2/8/22

* EMR

Source

Sensor

components of EMR

① Source

② Atmosphere

③ Earth : like vegetation, building etc.

④ Sensor : sensitive for diff. range of wavelength

Active : Artifical Source. Ex : Microwave

Passive : Natural Source Ex : Sunlight

- Atmospheric window : Range of wavelength

400 nm - 700 nm

Types of ref reflected energy

- Reflection
- Emission
- Scattering

⑤ Image

- Digital Image Processing

8.22

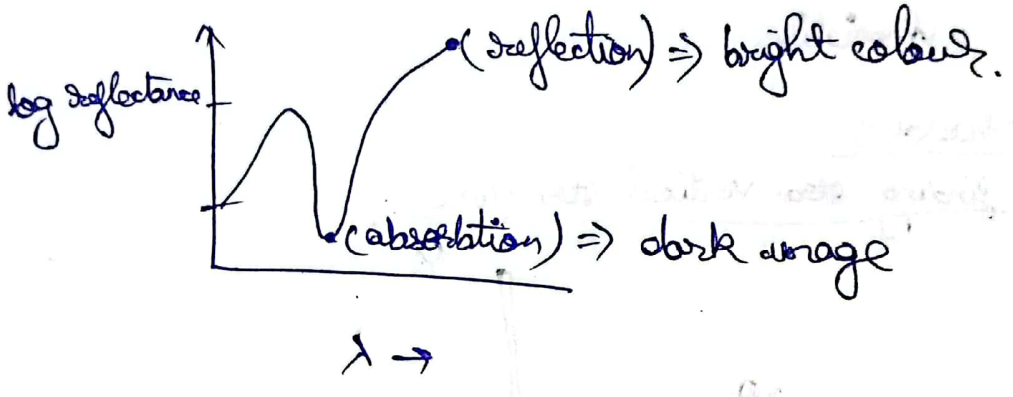
- three attribute relation

$$c = \lambda f$$

$$E = hcf$$

- wavelength visible range = (0.4 - 0.7) μm

- Diff. wavelength gives diff. pictures of same objects



- Bright (white) — 255
- shades of grey — ... 3 2 1
- Dark (grey) — 0

In digital image colours have given some numbers.

bright → 255
Dark → 0
} in case of 8 bit $(2^8 - 1)$

8 bit

In case of 16 bit: $(2^{16} - 1)$.

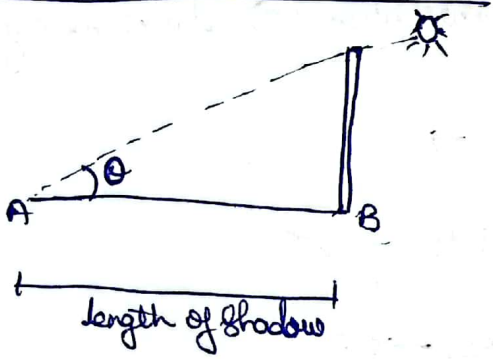
• Fundamental Recognition Elements

- Helps to identify diff elements like meta. rock, sedi. rock etc.

- Shape
- Size
- Shadows
- Colour
- Texture
- Pattern
- Site
- Associations

Shadows

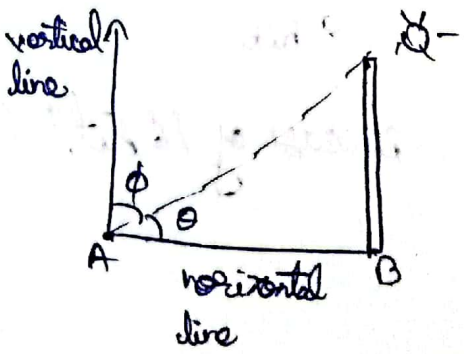
For finding ~~the~~ Vertical structures.



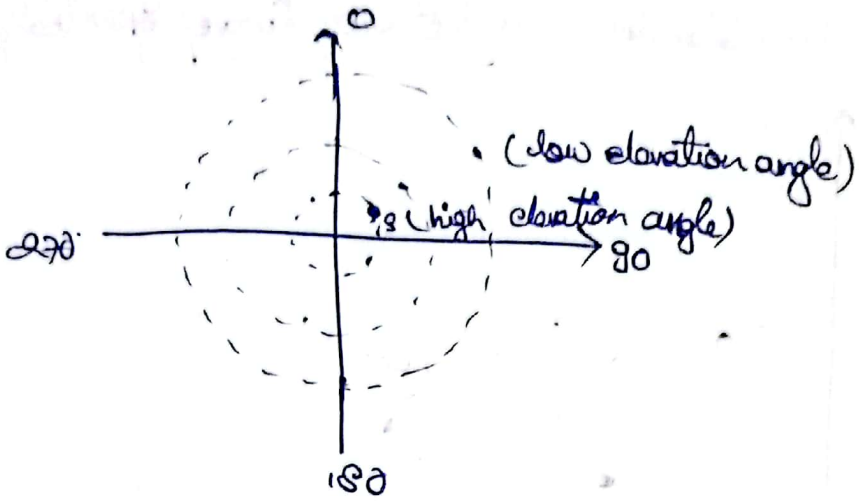
- Solar Elevation angle ⇒ (θ).
Solar Zenith "
Solar Azimuth "

