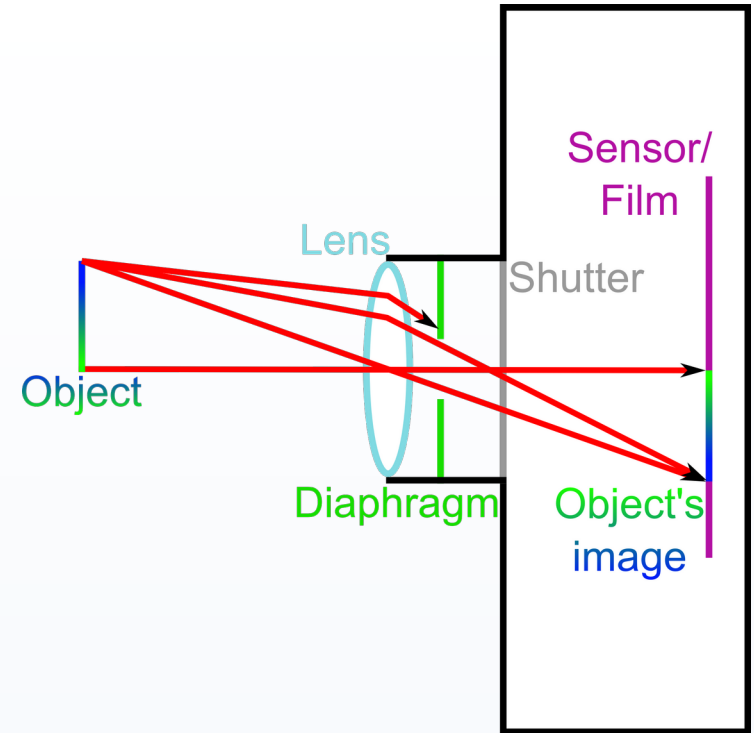


EGM702 – Photogrammetry and Advanced Image Analysis

Week 1, Part 2: Scale and parallax

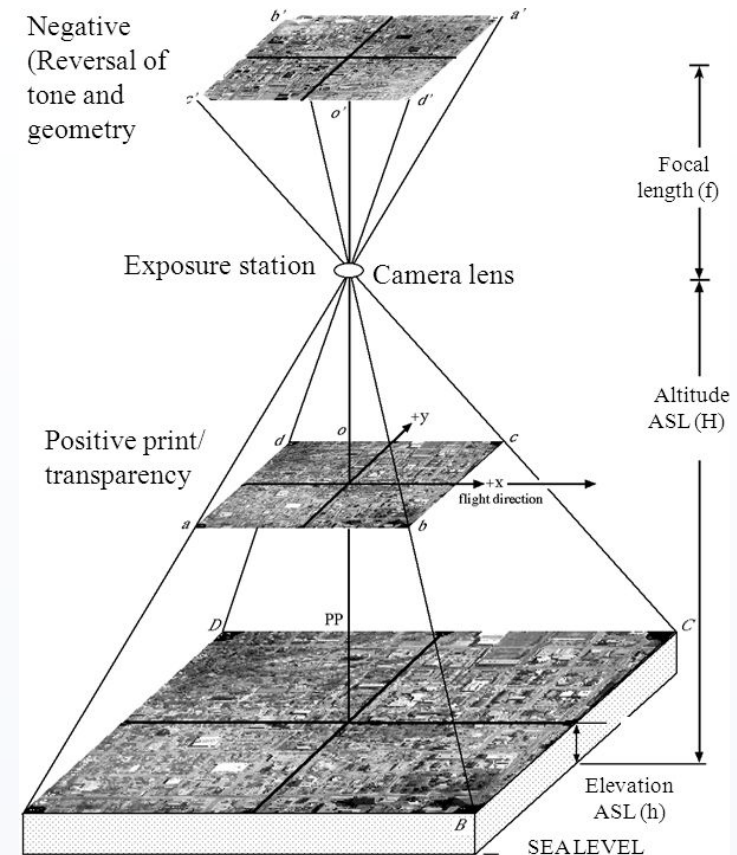
How a camera works

- Electromagnetic radiation leaves an object
- Enters camera lens
- Lens captures, focuses EMR
- Shutter opens, image is recorded on sensor or film
- In the before times, film had to be developed

