COURSE : DISASTER MANAGEMENT (MA/ MSc PART I)
Paper : IV
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Topic : Remote Sensors

Remote Sensors

The instruments used to measure the electromagnetic radiation reflected/emitted by the target under study are usually referred to as remote sensors. There are two classes of remote sensor: passive and active.

- **Passive remote sensor:** Sensors which sense natural radiations, either emitted or reflected from the earth, are called passive sensors — the sun as a source of energy or radiation. The sun provides a very convenient source of energy for remote sensing. The sun's energy is either reflected, as it is for visible wavelengths, or absorbed and then reemitted, as it is for thermal infrared wavelengths. Remote sensing systems which measure the energy that is naturally available are called passive sensors. Passive sensors can only be used to detect energy when the naturally occurring energy is available. For all reflected energy, this can only take place during the time when the sun is illuminating the Earth. There is no reflected energy available from the sun at night. The energy that is naturally emitted (such as thermal infrared) can be detected day or night, as long as the amount of energy is large enough to be recorded.
- **Active remote sensor:** Sensors which carry electromagnetic radiation of a specific wavelength or band of wavelengths to illuminate the earth's surface are called active sensors. Active sensors provide their own energy source for illumination. The sensor emits radiation which is directed toward the target to be investigated. The radiation reflected from that target is detected and measured by the sensor. Advantages for active sensors include the ability to obtain measurements anytime, regardless of the time of day or season. Active sensors can be used for examining wavelengths that are not sufficiently provided by the sun, such as microwaves, or to better control the way a target is illuminated. However, active systems require the generation of a fairly large amount of energy to adequately illuminate targets. Some examples of active sensors are a laser fluorosensor and a synthetic aperture radar (SAR).

Parameters of a Sensing System

The major parameters of a sensing system which can be considered as indicators of the quality of data and which have bearing on optimum utilization for specific end use include:

1. **Spatial resolution:** The capability of the sensor to discriminate the smallest object on the ground of different sizes; usually specified in terms of linear dimension. As a general rule, the higher the resolution, the smaller the object that can be identified.
2. **Spectral resolution:** The spectral bandwidth with which the data is collected.
3. **Radiometric resolution:** The capability of the sensor to discriminate two targets based on its reflectance/emittance difference; it is measured in terms of the smallest reflectance/emittance that can be detected. Higher the radiometric resolution, smaller the radiance differences that can be detected between two targets.
4. **Temporal resolution:** The capability to view the same target, under similar conditions, at regular intervals.

Electromagnetic spectrum: The electromagnetic spectrum ranges from the shorter wavelengths (including gamma and x-rays) to the longer wavelengths (including microwaves and broadcast radio waves). There are several regions of the electromagnetic spectrum which are useful for remote sensing. For most purposes, the ultraviolet or UV portion of the spectrum has the shortest wavelengths which are practical for remote sensing. This radiation is just beyond the violet portion of the visible wavelengths, hence its name. Some Earth surface materials, primarily rocks, and minerals, fluoresce or emit visible light when illuminated by UV radiation.

The light which our eyes—our "remote sensors"—can detect is part of the visible spectrum. It is important to recognize how small the visible portion is relative to the rest of the spectrum. There is a lot of radiation around us which is "invisible" to our eyes, but can be detected by other remote sensing instruments and used to our advantage. The visible wavelengths cover a range from approximately 0.4 to 0.7 μm. The longest visible wavelength is red, and the shortest is violet. Common wavelengths of what we perceive as particular colors from the visible portion of the spectrum are listed below. It is important to note that this is the only portion of the spectrum we can associate with the concept of colors.

1. **Violet:** 0.4 - 0.446 μm
2. **Blue:** 0.446 - 0.500 μm
3. **Green:** 0.500 - 0.578 μm
4. **Yellow:** 0.578 - 0.592 μm
5. **Orange:** 0.592 - 0.620 μm
6. **Red:** 0.620 - 0.7 μm

The portion of the spectrum of more recent interest to remote sensing is the microwave region from about 1 mm to 1 m. This covers the longest wavelengths used for remote sensing. The shorter wavelengths have properties similar to the thermal infrared Region while the longer wavelengths approach the wavelengths used for radio broadcasts.