

CSc 59955 Satellite Image Processing

Prof. Irina Gladkova
Times: Tu,Th 3:30-4:45pm
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Fall Semester, 2010

Catalog Course Description:

This course will deal with concepts and methods that are involved in appropriately defining and analyzing the information content of various kinds of data. We will introduce and discuss concepts from Shannon's treatment of information theory: the basic notions of entropy, relative entropy, and mutual information, and show how they arise as natural answers to questions of data compression, channel capacity, rate distortion, pattern recognition and classification. We will discuss Bayesian approach to the classification problem, pattern recognition systems such as segmentation, classification, feature extraction etc.

Prerequisite(s):

Math 34600 or 39200 and CSc 21700 or EE 31100.

Required text:

Nicholas Short "Remote Sensing Tutorial" available at <http://rst.gsfc.nasa.gov/>
Claude E. Shannon. A mathematical theory of communication. Bell System Technical Journal (available at <http://cm.bell-labs.com/cm/ms/what/shannonday/shannon1948.pdf>)

Supplementary text:

Richard O. Duda, Peter E. Hart and David G. Stork, "Pattern Classification", Wiley-Interscience; ISBN-10: 0471056693, ISBN-13: 978-0471056690 is a classic text on the subject
Lecture slides etc. available from <http://rii.ricoh.com/stork/DHS.html>
There is also a book Computer Manual in MATLAB to Accompany Pattern Classification, Second Edition (Paperback), which spells out the pseudo-code for each algorithm in Pattern Classification.

Grades:

based on presentation (40%), project (50%) and attendance (10%).

Data:

Multispectral imaging is becoming an increasingly important tool for monitoring the Earth and its environment from space borne and airborne platforms. Multispectral imaging data consists of visible and IR measurements from a scene across space and spectrum. We have a representative selection of satellite based earth science data from both polar and geostationary orbiting imagers such as

Advanced Very High Resolution Radiometer (AVHRR),

SEVIRI,

the current GOES imager,

the Moderate Resolution Imaging Spectroradiometer (MODIS) imager.

SEVIRI aboard the ESA/EUMETSAT operated Meteosat Second Generation (MSG) satellites and current GOES imagers operated by NOAA are geostationary imagers. The AVHRR aboard the NOAA Polar Orbiting Environmental Satellites and MODIS aboard the NASA Terra and Aqua satellites have polar orbits.

Topics covered:

- History of Remote Sensing; Remote Sensing Systems
- The Basic Principles behind Remote Sensing: Concept of Remote Sensing, Sensor technology, Types of Resolution
- Image Preprocessing: Contrast Stretching and Density Slicing, Spatial Filtering
- Concepts of Information theory: Entropy, Relative Entropy, and Mutual Information
- Data Reduction Techniques: Principal Components Analysis, Clustering, Sampling
- Unsupervised Classification
- Supervised Classification
- Applications:
 - Vegetation Applications - Agriculture, Forestry, and Ecology
 - The Water Planet - Meteorological, Oceanographic and Hydrologic Applications of Remote Sensing

This is a subject of considerable practical importance, and one which is currently being very actively pursued at the Cooperative Remote Sensing Science and Technology Center (CREST) of CCNY. It is expected that as the course progresses, students who show signs of demonstrated interest and promise in this area may, at the instructor's discretion, be eligible for funding, which is available for the support of work in this area.