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Table of Content

1. Introduction

Remote sensing is the acquisition of information about an object without coming in physical contact of that object. And 'sensor' is a device that helps in gathering of information (amount of EMR emitted or reflected by the object). In other words, 'sensor' is the remote sensing device that records wavelengths of energy. Generally, these sensors are mounted or fixed with a 'platform'. Therefore, 'platform' is termed as a vehicle that carries remote sensing device (Fig. 1).

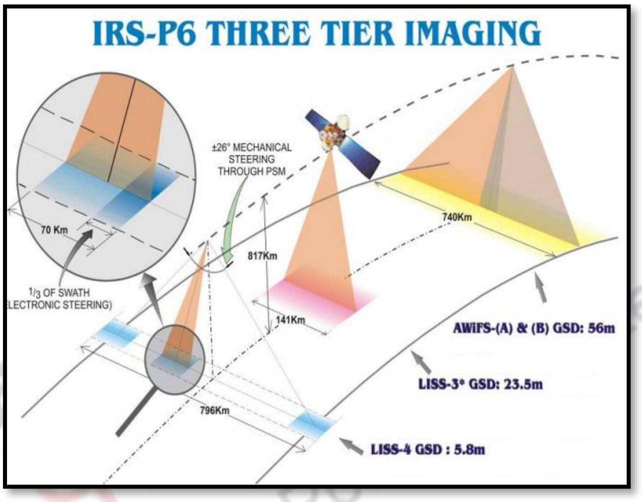


Fig. 1 Indian remote sensing platform and sensor.

2. Platforms

Platform is a stage where sensor or camera is mounted to acquire information about a target under investigation. According to Lillesand and Kiefer (2000), a platform is a vehicle, from which a sensor can be operated. Platforms can vary from stepladders to satellites. There are different types of platforms and based on its altitude above earth surface, these may be classified as:

2.1 Ground based Platforms

Wide varieties of ground-based platforms are used in remote sensing. Some of the common ones are hand held devices, tripods, towers and cranes. To study properties of a single plant or a small patch of grass, ground based platform is used.

Ground based platforms (hand-held or mounted on a tripod) are also used for sensor calibration, quality control and for the development of new sensors.

For the field investigations, some of the most popular platforms have been used are 'cherry picker platform, portable masts and towers. The cherry picker platforms can be extended to approx. 15m. They have been used by various laboratories to carry spectral reflectance meters and photographic systems. Portable masts are also available in various forms and can be used to support cameras and sensors for testing. The main problem with these masts is that of stabilizing the platform, particularly in windy conditions. Permanent ground platforms like towers and cranes are used for monitoring atmospheric phenomenon and long-term monitoring of terrestrial features. Towers can be built on site and can be tall enough to project through a forest canopy so that a range of measurements can be taken from the forest floor, through the canopy and from above the canopy (Fig. 2)

Fig. 2 Crane, Ground based platform.

2.2 Balloon Platforms

Balloons as platforms are not very expensive like aircrafts. They have a great variety of shapes, sizes and performance capabilities. The balloons have low acceleration, require no power and exhibit low vibrations. There are three main types of balloon systems, viz. free balloons, Tethered balloons and Powered Balloons. *Free balloons* can reach almost top of the atmosphere; hence, they can provide a platform at intermediate altitude between those of aircraft and spacecraft (Fig. 3).

Fig. 3 Balloon as platform.

Free floating or anchored balloons have altitude range of 22-40 km and can be used to a limited extent as a platform. It is used for probing the atmosphere and also useful to test the instrument under development.

In India, at present, Tata Institute of Fundamental Research, Mumbai, has setup a National balloon facility at Hyderabad. Teethered balloons are connected to the earth station by means of wire shaving high tensional strength and high flexibility.

2.3 Aircraft Platform

Aerial platforms are primarily stable wing aircraft. Helicopters are also occasionally used for this purpose. Generally, aircraft are used to collect very detailed images. Helicopters can be for pinpoint locations but it vibrates and lacks stability.

2.3.1 Low Altitude Aircraft

It is most widely used and generally operates below 30,000 ft. They have single engine or light twin engine. It is suitable for obtaining image data for small areas having large scale (Fig. 4).

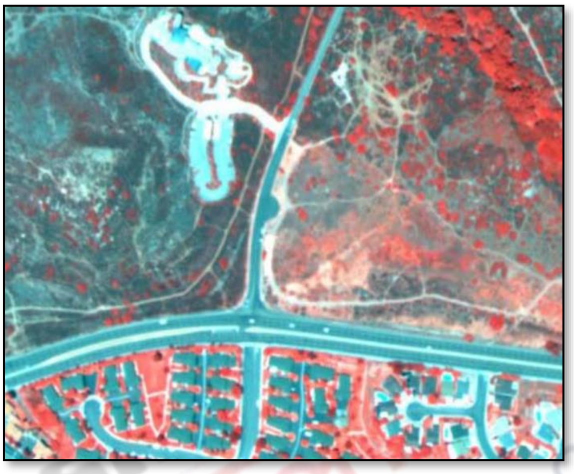


Fig. 4 Low altitude aircraft produced image.

