UNIT 22

Remote Sensing and Photogrammetry

Start-up

In class discuss the following questions:

A. What do you know about remote sensing?
B. What does photogrammetry do?
C. Is there a connection between the two?
D. Name some applications of remote sensing and/or photogrammetry.

Reading

Remote sensing is the acquisition of information about an object or phenomenon without making physical contact with the object. Thus it works in contrast

to the on-site observation. In modern usage, the term generally refers to the use of aerial sensor technologies to detect and classify objects on Earth (both on the surface, and in the atmosphere and oceans) by means of propagated signals (e.g. electromagnetic radiation). It may be split into active remote sensing (when a signal is first emitted from aircraft or satellites) or passive (e.g. sunlight) when information is merely recorded.

Passive sensors gather natural radiation that is emitted or reflected by the object or surrounding areas. Reflected sunlight is the most common source of radiation measured by passive sensors. Examples of passive remote sensors include film photography, infrared, charge-coupled devices, and radiometers. Active collection, on the other hand, emits energy in order to scan objects and areas whereupon a sensor then detects and measures the radiation that is reflected or backscattered from the target. RADAR and LiDAR are examples of active remote sensing where the time delay between emission and return is measured, establishing the location, speed and direction of an object.

Remote sensing makes it possible to collect data on dangerous or inaccessible areas. Remote sensing applications include monitoring deforestation in areas such as the Amazon Basin, glacial features in Arctic and Antarctic regions, and depth sounding of coastal and ocean depths. Remote sensing also replaces costly and slow data collection on the ground, ensuring in the process that areas or objects are not disturbed.

Overhead geodetic collection was first used in aerial submarine detection and gravitational data used in military maps. This data revealed minute perturbations in the Earth's gravitational field that may be used to determine changes in the mass distribution of the Earth, which in turn may be used for geological studies.

"***Photogrammetry*** *consists of making precise measurements from photographs and other imaging sources to determine the relative locations of points in space*".
American Society for Photogrammetry and Remote Sensing (ASPRS)

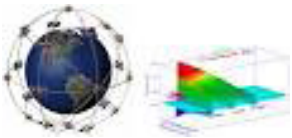
Photogrammetry is a photographic technique which gives measurements of the land from photographs taken from the air, especially for recovering the exact positions of surface points. Moreover, it may be used to recover the motion pathways of designated reference points located on any moving object, on its components and in the immediately adjacent environment. Through a series of precise mathematical calculations, the photographs can be analyzed by computer to produce extremely accurate maps and measurements.

Photogrammetry is as old as modern photography. It can be dated to the mid-nineteenth century and its detection component has been emerging from radiolocation, multilateration and radiometry while its 3-D positioning estimative component (based on modeling) employs methods related to triangulation, trilateration and multidimensional scaling.

Photogrammetry is used in different fields, such as topographic mapping, architecture, engineering, manufacturing, quality control, police investigation, and geology, as well as by archaeologists to quickly produce plans of large or complex sites and by meteorologists as a way to determine the actual wind speed of a tornado where objective weather data cannot be obtained.

Its applications include satellite tracking of the relative positioning alterations in all Earth environments (e.g. tectonic motions etc.), the research on the swimming of fish, of bird or insect flight, and other relative motion processes. The quantitative results of photogrammetry are then used to guide and match the results of computational models of the natural systems, thus helping to invalidate or confirm new theories, to design novel vehicles or new methods for predicting or/and controlling the consequences of earthquakes, tsunamis or any other weather types, and many other processes.

A more sophisticated technique, called **stereophotogrammetry**, involves estimating the three-dimensional coordinates of points on an object. These are determined by measurements made in two or more photographic images taken from different positions. Common points are identified on each image. A line of sight (or ray) can be constructed from the camera location to the point on the object. It is the intersection of these rays (triangulation) that determines the three- dimensional location of the point. More sophisticated algorithms can exploit other information about the scene that is known a priori, for example symmetries, in some cases allowing reconstructions of 3-D coordinates from only one camera position. Stereophotogrammetry is emerging as a robust non-contacting measurement technique to determine dynamic characteristics and mode shapes of non-rotating and rotating structures.