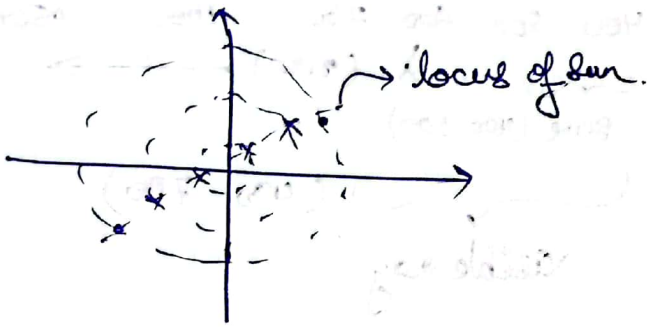
Solar zenith angle: (ϕ)

$\phi + \theta = 90^\circ$



Solar azimuth angle:



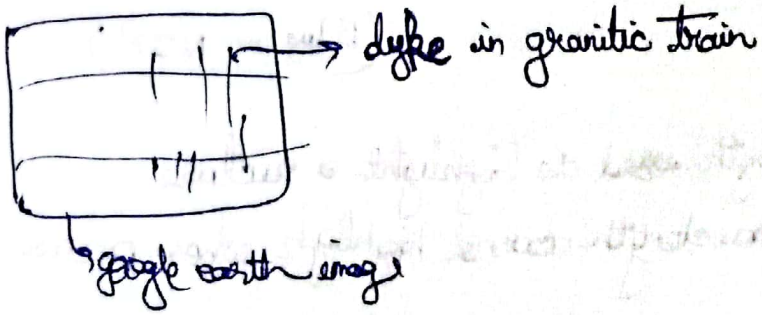


Texture:

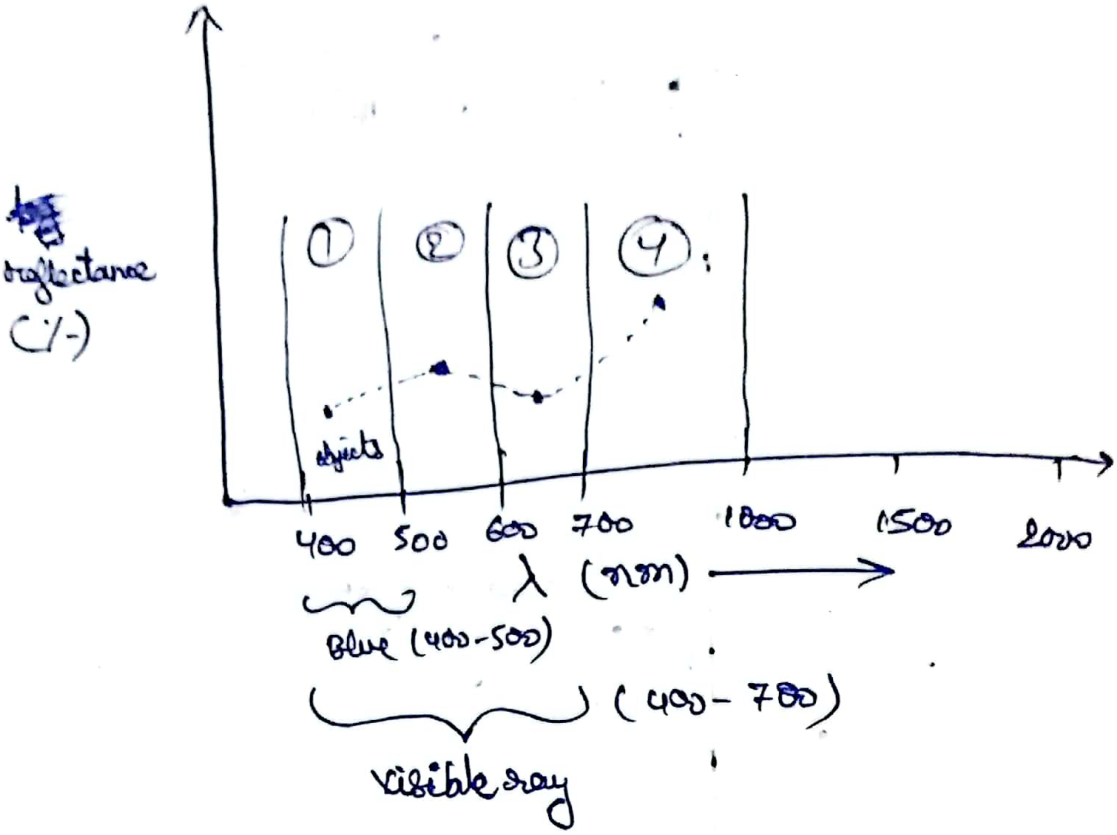
Rough kind of texture ⇒ Igneous

Smooth " " " ⇒ Sedimentary

· River flow along joints (



* Spectral Signature / Reflectance Curve / Spectral Profile



- Blue - (400-500)
- green - (500-600)
- Red (600-700)

- Near Infrared (700-1000)
- Short wave infrared (>1000)

- Landsat multispectral scanner: Record 4 band (Blue - NIR)

- Band of wavelength used to highlight a picture. Individual wavelength cannot highligh whole picture.

For any picture 3 gray scale required: 1 2 3

RGB → false colour composite

Blue band, green band, Red band.

BGR → true colour combination

Digital Number:

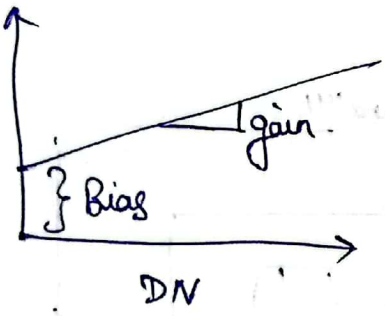
* When satellite capture image they have digital number (DN)

Then digital number converted to Radiance value.