2.3.2 Low Altitude Aircraft

It is more stable and operates above 30,000 ft. High altitude aircraft includes jet aircraft with good rate of climb, maximum speed, and high operating ceiling. It acquires imagery for large areas (smaller scale). Examples are NHAP, NAPP, AVIRIS.

Aircraft platform acquire imagery under suitable weather conditions. It controls platform variables such as altitude. Time of coverage can also be controlled. However, it is expensive, less stable than spacecraft and has motion blurring (Fig. 5).

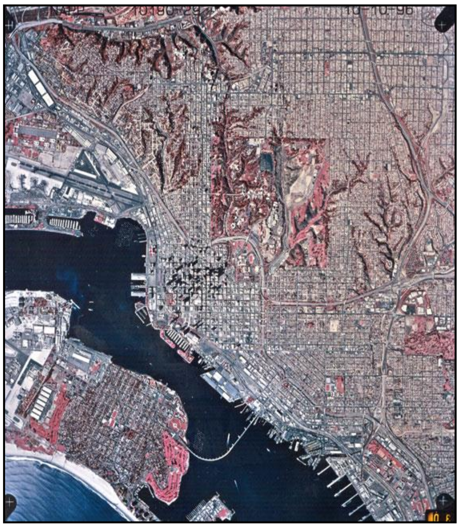


Fig. 5 Image by High altitude aircraft.

2.4 Rockets as Platforms

Prior to use of airplanes, aerial photographs were obtained by rocketing a camera into the sky and then retrieving the camera and film.

Synoptic imagery can be obtained from rockets for areas of some 500,000 square km. The Skylark earth Resource Rocket is fired from a mobile launcher to altitudes between 90 - 400 kms. With the help of a parachute, the payload and the spent motor are returned to the ground gently thereby enabling speedy recovery of the photographic records. This rocket system has been used in surveys over Australia and Argentina. In 1946, V-2 rockets acquired from Germany after World War II were launched to high altitudes from White Sands, New Mexico. These rockets contained automated still or movie cameras that took picture as the vehicle ascended. The main problem with rockets is that they are one-time observations only. Except for one time qualitative or reconnaissance purposes, rocket platforms are not of much use in regular operational systems (Fig. 6).

Fig. 6 Rocket as Platform

2.5 Spacecraft as Platform

Remote sensing is also conducted from the space shuttle or artificial satellites. Artificial satellites are manmade objects, which revolve around another object.

The 1960s saw the primary platform used to carry remotely sensed instruments shifted from airplanes to satellite. Satellite can cover much more land space than planes and can monitor areas on a regular basis.

Beginning with the first television and infrared observation Satellite (tiRoS-1) in 1960, early weather satellites returned rather poor views of cloud patterns and almost indistinct images of the earth's surface. Space photography becomes better and was further extended with the Apollo program. Then in 1973, Skylab the first American space workshop was launched and its astronauts took over 35,000 images of the earth with the earth Resources experiment Package (eReP) on board. Later on with LANADSAT and SPOT Satellite program, space photography received a higher impetus (Fig. 7).

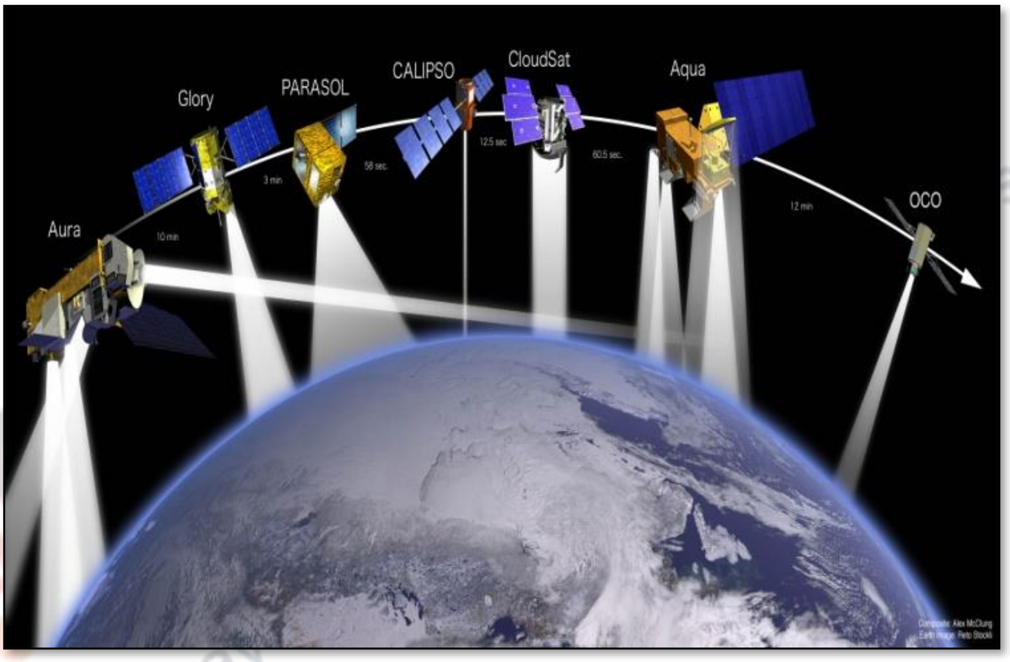


Fig. 7 Spacecraft as platform.

