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Types and Geometry of Sensors

Sensors

Sensor is a device that gathers energy (EMR or other), converts it into a signal and presents it in a form suitable for obtaining information about the target under investigation. According to Jensen (2000), remote sensors are mechanical devices, which collect information, usually in storable form, about objects or scenes, while being at some distance from them. Sensors used for remote sensing can be either those operating in Optical Infrared (OIR) region or those operating in the microwave region. Depending on the source of energy, sensors are categorized as active or passive:

Active Sensor

Active sensors are those, which have their own source of EMR for illuminating the objects. Radar (Radio Detection and Ranging) and Lidar (Light Detection and Ranging) are some examples of active sensor. Photographic camera becomes an active sensor when used with a flash bulb. Radar is composed of a transmitter and a receiver. The transmitter emits a wave, which hits objects in the environment and gets reflected or echoed back to the receiver. The main advantage is that active sensors can obtain imagery in wavebands where natural signal levels are extremely low and also are independent of natural illumination. The major disadvantage with active sensor is that it needs high energy levels, therefore adequate inputs of power is necessary.

Passive Sensors:

Passive sensors do not have their own source of energy. These sensors receive solar electromagnetic energy reflected from the surface or energy emitted by the surface itself. Therefore, except or thermal sensors they cannot be used at night time. Thus in passive sensing, there is no control over the source of electromagnetic radiation. Photographic cameras (without the use of bulb), multispectral scanners vidicon cameras etc. are examples of passive remote sensors. The advantage with passive sensor is that it is simple and do not require high power. The disadvantage is that during bad weather conditions the passive sensors do not work. The Thematic Mapper (TM) sensor system on the Landsat satellite is a passive sensor.

Optical-Infrared Sensors

Optical infrared remote sensors are used to record reflected/emitted radiation of visible, near middle and far infrared regions of electromagnetic radiation. They can observe for wavelength extended from 400-2000 nm. Sun is the source of optical remote sensing. There are two kinds of observation methods using optical sensors: visible/near infrared remote sensing and thermal infrared remote sensing.

Visible/Near Infrared Remote Sensing

In this, visible light and near infrared rays of sunlight reflected by objects on the ground is observed. The magnitude of reflection infers the conditions of land surface, e.g., plant species and their distribution, rivers, lakes, urban areas etc. In the absence of sunlight or darkness, this method cannot be used.

Panchromatic Imaging System

In this type of sensor, radiation is detected within a broad wavelength range. In panchromatic band, visible and near infrared are included. The imagery appears as a black and white photograph. Examples of panchromatic imaging system are Landsat ETM+ PAN, SPOT HRV-PAN and IKONOS PAN, IRS-1C, IRS-1D and CARTOSAT-series. Spectral range of Panchromatic band of ETM+ is 0.52 µm to 0.9 µm, CARTOSAT-2B is 0.45-0.85 µm, SPOT is 0.45- 0.745 µm.

Multispectral imaging system

The multispectral imaging system uses a multichannel detectors and records radiation within a narrow range of wavelength. Both brightness and color information are available on the image. LANDSAT, LANDSAT TM, SPOT HRV-XS and LISS etc. are the examples.

Thermal Infrared Remote Sensing

In thermal infrared remote sensing, sensors acquire those energy/ heat that are radiated by earth surface due to interaction with solar radiation. This is also used to observe the high temperature areas, such as volcanic activities and forest fires. Based on the strength of

radiation, one can surface temperatures of land and sea, and status of volcanic activities and forest fires. This method can observe at night when there is no cloud. The optical remote sensing can be classified into following:

Hyperspectral Imaging System

Hyperspectral imaging system records the radiation of terrain in 100s of narrow spectral bands. Therefore the spectral signature of an object can be achieved accurately, helps in object identification more precisely. Example, Hyperion data is recorded in 242 spectral bands and AVIRIS data is recorded in 224 spectral bands.

Microwave Sensors

These types of sensors receive microwaves, which are having longer wavelength than visible light and infrared rays. The observation is not affected by day, night or weather. Microwave portion of the spectrum includes wavelengths within the approximate range of 1 mm to1m. The longest microwaves are about 2,500,000 times longer than the shortest light waves. There are two types of observation methods using microwave sensor: a) Active sensor- The sensor emits microwaves and observes microwaves reflected by land surface features. It is used to observe mountains, valleys, surface of oceans wind, wave and ice conditions and b) Passive sensor- This type of sensor records microwaves that naturally radiated from earth surface features. It is suitable to observe sea surface temperature, snow accumulation, thickness of ice, soil moisture and hydrological applications etc. RISAT is an Indian remote sensing satellite provides microwave data.