Radiance:

Radiance

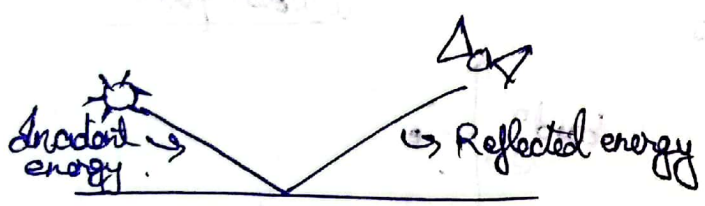
• Amount of radiation coming from an area



Radiance = Bias + DN . gain

Unit (W/m^2).

Reflectance:



$$\text{Reflectance} = \frac{\text{Reflected energy}}{\text{Incident energy}}$$

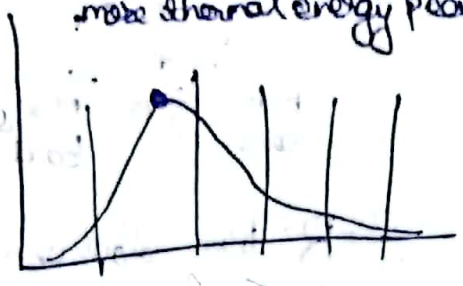
• It is proportion of radiation striking a surface to radiation reflected off it.

• Spectrometer

• It is ratio of energy reflected by the surface to the energy incident on the surface.

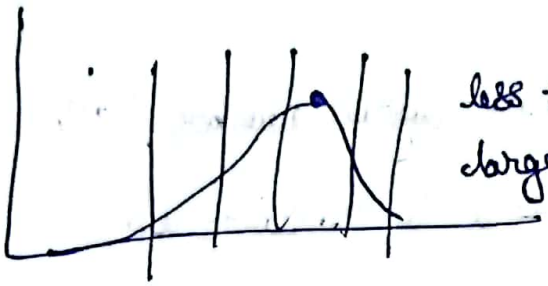
Wien displacement law

more thermal energy peak shift towards lower λ

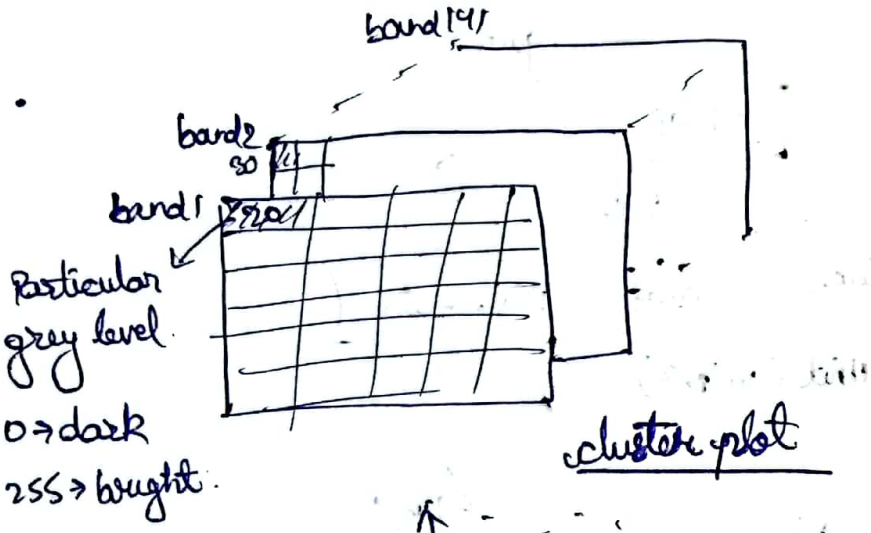


$$\lambda_{max} = \frac{A}{T}$$

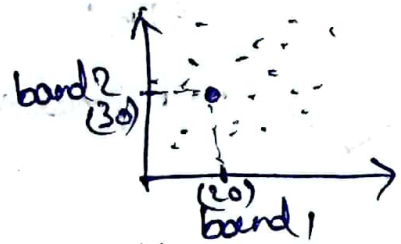
$A = 2898$ $\mu m \cdot K$



less thermal energy shift towards larger λ.