Comprehension and Vocabulary Exercises

A. Please answer the following questions:

1. What is the opposite method to remote sensing?
2. How many types of remote sensing are there?
3. What kind of technologies are there used nowadays?
4. How does active remote sensing differ from passive remote sensing?
5. Give examples of each type.
6. Where is remote sensing used and why?
7. What does photogrammetry do?
8. Which scientific fields use photogrammetry?
9. Give some examples of its uses.
10. What is stereophotogrammetry?

B. Look back in the first paragraph and locate the words that match the definitions stated below. (They are in the same order they appear in the text):

1. The act of gaining possession.
2. Operated from a distance.
3. Anything that receives a signal or stimulus and responds to it.
4. Moved through, or transmitted, esp. in the form of a wave.
5. Given off (radiation or particles).
6. As specified; simply.

C. Match the terms with the definitions:

1. scatter (to)	a. a cause of disturbance or upset.
2. basin	b. a cyclone or twister (U.S. informal).
3. perturbation	c. requiring no evidence for its validation or support.
4. designate (to)	d. a depression in the earth's surface.
5. tornado	e. to throw about in various directions; strew.
6. invalidate (to)	f. to indicate or specify.
7. a priori	g. to render weak or ineffective, as an argument.
8. robust	h. strong in constitution; straightforward and imbued with common sense.

D. Read the following passage and fill in the blanks with the words below:

methods, contours, establish, developed, involved, industry

Photogrammetric mapping may be _____ from aerial photographs and is particularly useful for showing land _____, site conditions and details for large areas.

Usually the photography is made specifically for the project _____. Ground control surveys must be used to _____ measurements, both horizontally and vertically, to photo identifiable points in order to insure scale accuracy of the photo model.

3Ds takes pride in using innovative new methods and technologies in the mapping _____. Photogrammetry and LiDAR are two good examples of the new _____ we have integrated into our collective skillset.

E. Read the following passage and fill in the blanks with the phrases below:

1. urban planning, terrain analysis **2.** physical objects and the environment **3.** determining proposed locations **4.** photographic images **5.** of base maps from

Photogrammetric surveyors specialize in the science of obtaining reliable spatial information from _____. Photogrammetrists analyze aerial and terrestrial photographs to obtain information about _____. The most common utilization of photogrammetry is in the production _____ aerial photography. Mapping generated using photogrammetry provides a cost-effective method of establishing an accurate digital base for such things as _____ and forest management. Photogrammetry can be used for landfill or gravel pit monitoring, determining the location of ore bodies or _____ for utilities, such as pipelines and transmission lines.

F. Match the two halves (1-5 and a-e) in order to form a meaningful paragraph (1-5 appear in the right order):

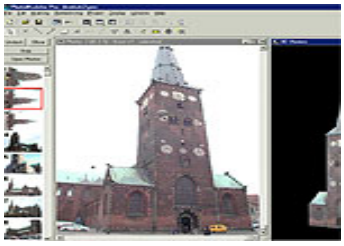
1. Satellites are remote	a. can collect images
2. about the planet without	b. the EM spectrum.
3. A satellite sensor works	c. the electromagnetic spectrum
4. with a few important exceptions.	d. sensors that collect information
5. in the visible portion of	e. like our eyes do,

6. whereas satellite sensors
7. from all over

f. Our eyes only collect images
g. physically contacting it.

G. Which of the following terms does not fit the list?

1. tornado
2. tsunami
3. earthquake
4. deforestation
5. hurricane
6. storm



Language Development

A. The prefix de- forming verbs means removal of or from something specified (e.g. deforest), reversal of something, or departure from. Write other verbs having this prefix:

_____

_____

_____

B. Write the derivatives of the following words:

1. estimative _____

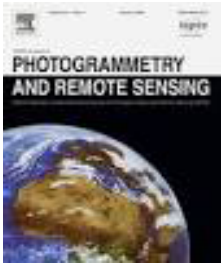
2. acquisition _____

3. propagate _____

4. emit _____

5. perturbation _____

6. invalidate _____



C. Discussion and Writing: With the help of the Internet, library resources or your own knowledge, describe what the followings refer to:

1. Charge-coupled devices

_____

_____

_____

2. Depth sounding

_____

_____

_____

3. Radiometry

_____

_____

_____

4. RADAR

5. LiDAR

6. Multilateration