3. Types of Orbits

There are two types of orbiting satellites -

3.1 Sun-synchronous Orbits

In sun-synchronous orbit, satellite is orbiting in synchronous with sun. In this type of orbit, satellite passes every location at the same time each day. Such an orbit is near polar with altitudes between 300 and 1000 km. They are also known as "polar orbiters" because of the high latitudes they cross. The noon satellites pass over near noon and midnight, whereas morning satellites pass over near dawn and dusk.

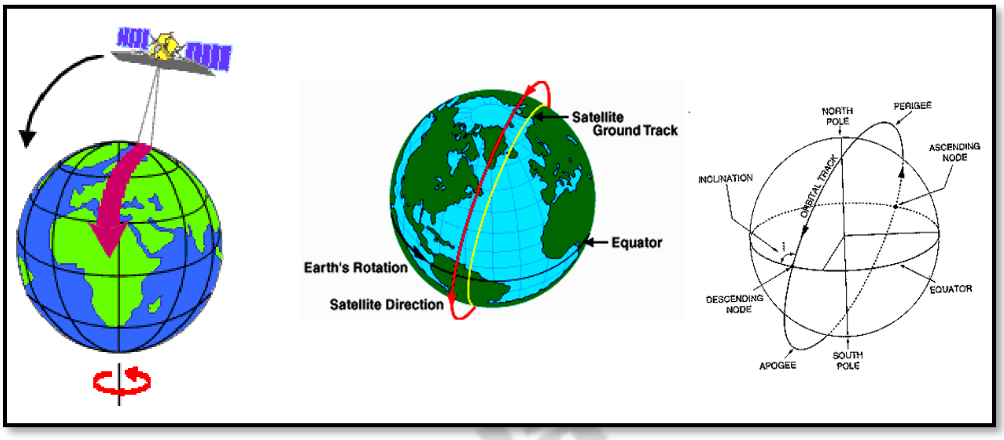


Fig. 8 Sun-synchronous orbit.

Satellite in a sun-synchronous orbit has an inclination that carries the satellite track westward at a rate that compensates for the change in local sun time as the satellite moves from north to south. Infact most earth observation satellites are placed in orbits designed to acquire imagery between 9.30 and 10.30 A.M. This local time is set to minimize cloud cover in tropical regions and provides optimum illumination. Satellites in sun-synchronous orbits pass from north to south on the sunlit side (descending node) and from south to north on the shadowed side (the ascending node). During the descending pass, sensors that depend on reflected solar radiation acquire data, but radar and thermal sensors can acquire data independently of solar illumination, thereby observing the earth's surface during both passes.

The major advantage of such an orbit is that data taking is standardized with respect to the sun angle. Secondly, since the sun synchronous orbit is near polar, it provides nearly global coverage. Through these satellites, the entire globe is covered on regular basis and gives repetitive coverage on periodic basis. Some of them sun-synchronous satellites are LANDSAT Series, SPOT Series, IRS Series, NOAA, SEASAT, TIROS (Fig. 8 & 9).

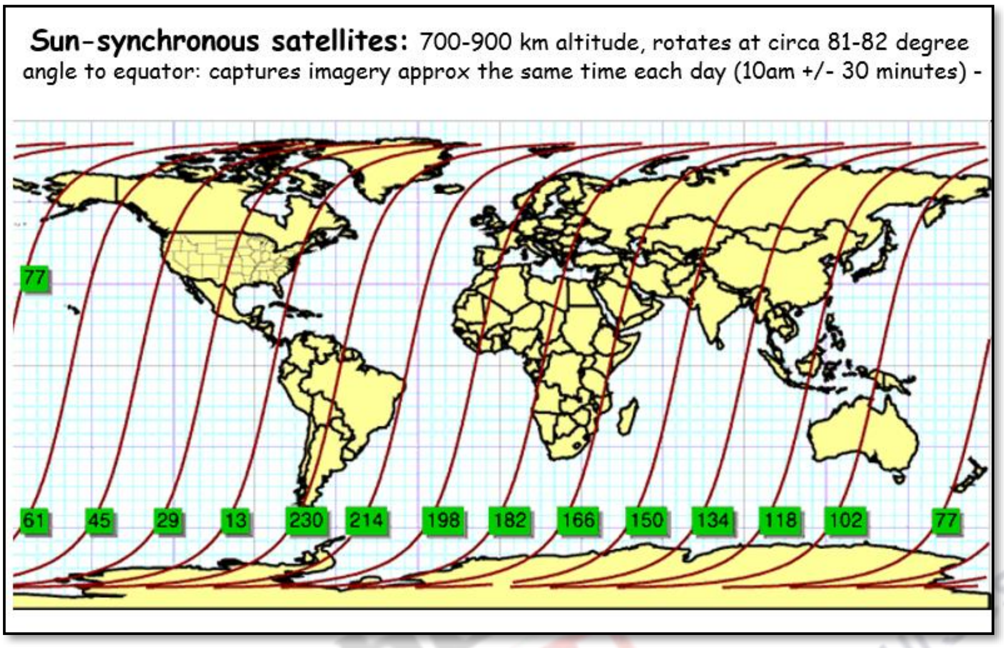


Fig. 9

3.2 Geostationary (geo-synchronous) Orbits

In geosynchronous orbit, satellite in synchronous with earth. It is basically designed to maintain a constant position with respect to a specific portion of the earth's surface area day and night (Fig. 10).

