University of Victoria

Faculty of Social Sciences
Department of Geography

Geography 491 A03
ADVANCED TOPICS IN MICROWAVE REMOTE SENSING
Fall 2014

Instructor: Dr. Randall Scharien
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Course Description

The aim of this course is to develop your theoretical and practical understanding of microwave remote sensing through readings, group discussions, presentations, and research projects. The course builds on GEOG319 or GEOG322 by focusing on the unique aspects of the microwave region of the electromagnetic spectrum. Microwaves have wavelengths on the order of 10 cm, approximately 100 000 times longer than optical wavelengths, so that interactions with the earth's surface, and approaches for landscape information extraction, require unique treatments. Both passive and active modes of microwave remote sensing are covered during the course. However, students are provided with greater exposure to active modes given the growth in innovative applications made possible by recent advances in radar technology.

Class Meetings

Monday/Thursday 08:30-09:50 COR B145

Text and Readings

There is no required text for this course but the following are recommended as reference material.

1. Richards, J.A., (2009). Remote Sensing with Imaging Radar. Springer, Heidelberg, Germany.

A resource book which does an excellent job of providing a rigorous treatment of microwave imaging but in a manner suited to earth scientists rather than practitioners of theoretical electromagnetism. Focus is on radar but the book includes a chapter on passive microwave remote sensing.

2. Woodhouse, I.H. (2006). Introduction to Microwave Remote Sensing. Taylor and Francis, Boca Raton, Florida.

A very readable primer in active and passive microwave remote sensing. Contains overviews of several application domains.

3. Ulaby, F.T, R.K. Moore, and A.K. Fung (1986). Microwave Remote Sensing: Active and Passive, Volume 3 Volume Scattering and Emission Theory, Advanced Systems and Applications. Addison-Wesley, Reading, Mass.

Third part of a three volume set considered by many to be the benchmark books that provided the first comprehensive treatment of microwave remote sensing. Part three is suggested due to its focus on many different application domains.

Assigned readings will be posted on Moodle. For project work and literature reviews you will be expected to make additional use of remote sensing journal articles, other material in the university libraries, and web-based information in support of your work.

Course Organization

CLASS MEETINGS

Each class meeting will typically comprise an overview lecture on a topic given by the instructor, followed by one or more students presenting a critical review and leading a discussion on their assigned journal article. The overview lectures build from assigned readings that will be posted on Moodle. You should come prepared for each lecture. This means you should have read and considered the relevant readings. Scheduling of student presentations and assignment of journal articles will occur in the first two weeks of the course.

There will also be two guest speakers (TBD) at different points throughout the term. They will provide unique and interesting perspectives on microwave remote sensing research, with linkages to management and industry applications where possible. The final class meeting will be used for term project presentations.

JOURNAL ARTICLE REVIEW AND DISCUSSION

Each student is required to conduct a critical review one peer-reviewed, published, journal article that addresses some aspect of microwave remote sensing (e.g. techniques or applications) and present that review to the class. This is to be followed by a discussion led by the reviewer. You are encouraged to use Power Point or other preferred media to communicate your review and lead your discussion. Evaluation criteria will be provided in class.

LITERATURE REVIEW

Each student is required to write a literature review paper on one of the suggested microwave remote sensing topics listed below, or another topic you are particularly

interested in. In either case you must confirm your selection with your instructor before proceeding. Your instructor can provide additional suggestions if needed. This assignment provides an opportunity to develop your critical thinking and writing abilities. Required format and evaluation criteria will be provided in class.

TERM PROJECT

A group term project (2-3 people) will address an interesting aspect of microwave remote sensing. Groups are expected to develop a proposal in early September and to devise an experiment which will span the length of the course. Students will have to consider logistical restraints, available data, software and manpower in the design of the project. The literature review component of your final report must not be taken directly from student literature review assignments.

The choice of your topic for your project is up to you and your group but a one page proposal is due on October 2, 2014. The final term project report is due on the last day of classes for the term December 3, 2014. Required format and evaluation criteria will be provided in class.