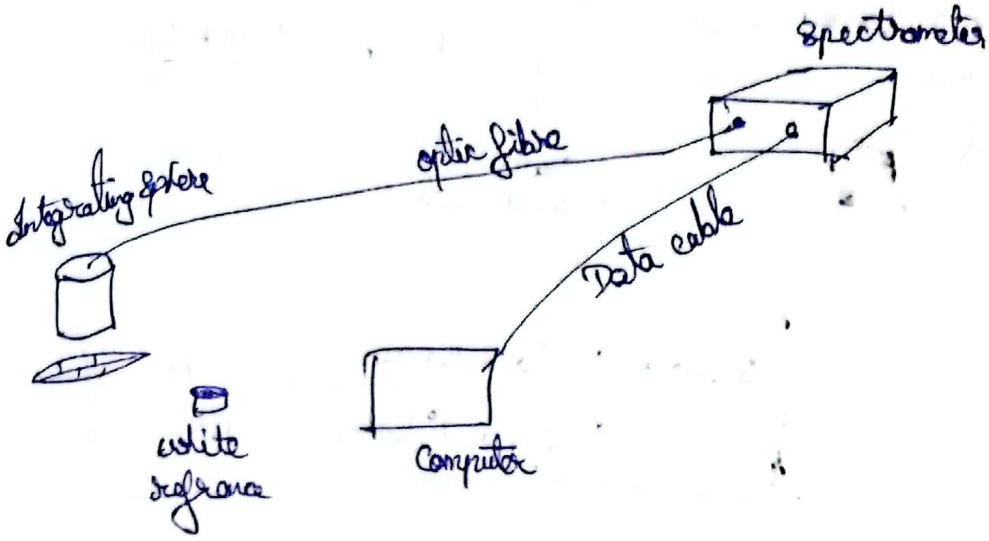
cluster plot

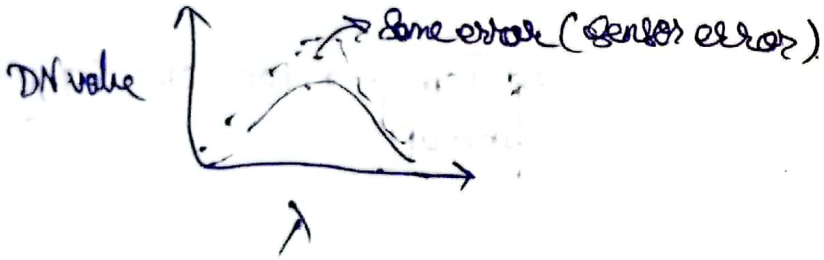


- Pixel Size
  → Spatial resolution

- band : If bands are high then, there will be more spectral resolution.

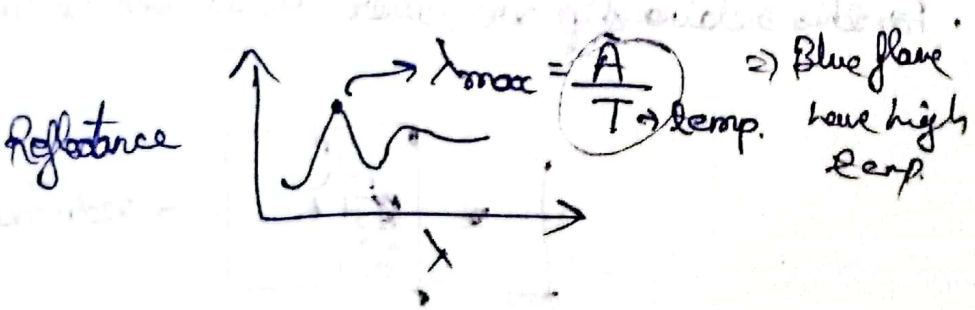
Radiometric If image has more bit, then it has more radiometric resolution



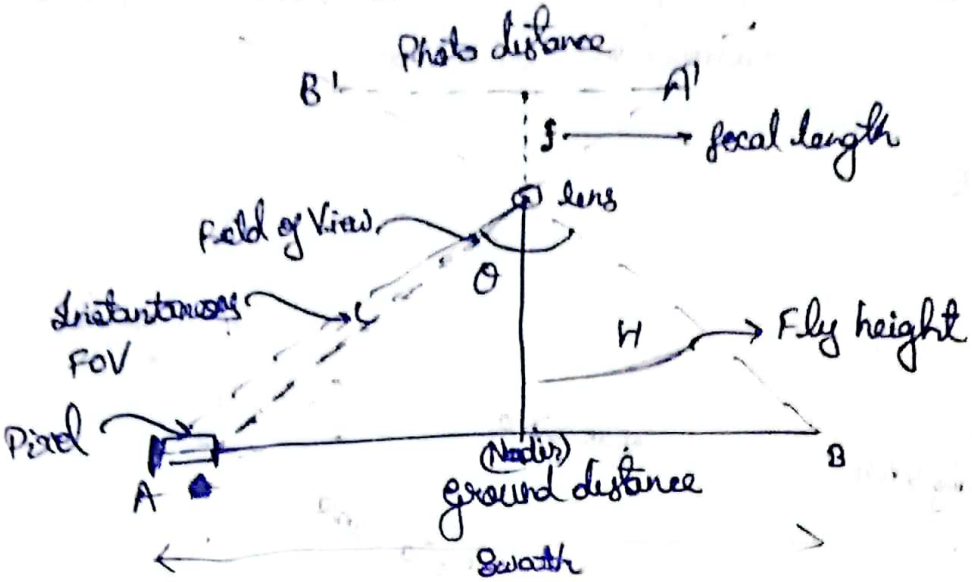


To reduce this reflectance is calculated.

$$\text{Reflectance} = \frac{\text{Reflected energy}}{\text{Incident energy}}$$



$$\text{Irradience} = \frac{\text{Energy}}{\text{Area}} \rightarrow \left(\frac{W}{m^2}\right)$$



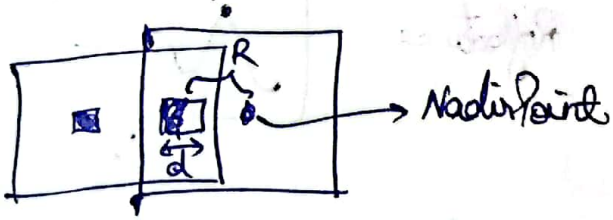
$$\text{Scale} = \frac{\text{Photo distance}}{\text{ground distance}} = \frac{B'A'}{BA}$$

