AT 652 -- Atmospheric Remote Sensing

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Course Objective – To familiarize stuudents with the basic principles of satellite- and ground-based atmospheric remote sensing, to make them comfortable with today's broad spectrum of algorithms, and to provide a sense for where the logical progress will occur in the field.

Office hours: Any time the door is open or by appointment. Initiate with an e-mail.
Course material on Web site: http://rain.atmos.colostate.edu / Courses / AT652

Username for web site: AT652
Password: ACRC212

Course Outline

1. **Introduction**
   - Course detail, objectives and outline
   - Satellite platforms and orbits
   - Inversion theory (brief overview)
2. **Basic properties of electromagnetic radiation**
   - Electromagnetic spectrum
   - Propagation, polarization and Doppler effect
   - Surface Properties across the EM spectrum
   - Extinction and Beer's law
3. **Interaction on the microscopic scale: molecular absorption**
   - Molecular absorption spectra
   - Line absorption, transmission functions
   - Radiative transfer
   - Column water vapor and liquid water
   - Weighting functions, sounding of temperature and moisture
4. **Interaction on the macroscopic level: particle scattering**
   - Refractive index, scattering
   - Particle scattering, backscattering: Depolarization ratios, ZDR and CDR
   - Radiative transfer
   - Radar and lidar remote sensing
5. **Optimal Estimation**
   - OE solutions
   - Bayes' theorem
   - Data Fusion
   - Artificial Intelligence/Machine Learning
   - Process Understanding
6. **Examples**
   - Precipitation
   - Carbon Dioxide

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Course Expectations:

Aside from attendance and interaction in regular lectures,

- A paper will be assigned most Thursdays (see schedule for paper). A student's name will be chosen randomly on the following Tuesday. Students should be prepared to present 2-3 minute summary (w/o slides) at that time. Notes are fine but reading of notes is discouraged.
- A group project detailing a specific "data fusion" project will be assigned on October 24th to assess student progress in the course.
- A final project will be assigned Nov. 12th to gauge student's ability to apply material learned in the course to build a working retrieval algorithm. Individual written reprots will be due on Wed. of Finals week.

While there is no text book for the class, there are a number of remote sensing books that students may avail themselves of.

- Stephens, G., 1994: Remote Sensing of the Lower Atmosphere: An Introduction. Oxford University Press, Inc. 523pp.

- Rodgers, C., 2000: Inverse Methods for Atmospheric Sounding – Theory and Practice. World Scientific, Series on Atmospheric, Oceanic and Planetary Physics, Vol. 2. 240 pp.

- Elachi, C., 1987: Introduction of the Physics and Tech. of Remote Sensing, Wiley, 413 pp.

- Bringi, V. N., and V. Chandrasekar, 2001: Polarimetric Doppler Weather Radar. Cambridge University Press, 636 pp.

- Ulaby, F. T., R. K. Moore and A. K. Fung, 1981: Microwave Remote Sensing Vols I-III, Addison-Westy, 2161 pp.

In addition, there are a number of good textbooks covering the basic principles of atmospheric radiation:

- Liou, K. N., 2002: An Introduction to Atmospheric Radiation (second edition), Academic Press - International Geophysical Series, 583 pp.

- Petty, G. W, 2006: A First Course in Atmospheric Radiation (second edition). Sundog Publishing. Madison, Wisconsin.460pp. (www.sundogpublishing.com/AtmosRad.htm)

- Bohren, C. F. and D. R. Huffman, 1983: Absorption and Scattering of Light by Small Particles, Wiley, 530 pp.

- Goody, R. M. and Y. L. Yung, 1989: Atmospheric Radiation: Theoretical Basis, Oxford Univ. Press, 519 pp.