Remote Sensing

Objective: Understand the basic concepts of remote sensing.

Background:

Dr. Nicholas Short defines remote sensing as the use of instruments or sensors to 'capture' the spectral and spatial relations of objects and materials observable at a distance. It is how the Earth's surface and atmosphere are observed, measured, and interpreted from orbit. Or in simpler terms, remote sensing refers to the recording, observing, perceiving (sensing) of objects or events in distant (remote) places. It allows us to have a bird's eye view of places and features on Earth.

The earliest forms of remote sensing began with the invention of the camera. In the 1840s, cameras were attached to tethered balloons and aerial photos were taken. Later, cameras were mounted onto pigeons and then airplanes. These were both used for military reconnaissance, but encountered problems when behind enemy lines. Satellite remote sensing began with the space age. The first civilian satellite capable of remote sensing was launched in 1972. The growth of this technology was expected to be rapid, but instead was slow. This slow growth has been attributed to the low picture resolution available.

As humans, we perform remote sensing nearly all the time. This is because we acquire most of our information about our surroundings through the senses of sight and hearing. These things do not require close contact between the sensing organs and external objects; therefore we are remote sensing (ESRI, 2002).

Energy is something that all remote sensing systems must have. Remote sensing uses electromagnetic radiation that is emitted or reflected from an object. All objects emit, reflect or absorb electromagnetic radiation at all times unless it has a temperature of absolute zero (-273°C). A remote sensor detects the electromagnetic radiation. A platform carries the remote sensors. Example platforms that are used today include airplanes, satellites, and kites. Remote sensing works because each object has a unique characteristic of reflection.

Active and passive are the two types of remote sensing instruments. Active instruments include radar (uses radio waves), lidar (uses lasers), sonar (uses sound). Active instruments provide their own energy. They send a pulse of energy out to the object and receive the radiation that is reflected back from the object. By providing the energy, these sensors work without the sun. However, passive instruments rely on sunlight as their source of energy. Passive instruments receive the energy that is being emitted or reflected. Radiometers, spectrometers, and aerial photography are all examples of passive instruments.

Some applications of remote sensing include determining the status of a growing crop, defining urban patterns, delineating the extent of flooding, recognizing rock types, and pinpointing areas of deforestation.

For More Information:

http://rst.gsfc.nasa.gov
http://ww2010.atmos.uiuc.edu/(Gh)/guides/rs/home.rxml

Morgan, M. & Ess, D. (2003). *The Precision-Farming Guide for Agriculturists.* Moline, Illinois: John Deere Publishing. (specifically chapter 5)

Activity for Remote Sensing

A. Open Google Earth (http://earth.google.com) and in the "Fly to" box, type in your hometown. Zoom in until you have a good view of your town. This is an aerial photograph, looking straight down.

- What differences do you see from the time of the picture to today? Similarities?
- How easy is it to recognize places when zoomed out? Zoomed in? Why?
- What are easily recognizable things in the aerial photo? Why are the easy to find?

Find a farm with some fields. (Make sure it is a clear picture and not fuzzy) Write down what you see (zoom in and out if necessary)

- Can you tell if there is a crop growing in the field?
- Do you see any problems within the field? (row skips, yellowing, wet/dry spots, etc.) How can you tell these are problem areas?
- Look at the surrounding landscape. Do you see any future or potential problems? (trees, ditches, creeks, etc)
- Can you tell which direction the field is farmed?
- Measure the field size.

Find a pond, what does it look like? Is it low, high, or unknown?
Can you find drainage ditches? Why do you think they are located there?
Can you tell if there is a height or evaluation difference from one field to the next?

B. Now open USA Photomaps. (To download: www.jdmcox.com) Go to your hometown and look at the aerial photograph. How is this photograph similar and/or different from the Google Earth picture?

- Is this program easier or harder to distinguish landmarks?
- What uses can you see for this program?
- Are these pictures older or newer than Google Earth?

Look for the farm field you found before.

- How is this picture different from Google Earth?
- Are there any changes in field characteristics? What are they?

C. To assist the students in learning the key terminology associated with Remote Sensing, assign each student or small group a word(s) to define. After finding a definition, the students present their finding to the class and explain why this word is important in terms of remote sensing.

Terminology:

Active sensing systems
Passive sensing systems
Aerial imaging (photos)
Platform
GIS (Geographic Information System)
Image correction techniques
Ground reference
Ground control points
Spatial resolution
Spectral resolution
Temporal resolution
Electromagnetic radiation