SEMESTER – IV, PAPER-II (Practical)

Remote Sensing

Unit 1

Definition of Remote Sensing.

"Remote Sensing is the acquisition and interpretation of spectral measurements made at a distant place to obtain information about the earth surface. In a simple sense, human sense organs are virtually organic forms of remote sensing." (Dr. A.N. Singh).

"The term remote sensing refers to methods that employ electromagnetic energy, such as, light, heat and radio waves, as the means of detecting and measuring target characteristics." (Floyd F. Sabin).

"Remote sensing is a multi disciplinary activity which deals with the inventory, monitoring and assessment of natural resources through the analysis of data obtained by observations from remote platform." (B.L Deekshatulu).

Use of Remote Sensing

1. Observation beyond the visible range of the Electro Magnetic Spectrum.
2. Invisible becomes Visible.
3. Acquisition of Quantitative & Qualitative Data.
4. Position / location related information is obtained.
5. Flexibility of many observation techniques and image processing algorithm.
6. Data can be permanently recorded and reproduced.
7. Synoptic coverage of a large area.
8. Area information can be obtained in comparison with traditional way of point wise sampling of earth surface.
9. Information can be obtained in a very short time.
10. Data obtainable from remote and inaccessible areas.

Process & Elements of Remote Sensing.

Process of remote sensing can be divided in two parts;

1. Data acquisition

   (a) Pictorial Form
   (b) Digital Form

2. Data Analysis

Types of Remote Sensing.

A. Aerial Photography
B. Satellite Remote Sensing.

Development of Remote Sensing.

1. Early history of Aerial photography – Photography started with the invention of Camera in 1839. In 1840 a French scientist Argo, explained the use of photography in

topographic surveying. First aerial photograph was clicked by a Persian photographer Gaspard Felixtournachon in 1858. To acquire these photographs he flew at a height of 60 meters in an air balloon in Bievre in France. In the same year Laussedalt also used balloon photography for topographic surveying. The oldest aerial photograph available was clicked on 13-October 1860 by James Walls Black of Boston City in USA. In the year 1882 E.D. Archibald, a meteorologist clicked an aerial photograph with the help of a Kite. In 1900 G.R. Lawrance an American scientist made kite photography popular all over the world.

Though the aeroplane was invented in 1903, but for aerial photography Wilber Wright used it to click aerial photographs to make motion pictures for Italian Navy. This technique was used in WW-I for military reconnaissance, for US Coast & Geodetic Survey and Hydro graphic office. Later these techniques were used for peaceful development.

Systematic aerial photography was developed for military surveillance and reconnaissance purposes beginning in World War I and reaching a climax during the Cold War with the use of modified combat aircraft such as the P-51, P-38, RB-66 and the F-4C, or specifically designed collection platforms such as the U2/TR-1, SR-71, A-5 and the OV-1 series both in overhead and stand-off collection. A more recent development is that of increasingly smaller sensor pods such as those used by law enforcement and the military, in both manned and unmanned platforms. The advantage of this approach is that this requires minimal modification to a given airframe. Later imaging technologies would include infrared, conventional, Doppler and synthetic aperture radar.

The development of artificial satellites in the latter half of the 20th century allowed remote sensing to progress to a global scale as of the end of the Cold War. Instrumentation aboard various Earth observing and weather satellites such as Land sat, the Nimbus and more recent missions such as RADARSAT and UARS provided global measurements of various data for civil, research, and military purposes. Space probes to other planets have also provided the opportunity to conduct remote sensing studies in extraterrestrial environments, synthetic aperture radar aboard the Magellan spacecraft provided detailed topographic maps of Venus, while instruments aboard SOHO allowed studies to be performed on the Sun and the solar wind, just to name a few examples.

Recent developments include, beginning in the 1960s and 1970s with the development of image processing of satellite imagery. Several research groups in Silicon Valley including NASA Ames Research Centre, GTE, and ESL Inc. developed Fourier transform techniques leading to the first notable enhancement of imagery data. In 1999 the first commercial satellite (IKONOS) collecting very high resolution imagery was launched.

How Remote Sensing Is Done.

A remote sensing system consists of a sensor for gathering data and processing unit to convert the data into information. There are two types of sensor.

1. **Passive Sensor**: - These do not have their own source of radiation and are sensitive to radiation from a natural origin, usually reflective sunlight or the energy emitted by an earthly object. The classical example is the Camera. Other examples are the Multi Spectral Scanner, the Thermal Scanner & Micro-wave Radio Meter.

2. **Active Sensor**: - **These** have a built-in source of radiation. The object is passive. Examples are the radar (radio detection and ranging) and lidar (light detection and ranging).

Stages in Remote Sensing

- A source of electro-magnetic energy EMR (sun/self emission).
- Transmission of energy from the source to the surface of the earth, as well as absorption and scattering by the atmosphere.
- Interaction of EMR with the earth surface: reflection and emission.
- Transmission of energy from the source to the remote sensor.
- Sensor data output.
- Data transmission, processing and analysis.

