Remote sensing

Unit 2

Types of remote sensing

Remote sensing is a type of geospatial technology that samples emitted and reflected electromagnetic (EM) radiation from the Earth's terrestrial, atmospheric, and aquatic ecosystems in order to detect and monitor the physical characteristics of an area without making physical contact. This method of data collection typically involves aircraft-based and satellite-based sensor technologies, which are classified as either passive sensors or active sensors.

Passive remote sensing

Passive sensors respond to external stimuli, gathering radiation that is reflected or emitted by an object or the surrounding space. The most common source of radiation measured by passive remote sensing is reflected sunlight. Popular examples of passive remote sensors include charge-coupled devices, film photography, radiometers, and infrared.

Active remote sensing

Active sensors use internal stimuli to collect data, emitting energy in order to scan objects and areas whereupon a sensor measures the energy reflected from the target. RADAR and LiDAR are typical active remote sensing tools that measure the time delay between emission and return in order to establish the location, direction, and speed of an object. The remote sensing data gathered is then processed and analyzed with remote sensing hardware and computer software, which is available in a variety of proprietary and open source applications.

Plateforms

For remote sensing applications, sensors should be mounted on suitable stable platforms. These platforms can be ground based air borne or space borne based. As the platform height increases the spatial resolution and observational area increases. Thus, higher the sensor is mounted; larger the spatial resolution and synoptic view is obtained. The types or characteristics of platform depend on the type of sensor to be attached and its application. Depending on task, platform can vary from ladder to satellite. For some task sensors are also placed on ground platforms. Though aircrafts and satellites are commonly used platforms, balloons and rockets are also used.

Aerial platforms

Balloons are used for remote sensing observation (aerial photography) and nature conservation studies. The first aerial images were acquired with a camera carried aloft by a balloon in 1859. Balloon floats at a constant height of about 30 km. It consists of a rigid circular base plate for supporting the entire sensor system which is protected by an insulating and shock proof light casing. The payload used for Indian balloon experiment of three Hasselblad cameras with different film filter combinations, to provide PAN, infra red black and white and infra red false color images. Flight altitude being high compared to normal aircraft height used for aerial survey, balloon imagery gives larger synoptic views. The balloon is governed by the wind at the floating altitude. Balloons are rarely used today because they are not very stable and the course of flight is not always predictable, although small balloons carrying expendable probes are still used for some meteorological research.

Satellites platforms

When one wants to monitor larger areas (even with global coverage) and/or obtain synoptic views of the same target/area, satellites are normally the platform of choice. Many of the commercial remote sensing images are acquired by sensors on board of satellites. A rocket is used to launch one or more satellites into space where the satellites are placed in a predefined orbit to image the earth for some period of time. Various parameters characterize a satellite's orbit. These include: orbital altitude, inclination angle, period, repeat cycle and type. These orbital parameters to a large extent determine the monitoring capabilities of the satellite.

Sensors

A sensor is a device used to measure a property, such as pressure, position, temperature, or acceleration, and respond

Optical

An optical sensor converts light rays into electronic signals. It measures the physical quantity of light and then translates it into a form that is readable by an instrument. An optical sensor is generally part of a larger system that integrates a source of light, a measuring device and the optical sensor. This is often connected to an electrical trigger. The trigger reacts to a change in the signal within the light sensor. An optical sensor can measure the changes from one or several light beams. When a change occurs, the light sensor operates as a photoelectric trigger and therefore either increases or decreases the electrical output. An optical switch enables signals in optical fibres or integrated optical circuits to be switched selectively from one circuit to another. An optical switch can operate by mechanical means or by electro-optic effects, magneto-optic effects as well as by other methods. Optical switches are optoelectronic devices which can be integrated with integrated or discrete microelectronic circuits.

Thermal

Temperature sensors detect a change in a physical parameter such as resistance or output voltage that corresponds to a temperature change. There are two basic types of temperature sensing:

▪Contact temperature sensing requires the sensor to be in direct physical contact with the media or object being sensed. It can be used to monitor the temperature of solids, liquids or gases over an extremely wide temperature range.
▪Non-contact measurement interprets the radiant energy of a heat source in the form of energy emitted in the infrared portion of the electromagnetic spectrum. This method can be used to monitor non-reflective solids and liquids but is not effective with gases due to their natural transparency.

Microwave

Microwave sensors, detect walking, running or crawling human targets in an outdoor environment. Southwest Microwave developed the industry's first bi-static microwave sensor in 1971, and has pioneered the development of flexible, reliable microwave links and transceivers for the protection of open areas, gates or entryways and rooftop or wall applications.

Microwave sensors generate an electromagnetic (RF) field between transmitter and receiver, creating an invisible volumetric detection zone. When an intruder enters the detection zone, changes to the field are registered and an alarm occurs.

Our microwave sensors are easy to install, provide high probability of detection, low nuisance alarms and resistance to rain, fog, wind, dust, falling snow and temperature extremes. Most operate at K-Band frequency, maximizing detection performance and minimizing interference from external radar sources.