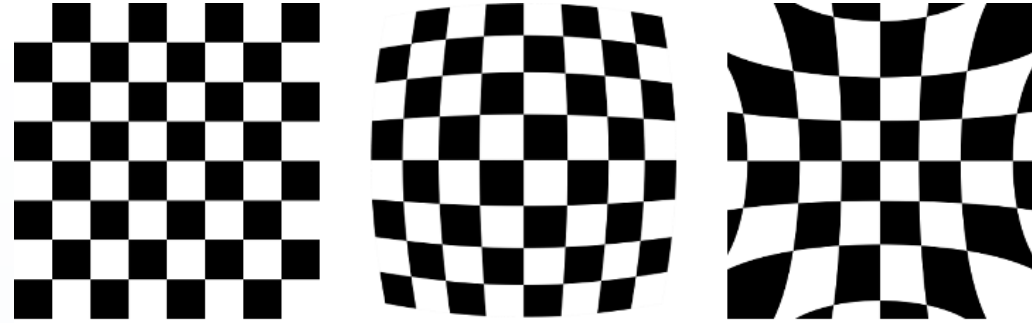


L. Girod, U. Oslo

- Image recorded is scaled down
- Historically, image coordinates defined using the principal point (PP, center) of photo
- Not all modern software use this definition



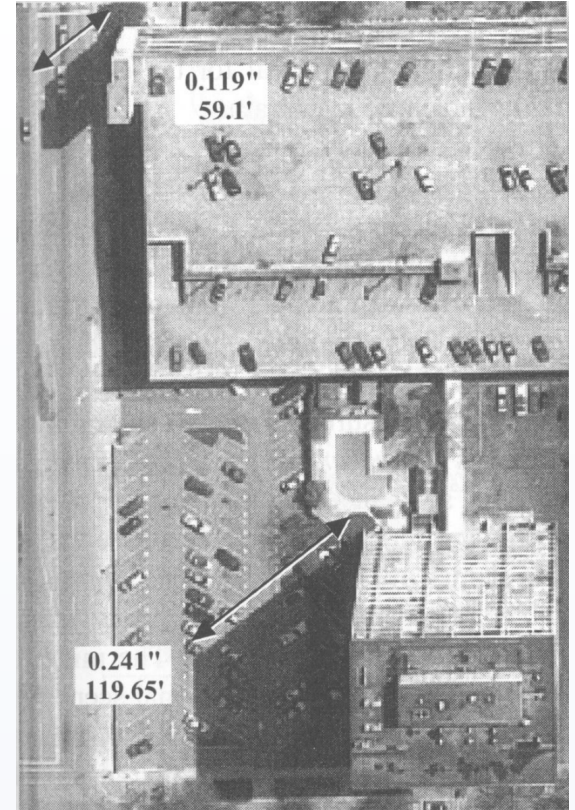
- Camera introduces distortion into image
- Generally increases with distance to PP (radial distortion)
- Can calculate using calibration target
- Can also calibrate using multiple images of same object



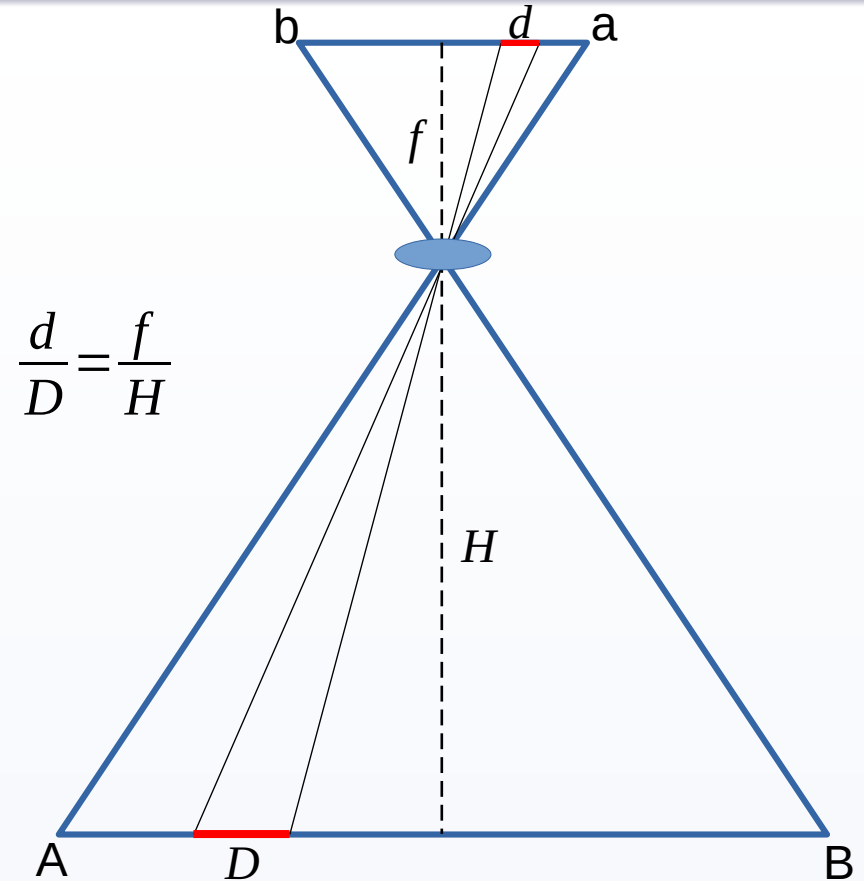
- Image is a smaller version of reality
- Scale: relationship between distance in photograph, real world
- Example: compare known ground distances to their size in the photograph