Platforms & Types of Remote Sensing.

Platform is a stage to mount the Camera or Sensor to acquire the information about a target under investigation.
Based on its Altitude above earth surface platform may be classified as

1. Ground Based plat form : Laboratories
2. Air-borne Platforms : Aircrafts, Helicopters , Free Balloons, Threaded Balloons & Powered Balloons
3. Space-borne platforms: Rocket & Satellites (Geosynchronous satellite, Sun synchronous satellite.

Remote sensing platforms

- There are three main categories of remote sensing platforms

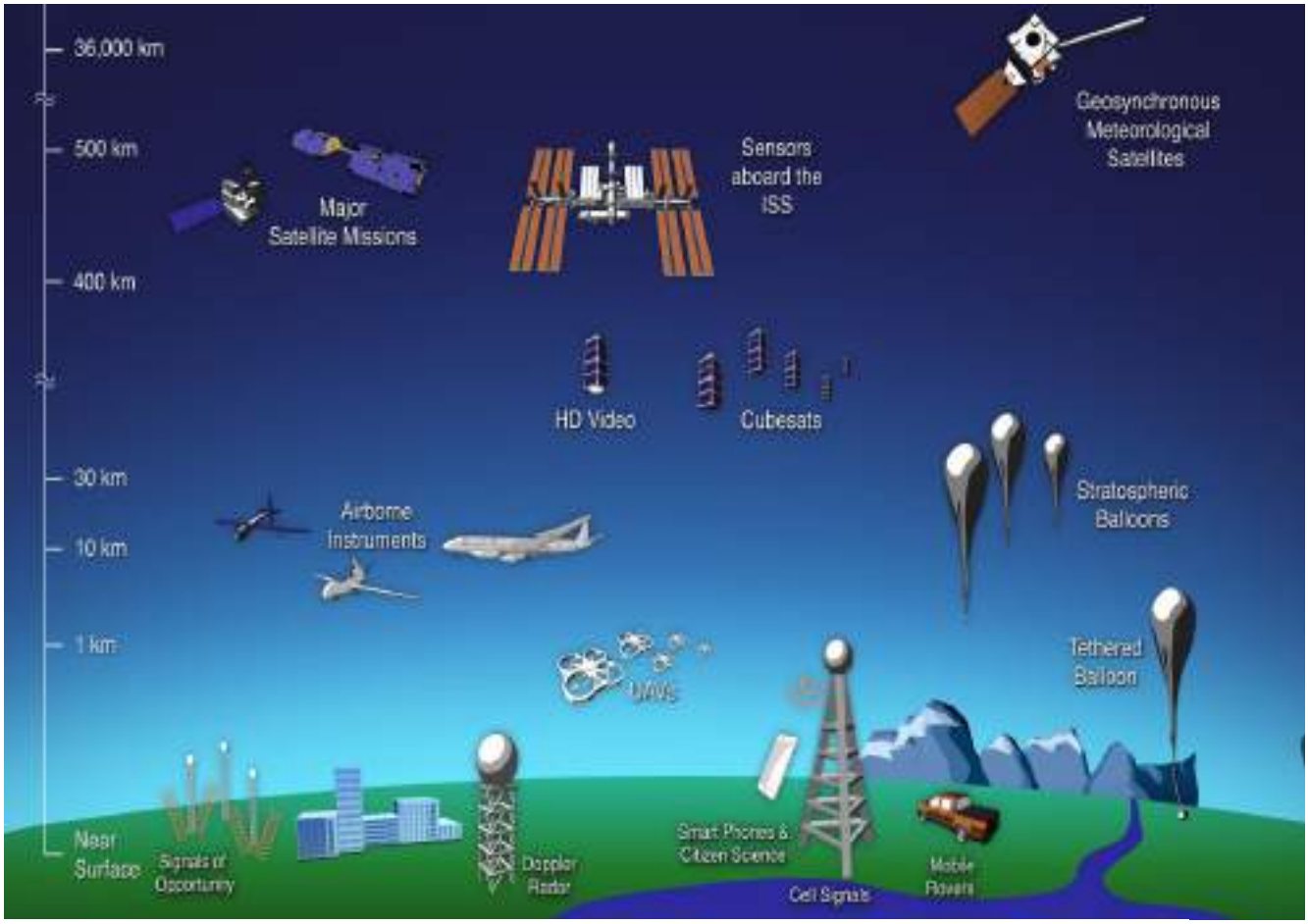
Commonest platforms

Spaceborne
- Satellite
- Shuttle

Airborne
- Aeroplane
- Helicopter
- Hot air balloon
- Air ship
- Tethered balloon

Ground-based
- Hand-held
- Raised platform

4th ISPRS Student Consortium and WG VI/5 Summer School, Warsaw 13-19 July 2009



Indian Remote Sensing Program.

India's remote sensing programme under the Indian Space research Organisation (ISRO) started of in 1988 with the IRS-1A.