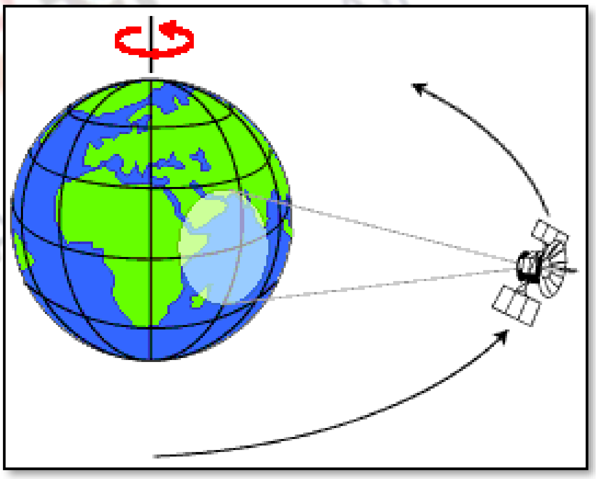


Fig. 10 Geostationary orbit.

These satellites move along in the same direction of the rotation of the earth, taking the same amount of time as the earth's rotation. Its coverage is limited to 70°N to 70°S latitudes and one satellite can view one-third globe. While moving west to east such satellites must have a velocity equal to that of the earth rotating about its axis west to east.

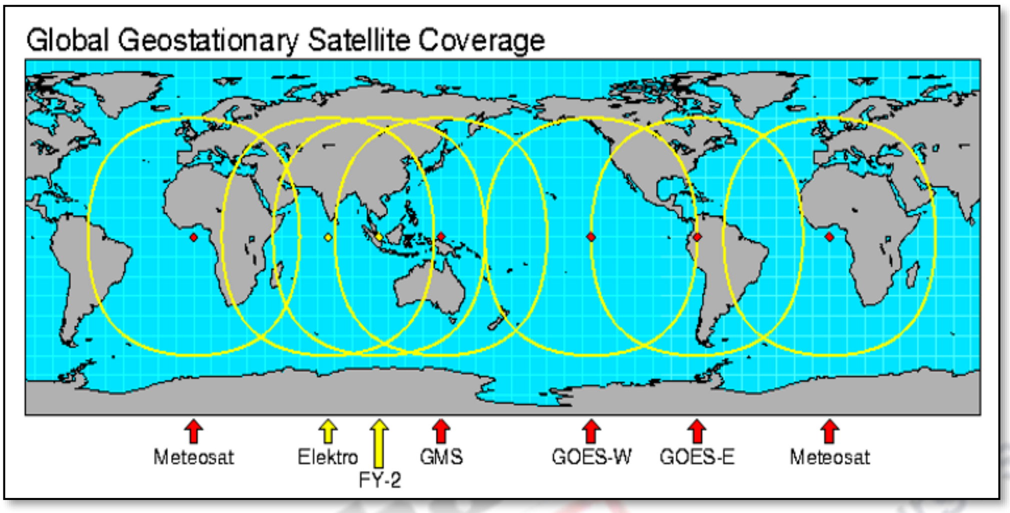


Fig. 11

The main advantage of this satellite is that since it is stationary (rather appears stationary); it allows continuous viewing of that portion of the earth within the line of sight of the satellite sensors. However, satellite can only "see" one hemisphere. These are orbiting approximately 36,000 km above the Earth. Geostationary orbits are ideal for meteorological or communications satellites. Some examples of geostationary satellites are GOES, METOSAT, INTELSAT, INSAT.

4. Sensors

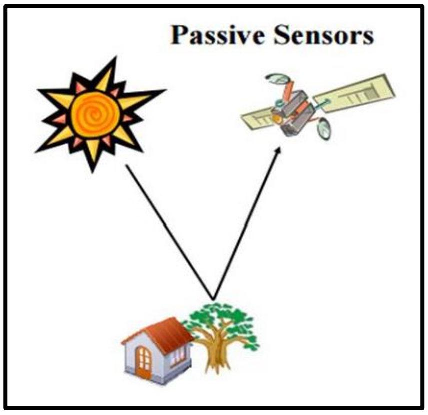
Sensor is a device that gathers energy (EMR or other), converts it into a signal and presents it in a form suitable for obtaining information about the target under investigation. According to Jensen (2000), remote sensors are mechanical devices, which collect information, usually in storable form, about 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:

4.1 Active Sensors

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.

4.2 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 for 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.

