Syllabus for GEOS 657 – Microwave Remote Sensing

1. **Course information:**

Title: Microwave remote Sensing
Number: GEOS 657
Credits: 3
Prerequisite: GEOS 422 or equivalent
Start/end day: January 20th to May 12th
Location: Tuesdays – Reichardt Building 237, 2 -4 p.m.
Thursdays – West Ridge Research Building, remote sensing lab, 2 p- 5 p.m.
Website: www.gi.alaska.edu/~mabra/; UAF blackboard

2. **Instructor Information:**

Name: Matthias Braun
Office: Room 108D, West Ridge Research Building (WRRB), Geophysical Institute
Telephone: 907-474-1522
email: mabra@gi.alaska.edu
Office hours: ad hoc / by appointment

3. **Course readings/materials:**

The class will not strictly follow a specific textbook. Various books area available covering the topic, an example is Woodhouse, I.H. (2006): Introduction to Microwave Remote Sensing. CRC Press, Taylor & Francis.
Online materials: e.g., Tutorials of the Canadian Center for Remote Sensing (http://www.ccrs.nrcan.gc.ca/resource/index_e.php#tutor) or parts of NASA's remote sensing tutorial (http://rst.gsfc.nasa.gov/).
Material for specific reading assignments will be provided.
All class powerpoint lecture materials, lab instructions, software manuals, and data sets required for your lab assignments will also be posted under blackboard.
Recommended remote sensing books:

- Massonet, D. & Souyris, J.-C. (2008): Imaging with Synthetic Aperture Radar. EPFL Press distributed by CRC Press.
- Henderson, F.M. & Lewis, A.J. (1998): Principles and Applications of Imaging Radar. Manual of Remote Sensing. Third Edition, Vol. 2. John Wiley & Sons. Inc.
- Olivie, C. & Quegan, S. (2004): Understanding Synthetic Aperture Radar Images. Scitech.
- Lee, J.-S. & Pottier, E. (2009): Polarimetric Radar Imaging. From Basics to Applications. CRC Press, Taylor & Francis.
- Rees, G. (2006): Remote Sensing of Snow and Ice. CRC Press, Taylor & Francis.
- Ferretti, A., Monti-Guarneri, A., Prati, C., Rocca, F. & Massonet, D. (2007): InSAR Principles. Guidelines for SAR Interferometry Processing and Interpretation. ESA TM-19, ISBN 92-9092-233-8.

Students are expected be able to read and follow original research articles from refereed journals as well as to do their literature search for their research work without instructor interaction.

4. **Course description:**

This course will introduce the students to the principles and physics of microwave remote sensing. It includes the sensor technology, platforms and data portals to retrieve data. Principle processing techniques and applications of active and passive microwave remote sensing data will be covered. The laboratory part of the course will provide hands-on experience with special processing techniques and the possibility of using these techniques for a student-defined term project in areas of geology, cryosphere, hydrology, environmental sciences, etc. Advanced processing techniques such as InSAR, differential InSAR or polarimetric InSAR will be included in the lectures but is not extensively addressed during the practical exercises.

5. **Course goals and student learning outcomes**

Goal: The goal of this course is to take the students beyond what they have learned in a basic remote sensing course (such as GEOS 422 or its equivalent). They will get deeper insights into the physical principles, analysis techniques and applications of active and passive microwave remote sensing. The course will have a strong, but not exclusive component on active radar remote sensing systems (Synthetic Aperture Radar - SAR).

Student learning outcomes: By the end of the course, students should be able to

- relate backscattering signals from different surfaces to physical processes;
- know the various sensors, their imaging principles and characteristics;
- outline an optimal plan for data acquisition for their application;
- perform standard pre-processing steps of SAR remote sensing images including multi-looking, speckle filtering, geocoding and terrain-correction;
- carry out advance digital processing steps including polarimetry, speckle and texture filters, coherence generation;
- understand basic retrieval algorithms;
- understand and know principles of advanced processing techniques such as InSAR or DInSAR;
- be able to judge the potential of microwave remote sensing for their applications and to design a small research project.

6. **Instructional methods:**

- 2x60 minute lecture and 2-3 hours lab exercises, meeting twice a week
- Lectures will be interactive and will involve use of power point presentations and group discussions. Material will be made available via Blackboard or during the class.
- Laboratory components will include hands-on experience with available image processing software package.
- Access to data will be organized via central accounts of national and international portals or directly via the instructor
- Reading assignments from course text book and research papers on selected topics will be an integral part of the course.
- Independent project work includes concise description / presentation of data analysis methodology and results

7. **Course calendar**

see tentative class schedule provided on blackboard

8. **Course policy:**

Attendance in lectures and labs is essential. For some reason, if the course participant cannot be present for a lecture or lab, they should inform the instructor in advance and make arrangements for make up of the time. Each student is expected to abide by the UAF Student Code of Conduct (visit: http://www.uaf.edu/catalog/current/academics/regs3.html)

9. **Grading policy:**

Interim short test / quiz: 10%
Homework assignments: 25%
Reading & discussion contribution: 15%
Independent project: 50% (25% presentation, 25% term paper)
A more detailed grading policy will be posted on the class website.

10. **Independent project:**

Each student is required to carry out an independent term project. The project must use digital image data acquired in the microwave domain of the electromagnetic spectrum but may also include data from other sources. Students are encouraged to work on a topic that helps extend their ongoing thesis research or professional work in industry. They are also encouraged to discuss their projects early on with the instructor and turn in a 1-2 page project proposal for approval by the indicated. Students should be aware that the independent term project is time demanding. Though some time will be available during the scheduled lab hours, these hours will be insufficient to complete the project, and students should be prepared to put in extra work hours. Judiciously selected projects with systematic work put in from the very start may be suitable for subsequent publication in either conference proceedings or the peer-reviewed journals. Students should keep this goal in mind as they develop and carry out their projects, and particularly as they prepare their final reports.

The student projects have to be presented in concise written form (term paper) and orally at the end of the class. Students are expected to follow AGU publication guidelines (Journal of Geophysical Research) for structure, citation and layout of the term papers. Concise writing is expected. For oral presentations digital media such as Powerpoint are expected standard, however other media are allowed.

11. **Disciplinary services:**

Should you have any special needs, please come and talk to us about it. The instructor will work with the Office of Disabilities Services to provide reasonable accommodation to students with disabilities.