RADAR

RADAR stands for Radio Detection and Ranging System. It is basically an electromagnetic system used to detect the location and distance of an object from the point where the RADAR is placed. It works by radiating energy into space and monitoring the echo or reflected signal from the objects. It operates in the UHF and microwave range.
The RADAR system generally consists of a transmitter which produces an electromagnetic signal which is radiated into space by an antenna. When this signal strikes any object, it gets reflected or reradiated in many directions. This reflected or echo signal is received by the radar antenna which delivers it to the receiver, where it is processed to determine the geographical statistics of the object. The range is determined by the calculating the time taken by the signal to travel from the RADAR to the target and back. The target’s location is measured in angle, from the direction of maximum amplitude echo signal, the antenna points to. To measure range and location of moving objects, Doppler Effect is used.

Aerial remote sensing

Aerial photography is one the earliest forms of remote sensing and is still one of the most widely used and cost effective methods of remote sensing. Before the development of multispectral sensors and computers, people were using traditional photography to capture aerial images. Since its inception, aerial photography has progressed from balloons and kites, to airplane, satellites and now unmanned aircraft systems (UAS). While the quality, resolution and platforms have evolved, aerial photography is still a cornerstone of remote sensing and is becoming cheaper and more accessible than ever. Aerial photography is useful both for regional analysis and for evaluating specific sites. It can also provide a historical perspective that allows us to view changes in landscapes overtime.

As we learned earlier in this course, the first aerial photographs were taken from balloons, kites and even pigeons. Aerial photography quickly expanded with advances in aeronautics. The military potential of aerial photography was obvious and aerial photography was widely used in WWI and WWII. The first non-military aerial photography programs were developed in the 1930's as part of the Agricultural Adjustment Act. In the United States the U.S. Department of

Agriculture (USDA) has been involved in the acquisition, use and distribution of aerial photography for more than 65 years. Aerial photography has numerous applications and is used by cartographers, engineers and scientists to analyze everything from urban expansion to the impacts of climate change.

Types of aerial photographs

Aerial photography is a general term used to describe the taking of photographs from an elevation, usually with the use of some sort of equipment such as an airplane, rocket, hot air balloon or drone. While any photo taken from an elevation can be considered aerial, there are various types of aerial photographs that are divided by particular elements including the camera axis, the scale of the image and the type of film used.

The types of aerial photographs based on camera axis include vertical, low oblique and high oblique. Each type covers a certain amount of area and involves tilting the camera to a specific degree. The result when these factors are applied can be striking.

Vertical

· Vertical Photographs – in this type of photo, the camera axis is in a vertical position, resulting in an image with little or no relief and a relatively small amount of area covered. As vertical images have a direct, overhead result they are often used in mapping.

Oblique

Low Oblique Photographs – to take this type of photo you need to tilt the camera axis more than three degrees. In this case, the horizon will not be visible in the final image and the image will be somewhat distorted as a result. These photos can be useful for taking close up shots that require more detail, such as those used for advertising.

High Oblique Photographs – here the camera axis is tilted to approximately 60 degrees, which allows for a larger area to be covered and will include the horizon in the final shot. This gives you a better wide view of an area which allows you to identify geographical features and landmarks.

Scale of aerial photographs

Scale is the ratio of the distance between two points on an image to the actual distance between the same two points on the ground. Scale is an important describing factor of vertical aerial photography. It is important to know the scale of the image under examination, as this can affect how you perceive or interpret what appears in the image. Scale also allows features in the image to be measured.

Small scale images, with a ratio of 1:25000 or 1:50000 for example, are those which cover a large area with less detail. A large scale image, around 1:3000 or 1:5000 for example, will cover a smaller area but will show ground features in more detail.

This photograph was taken in 1988 during the All Scotland Survey. It has a nominal scale of 1:24000, which means that every centimetre on the image represents 24,000 centimetres, or 240 metres on the ground.

Flight procedures

A flight planning consists of a flight (navigation) map which shows where the aerial photographs are to be taken and parameters (specifications) which outlines the specific requirements such as aerial camera and film requirements, scale, flying height, end lap, side lap, tilt and swing round (yaw) tolerances.

Stereoscope

A stereoscope is a device for viewing a stereoscopic pair of separate images, depicting left-eye and right-eye views of the same scene, as a single three-dimensional image.

A typical stereoscope provides each eye with a lens that makes the image seen through it appear larger and more distant and usually also shifts its apparent horizontal position, so that for a person with normal binocular depth perception the edges of the two images seemingly fuse into one "stereo window". In current practice, the images are prepared so that the scene appears to be beyond this virtual window, through which objects are sometimes allowed to protrude, but this was not always the custom. A divider or other view-limiting feature is usually provided to prevent each eye from being distracted by also seeing the image intended for the other eye.

Optical stereoscope

This stereoscope not only folds to a convenient carrying size and comes with its own pocket case, it also features an adjustable interpupillary distance from 50 – 75 mm (2 – 3") for easy viewing.

The glass lenses are accurately ground for clear images with sharp definition.

Mirror stereoscope

The Mirror Stereoscope is widely used in photogrammetry and Aerial Photography for photo interpretation. It constitutes an almost indispensable auxiliary in the production of plans and maps for land and Cadastral surveys, in Geographical and Geological studies, as well as in Forest surveying etc. It also plays an important part in the field of Remote Sensing.

References

- www.omnisci.com
- www.ccpo.oda.edu
- www.stars-project.org
- www.sciencedirect.com
- Gsp.humboldt.edu
- www.tadfonline.com
- Dir.indiamart.com