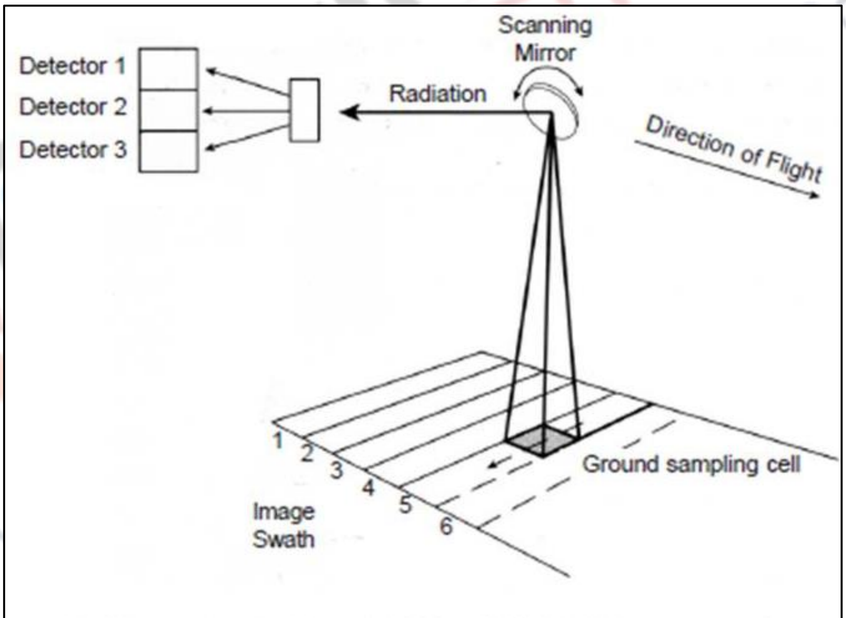


5. Types of Scanner

There are two types of Scanner:

5.1 Whiskbroom scanner (Transverse/mirror/ cross-track)

A transverse scanning system is an electro-mechanical device (small number of sensitive diodes) that obtains data from narrow swaths of terrain right angle to the direction of flight. It means scanner sweeps perpendicular to the path or swath, centered directly under the platform, i.e. at 'nadir'. The forward movement of the aircraft or satellite allows the next line of data to be obtained in the order 1, 2, 3, 4 etc. In this way, an image is built up in a sequential manner. In whiskbroom system, scanning is done by using rotating or oscillating mirror e.g. LANDSAT MSS /TM (Fig. 12).



Whiskbroom Scanning System : Obtaining digital data by transverse scanning system which employ an oscillating mirror.

Fig. 12

5.2 Pushbroom scanner (along-track)

The pushbroom scanner has a linear array of detectors, in which each detector measures the radiation reflected from a small area on the ground. In this type of scanning system, linear array of detectors scan in the direction parallel to the flight line. Linear arrays normally consist of numerous charge-coupled devices (CCDs) positioned end to end. Charge-Coupled Devices are designed to be very small and a single array may contain over 10,000 individual detectors. Normally, the arrays are located in the focal plane of the scanner such that all scan lines are viewed by all arrays simultaneously. This system is more reliable as against the scanning mirror of the transverse system and the detectors are light and need little power to operate (Fig. 13).

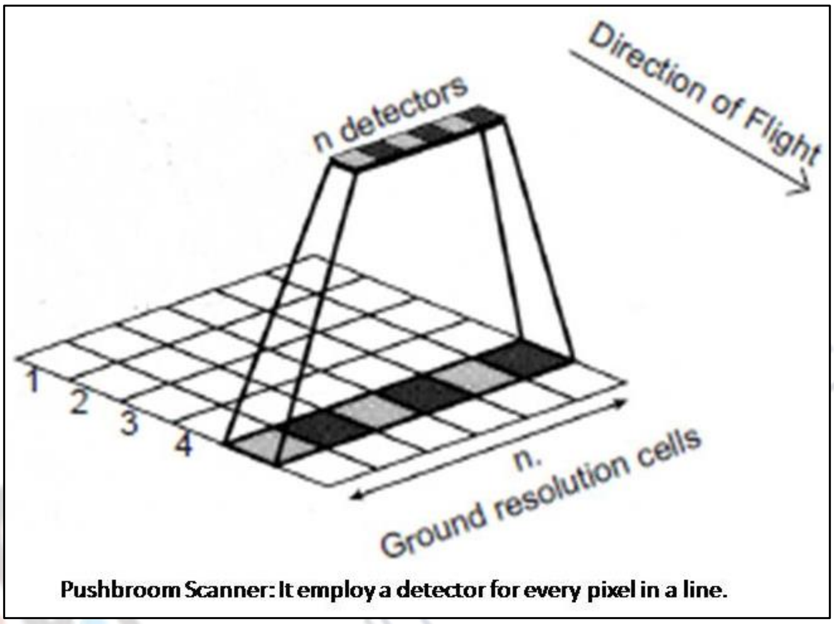


Fig. 13

6. Different Sensors and their characteristics

6.1 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.

6.1.1 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.

6.1.1.1 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.

6.1.1.2 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.

6.1.2 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:

6.1.3 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.

6.1.4 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.

7. Characteristics of some Scanners

7.1 LANDSAT

NASA, with the co-operation of the U.S. Department of Interior, began a conceptual study of the feasibility of a series of Earth Resources Technology Satellites (ERTS). During 1975, NASA officially renamed the ERTS programme as the "LANDSAT" programme. There have been four different types of sensors included in various combinations on these missions. These are Return Beam Vidicon camera (RBV) systems, Multispectral Scanner (MSS) systems, Thematic Mapper (TM) and Enhanced Thematic Mapper (ETM).