Capacity building for IRS and other remote sensing data is through Indian Institute of Remote sensing (IIRS) Dehradun and UN affiliated Centre of Space Science & Technology Education in Asia and the Pacific (CSSTEAP) Dehradun.

TIndia as of today has two satellite launch stations which are operated by ISRO

1. Thumba Equatorial Rocket Launch Station (TERLS), Tiruvanathapuram, Kerla.
2. Staish Dhawan Space Centre (SDSC), Sriharikota (SHAR) A.P.

The initial versions are composed of the 1 (A, B, C, D). The later versions are named based on their area of application including Ocean Sat, Carto Sat, Resource Sat. Some of the satellites have alternate designations based on the launch number and vehicle (P series for PSLV).

S. No.	Satellite	Date of Launch	Launch Vehicle	Status
1	IRS-1A	17 March 1988	Vostok, USSR	Mission Completed
2	IRS-1B	29 August 1991	Vostok, USSR	Mission Completed
3	IRS-P1 (also IE)	20 September 1993	PSLV-D1	Crashed, due to launch failure of PSLV
4	IRS-P2	15 October 1994	PSLV-D2	Mission Completed
5	IRS-1C	28 December 1995	Molniya, Russia	Mission Completed
6	IRS-P3	21 March 1996	PSLV-D3	Mission Completed
7	IRS 1D	29 September 1997	PSLV-C1	Mission Completed
S. No.	**Satellite**	**Date of Launch**	**Launch Vehicle**	**Status**
8	IRS-P4 (Oceansat-1)	27 May 1999	PSLV-C2	Mission Completed
9	Technology Experiment Satellite (TES)	22 October 2001	PSLV-C3	Mission Completed
10	IRS P6 (Resourcesat-1)	17 October 2003	PSLV-C5	In Service
11	IRS P5 (Cartosat 1)	5 May 2005	PSLV-C6	In Service
12	IRS P7 (Cartosat 2)	10 January 2007	PSLV-C7	In Service
13	Cartosat 2A	28 April 2008	PSLV-C9	In Service
14	IMS 1	28 April 2008	PSLV-C9	In Service
15	RISAT-2	20 April 2009	PSLV-C12	In Service
16	Oceansat-2	23 September 2009	PSLV-C14	In Service
17	Cartosat-2B	12 July 2010	PSLV-C15	In Service
18	Resourcesat-2	20 April 2011	PSLV-C16	In Service
19	Megha-Tropiques	12 October 2011	PSLV-C18	In Service
20	RISAT-1	26 April 2012	PSLV-C19	In Service
21	SARAL	25 Feb 2013	PSLV-C20	In Service
22	Cartosat-2C	22 June 2016	PSLV-C34	In Service
23	ScatSat-1	26 September 2016	PSLV-C35	In Service
24	RESOURCESAT-2A	07 Dec 2016	PSLV-C36	In Service
25	Cartosat-2D	15 Feb 2017	PSLV-C37	In Service
26	Cartosat-2E	23 June 2017	PSLV-C38	In Service
27	Cartosat-2F	12 Jan 2018	PSLV-C40	In Service
28	RISAT-2B	22 May 2019	PSLV-C46	In Service

29	Cartosat-3	27 Nov 2019	PSLV-C47	In Service
30	RISAT-2BR1	11 Dec 2019	PSLV-C48	In Service

IRS Data Availability

Data from IRS is available to its users through NRSC Data Centre and also through Bhuvan Geoportal of ISRO. NRSC data center provides data through its purchase process while Bhuvan Geoportal provides data in free and open domain.

Capacity Building for IRS and Other Remote Sensing Data

The capacity building programme of ISRO for IRS and other remote sensing applications is through Indian Institute of Remote Sensing (IIRS) Dehradun and UN affiliated Center of Space Science and Technology Education in Asia and the Pacific (CSSTEAP) Center located at Dehradun of Uttrakhand State in India.

Future IRS launches

Following are the remote sensing satellites planned by ISRO to be launched next strengthening the fleet of IRS satellites and widening their applications:

- **RESOURCESAT-3**: A follow on to Resourcesat-2, it will carry more advanced LISS-III-WS (Wide Swath) Sensor having similar swath and revisit capability as Advanced Wide Field Sensor (A WiFS), thus overcoming any spatial resolution limitation of A WiFS. Satellite would also carry Atmospheric Correction Sensor (ACS) for quantitative interpretation and geophysical parameter retrieval. It slated to be launched during 2021.

- **OCEANSAT-3**: Oceansat-3 would carry Thermal IR Sensor, 12 channels Ocean Colour Monitor, Scatterometer and Passive Microwave Radiometer. IR Sensor and Ocean Colour Monitor would be used in the analysis for operational Potential Fishing Zones. Satellite is mainly for Ocean biology and sea state applications. It is slated to the launched aboard PSLV in January 2020.

- **GISATs:** GISAT-1 is planned for launch in January 2020 and GISAT-2 is planned for launch in July 2020. They are expected to provide images from geostationary orbit during disasters.

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