matrices for accuracy assessment of a Classified SPOT image.
- Phoenix, Arizona, change detection analysis
- Vegetation patterns of Botswana: Multitemporal NDVI analysis
- Landsat MSS analysis of the geomorphology of braided rivers and alluvial fans
- Classification of forest types of Tibbs Run, Monongahela County, WV

- Use of FRAGSTATS and classified Landsat TM imagery in evaluating the composition of forest landscapes on the Monongahela National Forest

Deadlines

NOTE: IF YOU CAN DECIDE ON A TOPIC EARLIER, OR MAKE MORE RAPID PROGRESS, THAT IS TO YOUR ADVANTAGE. THE END OF THE SEMESTER CAN GET VERY BUSY.

Feb 1 Topic title, and a *one page description*. You should include at least **4 journal references**, the **source of data**, method of processing, possible limitations, etc.

Feb 22, March 8, 22 Written progress reports - one page. Discuss progress made, and any possible stumbling blocks.

April 5 Draft project report 1- *paper* copy. This copy will be peer-reviewed by a class colleague.

April 12 Draft project report 2- *paper* copy and *digital* submission on eCampus (TurnItIn utility). This copy will be reviewed by me.

April 26 Final *digital copy of report only*, and in-class presentation of report

Write up

The project completion report will have two parts:

1. A paper-based report on your project. The text should have the typical parts of a journal paper: provide aims, background literature, methods, results, conclusions, and references.
2. An in-class PowerPoint presentation (approximately 7 minutes). You ***must*** practice your presentation out loud, and *time* yourself. You will not realize how short the allotted time is, until you time yourself. Also, you cannot prepare for this by doing it "in your head." You must prepare by speaking out loud.

References

I suggest you use RefWorks, available through the library's website. Every reference in the reference list must be cited in the text; every citation in the text must be included in the reference list. Please follow the format of the International Journal of Remote Sesning.

Data Sources

There are large numbers of internet sites that offer free data. Particularly useful sites include:

USGS EROS site	edc.usgs.gov
NASA LP DAAC	lpdaac.usgs.gov
The U of Maryland Global land cover facilty	glcf.umiacs.umd.edu
AmericaView	americaview.org
WV GIS Technical Center	wvgis.wvu.edu/
WV View	wvview.org