7.1.1 Landsat 3 RBV Specifications

Satellite	Sensor	Band No.	Wavelength (μm)	Geo. Resolution
Landsat 3	RBV	1	0.505 to 0.75	40 x 40m

7.1.2 Landsat 4-5 MSS and TM specification

Sensor		Band No.	Wavelength (μm)	Geo. Resolution
MSS	Green Visible	1	0.50 to 0.60	82m
0	Red Visible	2	0.60 to 0.70	82m
0	Near IR	3	0.70 to 0.80	82m
0	Near IR	4	0.80 to 1.10	82m
0	Blue Visible	1	0.45 to 0.52	30m
0	Green Visible	2	0.52 to 0.60	30m
0	Red Visible	3	0.63 to 0.69	30m
0	Near IR	4	0.76 to 0.90	30m
0	Mid IR	5	1.55 to 1.75	30m
0	Thermal IR	6	10.4 to 12.5	120m
0	Mid IR	7	2.08 to 2.35	30m

7.1.3 Landsat 7 ETM+ characteristics

Sensor		Band No.	Wavelength (μm)	Geo. Resolution
ETM+	Blue Visible	1	0.45 to 0.52	30m
0	Green Visible	2	0.52 to 0.60	30m
0	Red Visible	3	0.63 to 0.69	30m
0	Near IR	4	0.76 to 0.90	30m
0	Mid IR	5	1.55 to 1.75	30m
0	Thermal IR	6	10.4 to 12.5	60m
0	Mid IR	7	2.08 to 2.35	30m
0	Panchromatic	8	0.50 to 0.90	15m

7.2 SPOT (Satellites Pour l'Observation de la Terre)

The SPOT (Satellites Pour l'Observation de la Terre or Earth-observing Satellites) remote-sensing programme was set up in 1978 by France in partnership with Belgium and Sweden. The SPOT satellites constellation offers acquisition and revisit capacity allowing to acquire imagery from anywhere in the world, every day. Each SPOT payload comprises two identical high-resolution optical imaging instruments, which can operate simultaneously or individually in either panchromatic (P mode: a single wide band in the visible part of the spectrum) or multispectral mode (XS mode: the green, red, and infrared bands of the electromagnetic spectrum). The temporal resolution is shortened from 26 to 4-5 days for the temperate zones.

Satellites SPOT 4 and 5 together ensure the provision of simultaneous acquisition of stereo pairs, high-resolution SPOT images and of VEGETATION global images. The continuity of the SPOT programme is planned with the development of Spot 6 and 7, which will offer 2-meter resolution images in a 60 km by 60 km swath.

7.2.1 SPOT 1, 2 and 3 Satellite's Characteristics

The SPOT 1, 2 and 3 satellites were identical and their payloads consisted of two identical HRV (Visible High-Resolution) optical instruments, data recorders (on magnetic tapes), and a system for transmitting the images to the ground-based receiving stations.

Mode	**Band**	**Spectral band**	**Resolution**
Mode	**Band**	**Spectral Band**	**Resolution**
XS-multispectral	XS1	0,50 - 0,59 µm (green)	20m x 20m
	XS2	0,61 - 0,68 µm (red)	20m x 20m
	XS3	0,78 - 0,89 µm (near IR)	20m x 20m
P-panchromatique	PAN	0,50 - 0,73 µm	10m x 10m

7.2.2 SPOT 5

The main payload consists of high resolution imaging instruments delivering the following product improvements compared to Spot 4: The HRS (High-Resolution Stereoscopic) imaging instrument dedicated to taking simultaneous stereopairs of a swath 120 km across and 600 km long; A ground resolution of 5 and 2.5 meters in panchromatic mode; A resolution in multispectral mode of 10 m in all 3 spectral bands in the visible and near infrared ranges.

The spectral band in the short wave infrared band (essential for VEGETATION data) is maintained at a resolution of 20 m due to limitations imposed by the geometry of the CCD sensors used in this band.

The Spot 5 spectral bands are the same as those for Spot 4. The panchromatic band does, however, return to the values used for Spot 1-2-3. As requested by many users, this ensures continuity of the spectral bands established since Spot 1.

Altitude: 822 km

Inclination: 98.7 degrees

Orbit: sun-synchronous polar

Period of revolution: 101 minutes

Swath width: 60 x 60 to 80 km

Repeat cycle: 26 days

Satellite: SPOT 5 (04/05/2002 – still operational)

7.2.2.1 HRG Sensors (High Resolution Geometric sensors)

Two HRG instruments are capable of generating data at 4 resolution levels with the same 60 km swath.

Mode	Band	Spectral band	Resolution
Multispectral	B1	0,50 - 0,59 µm	10m x 10m
	B2	0,61 - 0,68 µm	10m x 10m
	B3	0,78 - 0,89 µm	10m x 10m
	SWIR	1,58 - 1,75 µm	20m x 20m
M - monospectral	PAN	0,51 - 0,73 µm	5m x 5m (or 2.5m x 2.5m in supermode)

7.2.2.2 High-Resolution Stereoscopic sensors (HRS sensors)

The ability to acquire stereopair images quasi-simultaneously (90 sec) is a considerable advantage for the quality of digital elevation model (DEM) production. The resemblance between the two images is indeed maximum. Characteristics of sensor are given in the table below:

Mode	Band	Spectral band	Resolution	Swath	Max scene length	viewing angle of the telescopes
M - monospectral	PAN	0,51 - 0,73 µm	10m x 10m	120 km	600km	± 20°

7.2.2.3 VEGETATION Sensor

The VEGETATION programme is co-financed by the European Union, Belgium, France, Italy, and Sweden and being conducted under the supervision of the CNES (National Centre for Space Studies, France). The aim of the VEGETATION instrument is to provide accurate measurements of the main characteristics of the Earth's plant cover. Practically daily global coverage and a resolution of 1 km make this sensor an ideal tool for observing long-term regional and global environmental changes.