1 : 1000

1 cm in map → 1000 cm in ground distance

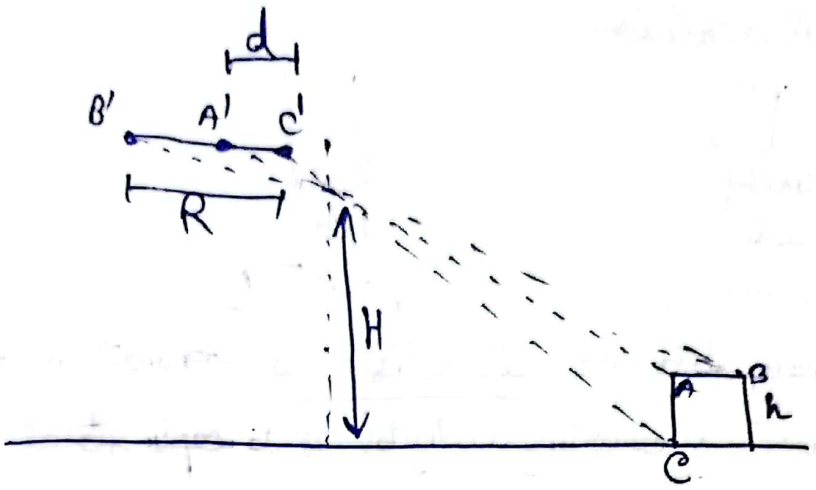
$$\text{Scale} = \frac{B'A'}{AB} = \frac{f}{H}$$

- For this relationship, the camera has to look vertical.



d → displacement amount / Parallax
R → height of building
H → fly height.

$$\frac{h}{H} = \frac{d}{R}$$

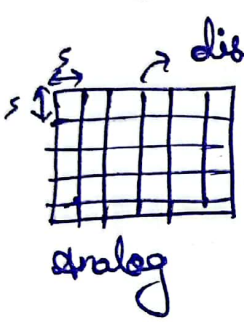


29.8.22

Resolution

Spatial resolution

- Analog data are discretise to convert it to digital data.
- Purpose of converting to digital is to ~~copy~~ stored in forms of numb



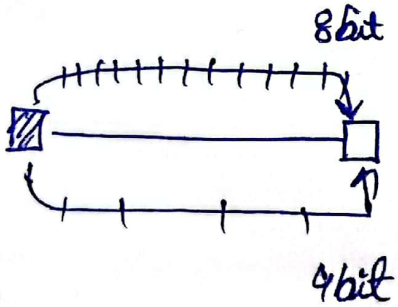
→ 5 m spatial resolution.

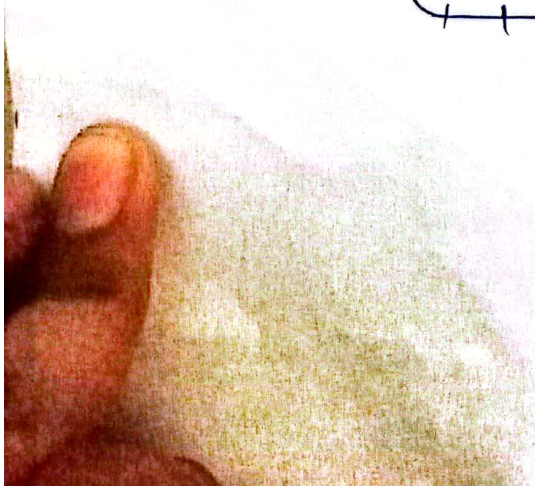
- ~~Smaller~~ Finer grids have more details

- Landsat image have 30m spatial resolution.

