

# DAILY ASSESSMENT

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Course:	Satellite Photogrammetry and its Applications	USN:	4AL17EC097
Topic:	Concepts of Satellite Photogrammetry	Semester & Section:	6 <sup>TH</sup> SEM & 'B' Section
Github Repository:	yamunashree-course		

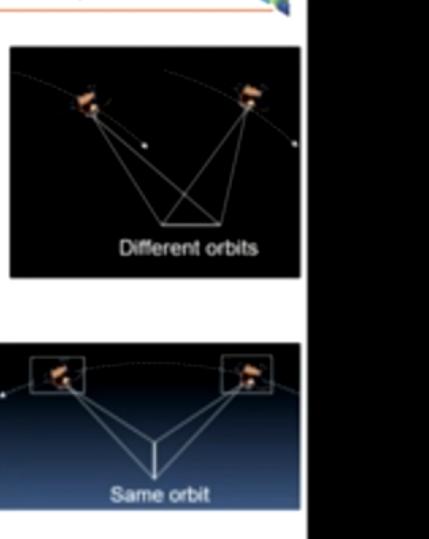
## SESSION DETAILS

INDIAN INSTITUTE OF REMOTE SENSING, DEHRADUN

### Stereo Imaging & topographic mapping

- Stereo satellite images are captured -
  - consecutively by a single satellite along the same orbit within a few seconds (along the track imaging technique)
  - or
  - by the same satellite (or different satellites) from different orbits in different dates (across the track imaging technique).
- The base-to-height (B/H) ratio should be close to 1 for high-quality stereo model with high elevation accuracy.
- Optimum base to height ratio is 0.6 to 1.0
- Atmospheric effects (refraction, optical thickness) become more significant at higher look angles

**Satellites :**  
Cartosat-1, IRS 1C/D, TMC on Chandrayaan  
IKONOS, World View, Pleiades, EROS-A, ALOS, MOMS-02, SPOT, Terra ASTER etc....



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## Stereo coverage

Two possible configurations:

- Across-track stereo
- Along-track stereo

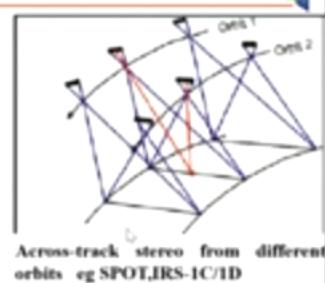
**Across-track stereo** - The pointing of the imaging sensor is oriented off-nadir in the across-track direction.

### Advantages:

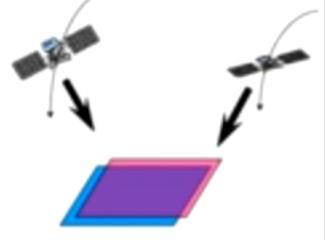
- Stable because the view is not changing while imaging
- Off-nadir view capability allows a revisit period about 4 to 5 times shorter than the repeatability cycle.

### Limitation:

Radiometry of the two images may be different.



Across-track stereo from different orbits eg SPOT,JRS-1C/1D



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- Rigorous modeling is most accurate of all because it takes into consideration the actual physical process of image capture.
- It requires both inner orientation and exterior orientation parameter
- Inner orientation parameters are generally available through calibration process.

### Interior Orientation

- Interior Orientation refers to the sensor elements calibration and the system behind the image plane

When using satellite sensors such as SPOT, IRS-1C, and other generic pushbroom sensors use perspective center for each scan line, the process is referred to as internal sensor modeling.

- In a satellite image the Interior Orientation parameters are:

- Principal point on the image
- Focal length of the camera
- Optics parameters

The transformation between file coordinates and image coordinates is constant.



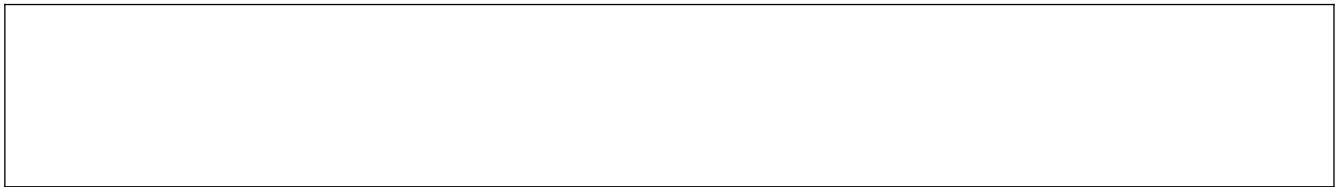
For perspective, or epipolar bundle of light rays is defined, where,

- $P_f$  = Image point
- $A_i$  = a value of image coordinates for main-ray  $i$
- $f$  = focal length of the camera
- $O_C$  = perspective center for each line  $i$ , aligned along the optic axis
- $P_p$  = principal point for main-ray  $i$

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## Branches of photogrammetry

Based on platform

- Ground based
- UAV/drone based
- Aerial photogrammetry
- Satellite photogrammetry

## Digital photogrammetry

- Digital photogrammetry is applied to digital images that are stored and processed on a computer.
- Digital photogrammetry is sometimes called soft copy photogrammetry.

Science, Technology and Art of making precise measurements on images produced by space borne imaging sensors to derive reliable topographic information of the word planetary surface.

## Advantages of imaging from space

- Synoptic view
- Large swath, repetitiveness
- Negligible internal distortions
- Formalities associated with aerial photography and flight arrangement are avoided here
- Constant scale, near orthomorphous projection
- Stable radiometry

## Tri-stereo Imaging

Tri-Stereo acquisitions reveal elevation that would otherwise remain hidden in steep terrain or urban canyons in dense build-up areas.

## Stereo coverage

- Two possible configuration
- Across-track stereo
  - Along-track stereo

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## Image acquisition methodology

- The satellites collect the images by scanning along a line which is called the scan line.
- line sensor arrays that scan an image strip while the satellite orbits.
- For each line scanned by the sensors of the satellite there is a unique perspective centre & a unique set of rotation angles.
- Each scan line of the scene has its own set of exterior orientation parameters, principal point in the centre of line.

## Data processing

- 3 empirical laws of planetary motion.
  - Every planet revolves around primary body in elliptical orbit with sun at one focus.
  - The radius vector sweeps out equal areas in equal interval of time.
  - The period of the orbit squared is proportional to the semimajor axis cubed.
- constitute a complete solution to the two body problem.
- Equation of motion for satellite are differential equations.
- Solution by numerical integration over time.

## Physical Sensor Model

- The physical sensor model aims to describe the relationship between image and ground coordinates, according to the physical properties of the image acquisition.

## Rational function Model

The Rational function Model (RFM) is an empirical mathematical model that has been

image and the object spaces.

### 3D polynomial model

- 3D polynomial model is used to model the relationship b/w the image & the object spaces.
- Choice of the polynomial order depends on the type of terrain, available number of GLP, and the stability of the satellite sensor in space.

### 3D affine model

- 3D affine model can be performed by limiting the polynomial model to the first order.
- 3D affine model has high integrity to represent the relationships b/w the image & the object spaces, especially when the model is applied to data obtained from ~~for~~ highly stable satellite sensors.

### Triangulation

Satellite block triangulation provides a model for calculating the spatial relationship between a satellite sensor & the ground coordinate system for each line of data.

### Orto rectification

Process of reducing geometric errors inherent within photography and imagery.

The ortho rectification process takes the raw digital imagery & applies a DEM & triangulation results to create an orthorectified image.





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