VEGETATION works independently from the HRVIRs. It includes a wide-angle radiometric 'camera' operating in four spectral bands (blue, red, near infrared, and middle-infrared). Given its 2,250km swaths, this instrument is thus able to cover almost all of the Earth's dry land in just one day.

Band	Spectral band	Resolution	Applications
B0	0,43 - 0,47µm (blue)	1165m x 1165m	Oceanographic applications / Atmospheric corrections
B2	0,61 - 0,68 µm (red)	1165m x 1165m	Vegetation photosynthesis activity
B3	0,79 - 0,89 µm (near IR)	1165m x 1165m	
MIR	1,58 - 1,75 µm (middle IR)	1165m x 1165m	Ground and vegetation humidity

7.3 Indian Remote Sensing Satellites (IRS series Sensors)

IRS mission started in 1979 with Bhaskar 1 and continued with IRS-1A, 1B, IRS-P2, IRS-1C, IRS-1D, IRS-P3, IRS-P4 and IRS-P6 (Resourcesat). Characteristics of some of IRS Sensors are discussed below:

Satellite	Types of Scanner	Orbit altitude	Orbit	Equatorial crossing time	Repetitive	Sensor
Reosourcesat-1 (IRSP6)	Pushproom	817 km	Polar sun-synchronous	10.30AM	5-24 days	LISS IV LISS III AWiFS

7.3.1 Resourcesat

Sensor	Sensor Channels	Resolution (m)	Swath Width (km)	Spectral Bands
Linear Imaging Self-Scanning System I (LISS-I)	LISS-I-1 LISS-I-2 LISS-I-3 LISS-I-4	72	148	0.45-0.52 (blue) 0.52-0.59 (green) 0.62-0.68 (red) 0.77-0.86 (near IR)
Linear Imaging Self-Scanning System II (LISS-II)	LISS-II-1 LISS-II-2 LISS-II-3 LISS-II-4	36	74	0.45-0.52 (blue) 0.52-0.59 (green) 0.62-0.68 (red) 0.77-0.86 (near IR)
Linear Imaging Self-Scanning System III (LISS-III)	LISS-III-2 LISS-III-3 LISS-III-4 LISS-III-5	23 50	142 148	0.52-0.59 (green) 0.62-0.68 (red) 0.77-0.86 (near IR) 1.55-1.70 (mid-IR)
	PAN	6	70	0.5-0.75
High Resolution Linear Imaging Self-Scanning System IV (LISS-IV)	LISS-IV-2 LISS-IV-3 LISS-IV-4	5.8	24 - 70	0.52-0.59 (green) 0.62-0.68 (red) 0.77-0.86 (near IR)
Wide Field Sensor (WiFS)	WiFS-1 WiFS-2	188	774	0.62-0.68 (red) 0.77-0.86 (near IR)
Advanced Wide Field Sensor (AWiFS)	AWiFS-2 AWiFS-3 AWiFS-4 AWiFS-5	56-70	370-740	0.52-0.59 (green) 0.62-0.68 (red) 0.77-0.86 (near IR) 1.55-1.70 (mid-IR)

7.3.2 Salient features of CARTOSAT-2 SERIES 2

The Cartosat-2 series satellite is the primary satellite injection into a 505 km polar Sun Synchronous Orbit by PSLV-C37.

Lift off Mass	713.2 Kgs	
Onboard data storage	2 x 300Giga bits SSR	
Payload	Panchromatic camera with 0.65m resolution 4 Bands Multispectral camera with 2.0 m with a swath of 10 km.	
Launch Date	February 15, 2017	
Launch Vehicle	PSLV- C37	
Launch Site	SDSC-SHAR Centre, Sriharikota, India	
Co-passenger	Nanosatellites from various countries like USA, Khazakisthan, ISRAEL, Netherlands, UAE & Switzerland	101 Nos
	Nano-Satellites build by ISAC-ISRO	2 Nos
Orbit	505 Kms Polar Sun Synchronous orbit with an inclination of 97.46 deg	
Achievements	• Onboard Autonomy • Macro Based Payload Sequencer , AOS commanding • New features like DWT compression, VIT mode, NUC for both PAN and MX • Slice redundancy compression system	

The IKONOS-2 (High Spatial Resolution Satellites)

The IKONOS-2 satellite was launched in September 1999 and has been delivering commercial data since early 2000. IKONOS data records 4 channels of multispectral data at 4 m resolution and one panchromatic channel with 1 m resolution.