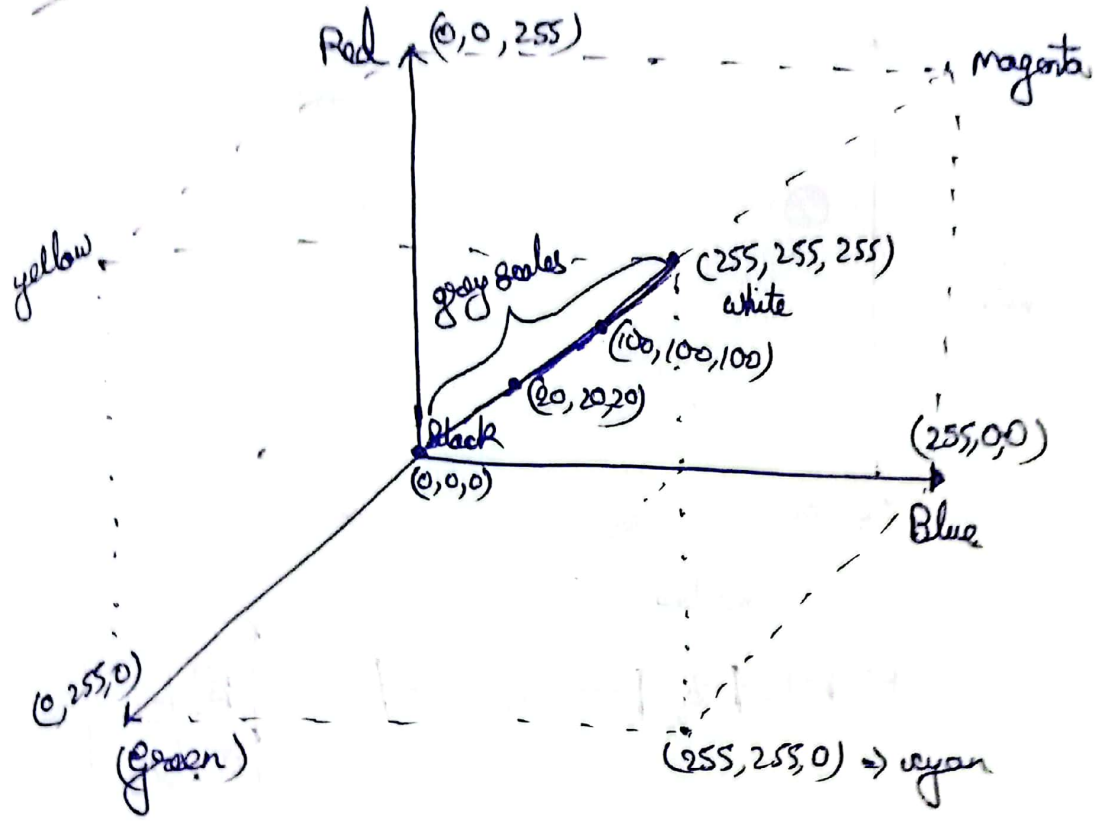
Radiometric resolution

gray scale:



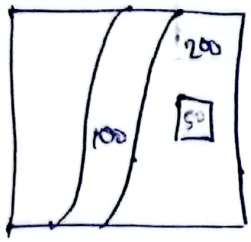


* Colour Cube

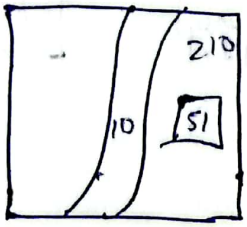


An 8bit image ⇒ Total no. of colour = $(28)^3$

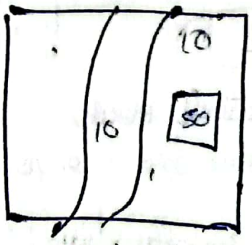
#



b_3



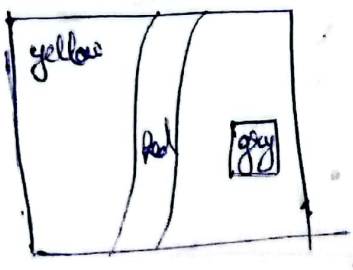
b_4



b_2

channel → R G B

what will visible? we consider only channel.

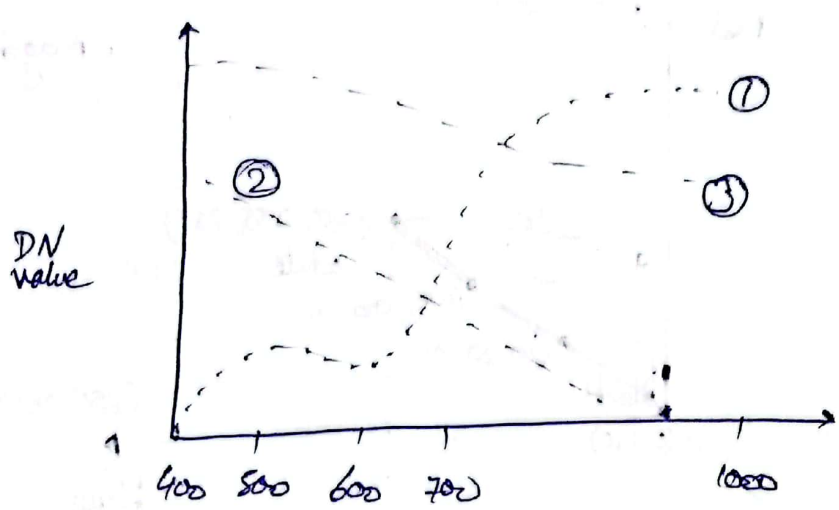


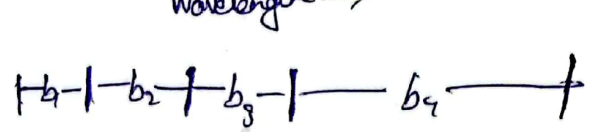
River → (100, 10, 10) near red.

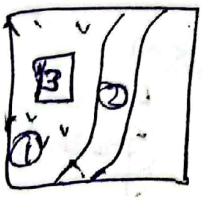
vegetation (200, 210, 10) near yellow

building (50, 50, 50) ⇒ grey

30.8.22

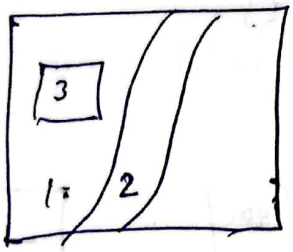






RGB
432 ⇒
314
321

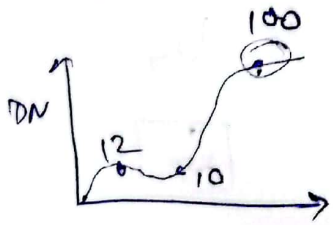
①	②	③
Red	Blue	gray
Blue	gray	gray
gray	Blue	gray



↳ Natural colour
true colour composition

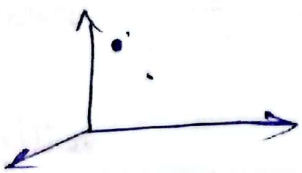
Explanation:

RGB ⇒
432



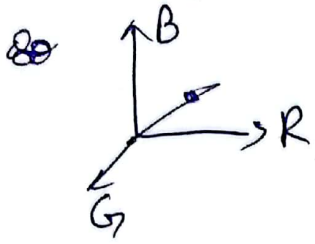
approx.
(100, 10, 12)
↓
object 1 ⇒ means Red

object 2
mean value



object 3:

DN value for 3 is ~~almost~~ appox similar



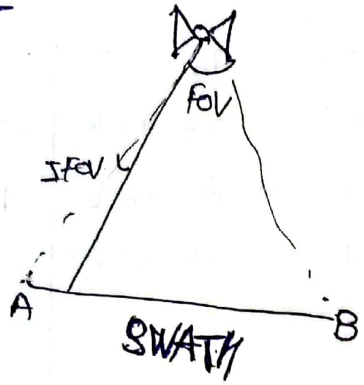
so it will be grey

* Camera type: Data format

(i) Whisk broom BIP

(ii) Push broom BIL

(iii) Snapshot BSQ



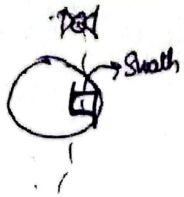
- Data format
- ~~rows~~
- Column
- Bands

for push broom.

* Orbit:

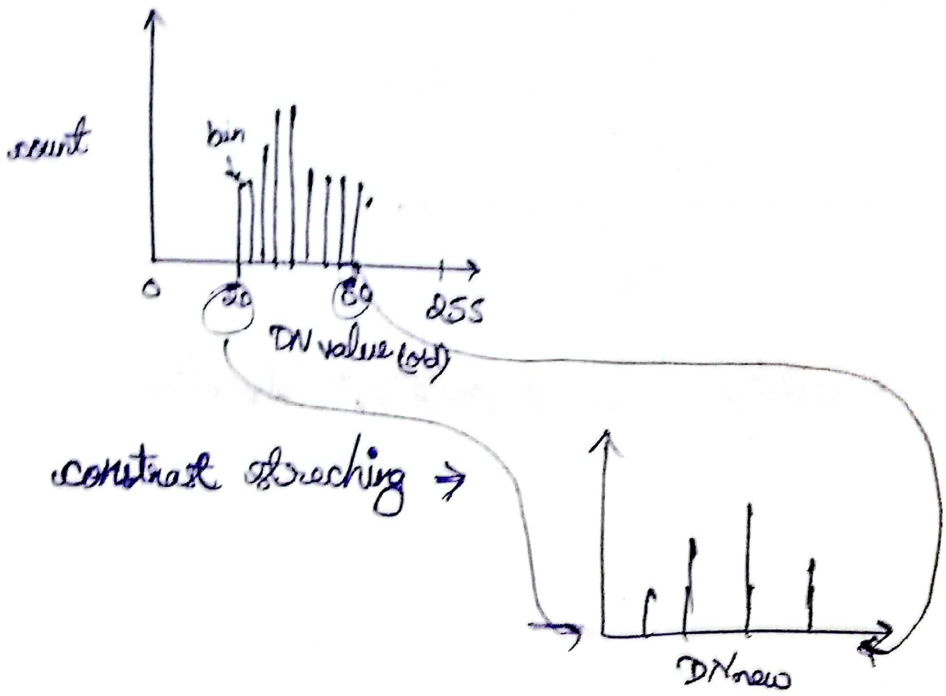
(i) geostationary orbit: observe only one location

(ii) Ascending polar orbit

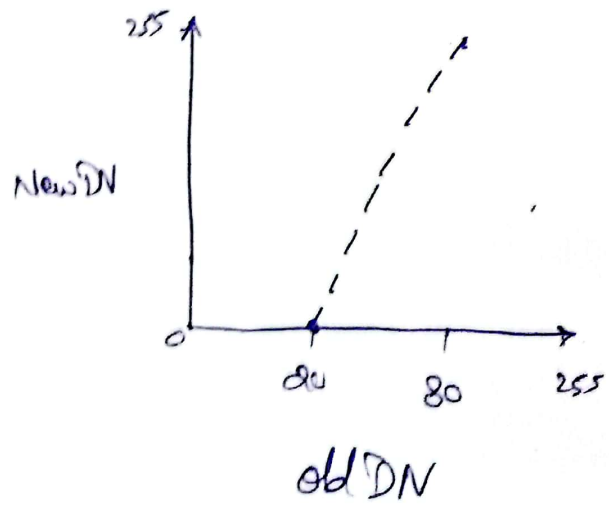


• Image Enhancement

contrast stretching



$$DN_{new} = \left(\frac{DN_{old} - DN_{min}}{DN_{max} - DN_{min}} \right) \times 255$$



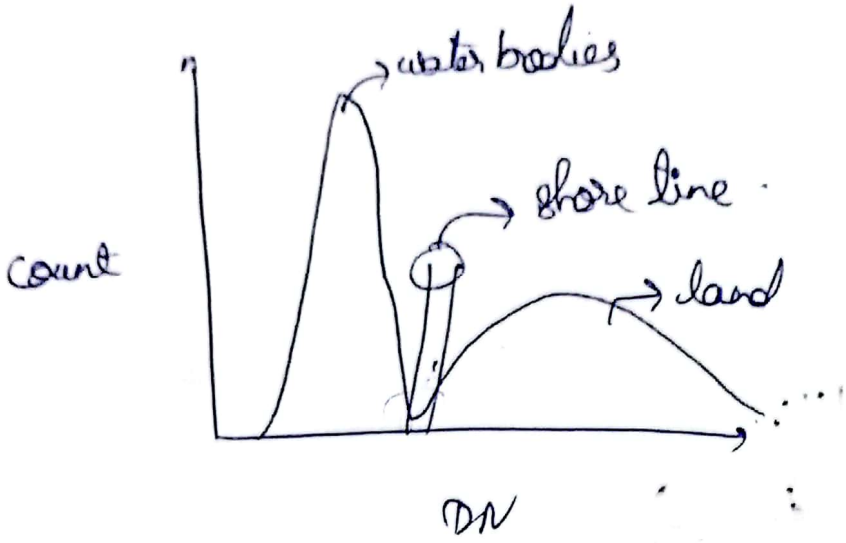


Image thresolding : Used to constraint shoreline

6922

* Georeferencing

. also require geographic location.