Sample topics for all of the above

Soil moisture retrieval
Interferometric SAR (InSAR) and/or Polarimetric Interferometric SAR (Pol-InSAR) for natural hazard and/or vegetation characterization
Microwave remote sensing of the ocean
Sea ice monitoring and/or classification by SAR
Passive microwave remote sensing for large scale environmental monitoring: successes and limitations
Phenology retrieval of agricultural and/or cryosphere surfaces
Forest biomass estimation
Radar altimetry for mass balance and dynamics of ice sheets
Snowpack properties
Polarimetric techniques: descriptors, decompositions, compact polarimetry
Polarisation coherence tomography (PCT) and forest biomass estimation
Microwave scattering modeling
Flood mapping and emergency management
Agricultural monitoring
Surface roughness and dielectric permittivity characterization
Oil spill monitoring
Optical-SAR image fusion

FINAL EXAM

There is no final exam in this course.

Grading Scheme

Class Participation and Attendance	10%
Critical Journal Article Presentation and Discussion	15%
Literature Review	20%
Project Proposal	5%
Project Presentation	10%
Project Report	40%

Course Schedule

Date	Week	Topic
Sep. 04	1	Passive and active microwave remote sensing missions and concepts: Overview
Sep. 08	2	Passive and active microwave interaction with earth surface features
Sep. 11		
Sep. 15	3	Synthetic Aperture Radar (SAR): Canada's role and the golden age of SAR
Sep. 18		
Sep. 22	4	Radar polarimetry theory and applications
Sep. 25		
Sep. 29	5	Radar altimetry and the cryosphere
Oct. 02		**Project Proposal Due**
Oct. 06	6	Importance of field observations and problems of scaling
Oct. 09		
Oct. 13	7	***No Classes – Thanksgiving Day***
Oct. 16		Guest Lecture: TBD
Oct. 20	8	Project discussion and software demonstration
Oct. 23		
Oct. 27	9	Multi-temporal analysis
Oct. 30		**Literature Review Due**
Nov. 03	10	Selected Topic I [1]
Nov. 06		
Nov. 10	11	***No Classes – Reading Break***
Nov. 13		Guest Lecture: TBD
Nov. 17	12	Radar interferometry and the emerging area of radar tomography
Nov. 20		
Nov. 24	13	Selected Topic II [1]
Nov. 27		
Dec. 01	14	Project Presentations
Dec. 03		Last Day of Classes for the Term- **Final Project Due**

[1] Selected topics will be determined on the basis of active participation and open discussions as the course evolves.

Late Assignment Policy

Late assignments and presentations are not permitted except for circumstances involving medical or compassionate reasons. Written verification as proof may be requested at the discretion of the instructor.

Course Experience Survey (CES)

Your feedback on this course is valued. Towards the end of term, as in all other courses at UVic, you will have the opportunity to complete an anonymous course experience survey (CES) regarding your learning experience. The CES is vital to providing feedback to the instructor regarding course content and teaching, as well as to help the department improve the overall program for future students. The survey is accessed via MyPage and can be completed using your laptop, tablet, or mobile device. You will be reminded and provided detailed information nearer to the completion of this course but please be thinking about this important activity throughout its duration.

Grade Scale

A+	A	A-	B+	B	B-	C+	C	D	F
90-100%	85-89%	80-84%	77-79%	73-76%	70-72%	65-69%	60-64%	50-59%	0-49%

Academic Integrity

Academic integrity requires commitment to the values of honesty, trust, fairness, respect and responsibility. It is expected that students, faculty members and staff at the University of Victoria, as members of an intellectual community, will adhere to these ethical values in all activities related to learning, teaching, research and service. Any action that contravenes this standard, including misrepresentation, falsification or deception, undermines the intention and worth of scholarly work and violates the fundamental academic rights of members of our community. Students are advised to consult the university's Policy on Academic Integrity in the University Calendar. The instructor reserves the right to use plagiarism detection software programs to detect plagiarism in term papers.

The University of Victoria is committed to promoting, providing and protecting a positive and safe learning and working environment for all its members.