Spectral Characteristic of IKONOS data

Band	**Wavelength**	**Resolution**
Panchromatic	0.45 - 0.90 um (Visible)	1 m
1	0.45 - 0.52 um (Blue)	4 m
2	0.52 - 0.60 um (Green)	4 m
3	0.63 - 0.69 um (Red)	4 m
4	0.76 - 0.90 um (Near IR)	4 m

Frequently Asked Questions-

Q1. What do mean by remote sensing platform?

Ans: Remote sensing platform is a stage to mount the sensor or camera to acquire the information about a target under investigation. According to Lillesand and Kiefer (2000), a platform is a vehicle, from which a sensor can be operated. Following are the different types of platforms used in remote sensing:

- Ground based platforms
- Balloon platforms
- Aircraft platform
- Rocket platform and
- Satellite platforms.

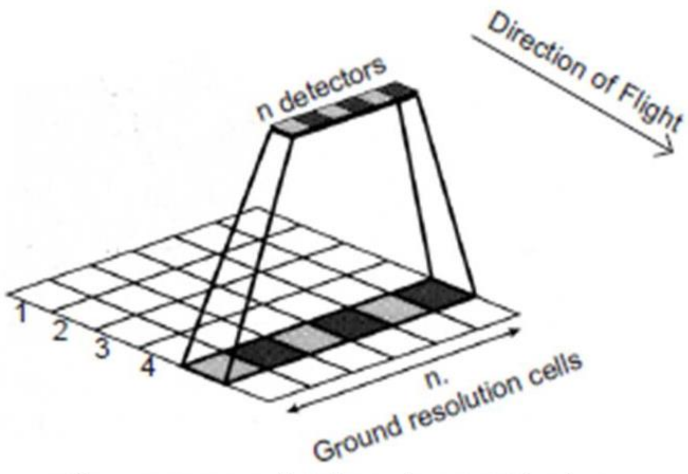
Q2. What is a geostationary orbit?

Ans: Geostationary orbit is a path in which satellite moves in the same direction of the rotation of the earth, taking the same amount of time as the earth's rotation. While moving west to east such satellites must have a velocity equal to that of the earth rotating about its axis west to east. The main advantage of this satellite is that, it allows continuous viewing of a particular portion of the earth within the line of sight of the satellite sensors. Some examples of geostationary satellites are GOES, METOSAT, INTELSAT, INSAT.

Q3. What is the concept of Pushbroom scanner?

Ans: Pushbroom scanner (along-track scanner) is a type of scanning system in which detector scans the terrain of earth in the flight direction directly beneath the platform. The detector scans the whole terrain equal to width of swath in a strip or line. To build up a two-dimensional image by recording successive scan lines, the detectors are oriented at right angles to the flight direction.

In an along- track system there is a mechanical scanning mirror for pixel by pixel scanning along the swath direction. In this scanning system a linear array of detectors is used typically consist of numerous charge coupled devices (*CCDs*) positioned end to end.



Pushbroom Scanner: It employ a detector for every pixel in a line.

Q4. Write down the characteristics of SPOT 1, 2 and 3 satellites?

Ans: The SPOT 1, 2 and 3 satellites were identical and their payloads consisted of two identical HRV (Visible High-Resolution) optical instruments, data recorders (on magnetic tapes), and a system for transmitting the images to the ground-based receiving stations. SPOT 1, 2 and 3 satellites have following characteristic:

Mode	**Band**	**Spectral band**	**Resolution**
Mode	**Band**	**Spectral Band**	**Resolution**
XS-multispectral	XS1	0,50 - 0,59 µm (green)	20m x 20m
	XS2	0,61 - 0,68 µm (red)	20m x 20m
	XS3	0,78 - 0,89 µm (near IR)	20m x 20m
P-panchromatique	PAN	0,50 - 0,73 µm	10m x 10m

Q5. Define active remote sensing sensors?

Ans: 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.

Multiple Choice Questions-

1. Landsat program began in

(a) 1972
(b) 2003
(c) 1973
(d) 1937

Ans: a

2. First satellite of NASA was

(a) Sputnik 2
(b) Explorer 1
(c) Sputnik 1
(d) Terra 1

Ans: d

3. In which year CARTOSAT -2 was launched

(a) In 2017
(b) In 2016
(c) In 2015
(d) In 2007

Ans: a

4. What is the spatial resolution of PAN of LISS-IV

(a) 6 meter
(b) 5.8 meter
(c) 23 meter
(d) 50 meter

Ans: b

5. Which of the following are active Sensors

(a) Radar (Radio Detection and Ranging)
(b) Thematic Mapper (TM)
(c) Both a and b
(d) None of the Above

Ans: a

Suggested Readings:

1. Gibson, Paul (2000), Introductory Remote Sensing: Principles and Concepts, 1st Edn., Routledge Publications, London. ISBN: 0415196469, 978-0415196468.
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3. Lillesand Thomas, Keifer Ralph W. and Chipman Jonathan (2015). Remote sensing and Image Interpretation, 7th Edn. John Wiley & Sons, New York. ISBN : 978-1-118-34328-9.
4. Reddy, Anji M. (2012), Textbook of remote sensing and geographical information systems, 4th Edn., B S Publications. ISBN: 9381075972, 978-9381075975.
5. Kumar, S. (2016), Basics of Remote Sensing and GIS, 1st Edn., Laxmi Publications. ISBN: 8131805441, 978-8131805442.
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