It is act of assigning location to atoms of information.

* Georeferencing system:

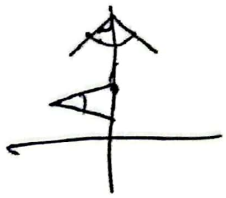
. It should be unique and shared, Persistant

① Placenames → not unique

② Postal address → mountains have not postal address.

③ Lat & log → has some limitations → it cannot be represented on plane paper

latitude & long are angular concept



In place of that Easting & northing marked in paper.

④ GPS: → best way to locate.

. 4 GPS required to identify your location.
sat.

⑤ Projection & coordinate system. → most method for maps

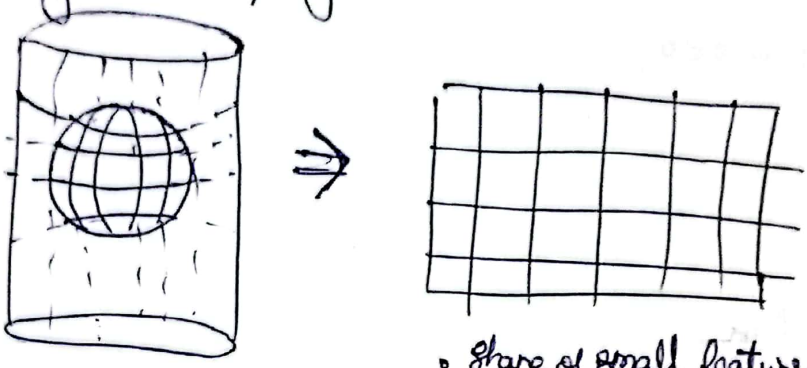
Before GPS, it is used to locate yourself. with help of chronometer & toposheet.

Projections & Coordinates

Map projections :

World Geodesic system determines shapes of earth in 1984

(i) Cylindrical projection



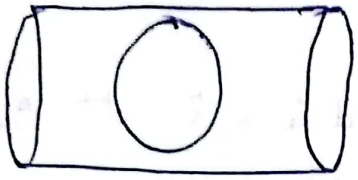
- Shape of small features are preserved
- Features in high latitudes are significantly gets enlarged. (area distortion)

(ii) Conic projection

(iii) Azimuthal

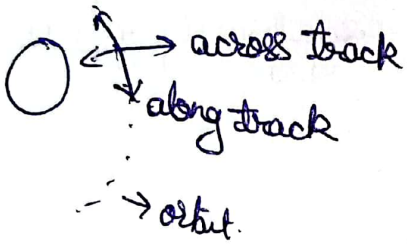
Area preserved
Shape gets distorted

* Universal Transverse Mercator Projection → is ideal for projection

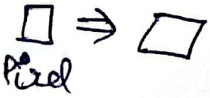


Max^m distortions is 0.04 %.

* Geometric distortion



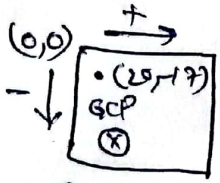
Due to movement of satellite & earth, distortion of pixel happens.



* Image registration

We have to identify ground control picture → that cannot change over a time span.

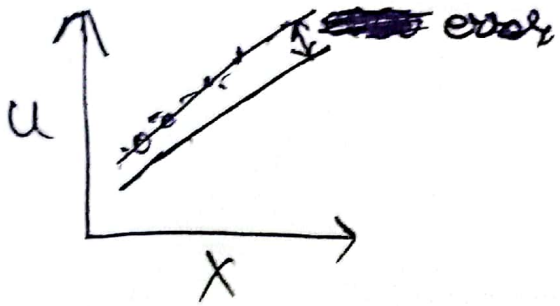
Topo sheet (geog).
1972



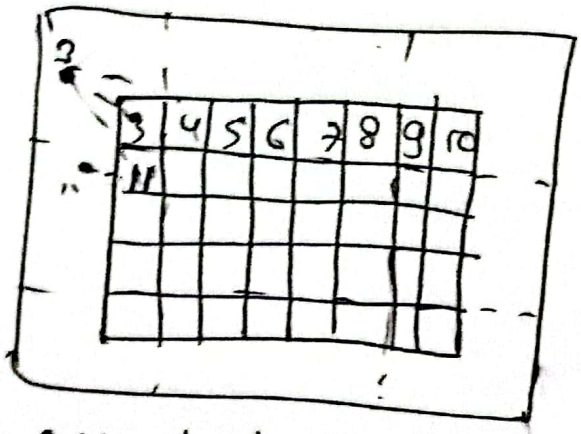
Raw satellite image
2010

Mapping polynomial for image projection

Desired		Read image	
X	Y	U	V
23567	52762	20	-17



Resampling



- Nearest neighbourhood method applied
- RMSE usually measured in precision of resampling
  ↓
  Root mean Square error

Next tuesday

test