$$s = \frac{ab}{AB} = \frac{0.119}{59.1}$$

$$= \frac{1}{5959.65}$$



- We often lack this knowledge
- Fortunately, geometry comes to the rescue!
- Need to know:
 - Distance between camera & ground, H
 - Focal length, f
- What happens when H is not constant?



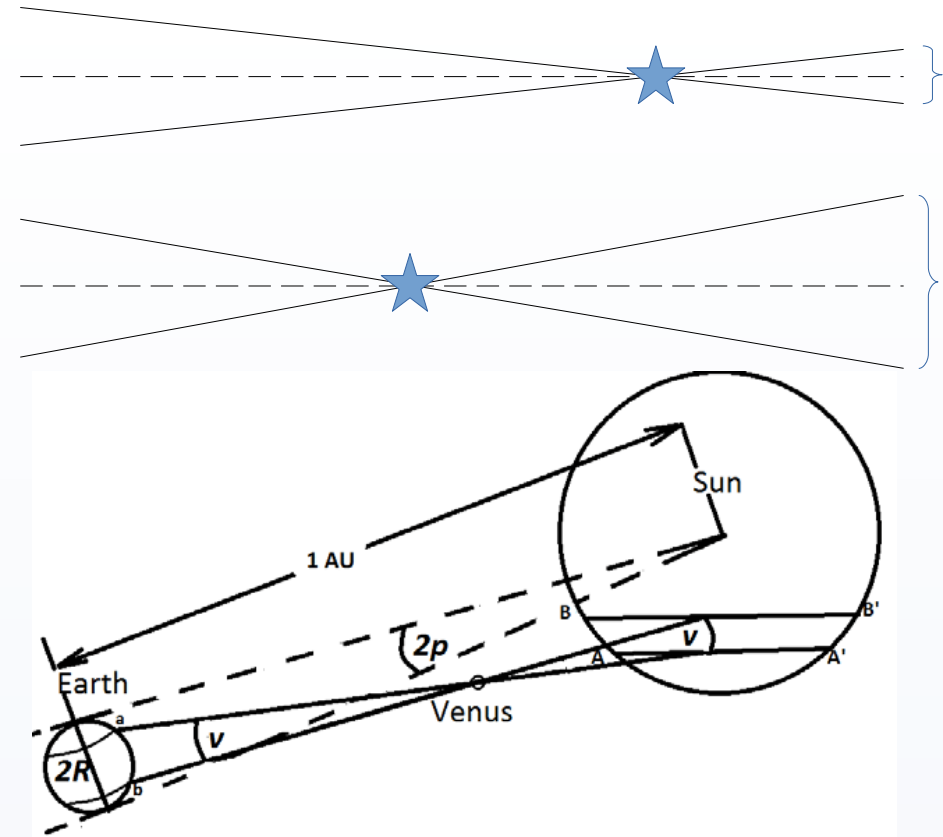
Relief displacement (foreshortening)

- Outside of Ohio, the ground isn't always flat
- Causes objects to lean away from the principal point: they appear displaced
- Depends on height, distance from principal point



- Hold your thumb at arm's length from your body
- Close your left eye
- Now, close your right eye while opening your left eye
- Your thumb appears to move – this apparent displacement is called parallax
- Now, try the same exercise with your thumb closer to your face – does your thumb move more, or less?

- Depends on distance between observation point and object
- Can be used to measure distances to objects
- Example: Astronomy (Transit of Venus)



- We can use geometry to relate the objects we see in an image to the real world
- Not always simple – uneven terrain causes shifts in position
- But, we can use these shifts in position to calculate distance, three-dimensional coordinates (topography)

- Lillesand, Kiefer & Chipman – Chapter 3
- Review: Digital Images [[EGM310](#)]
- Stellar parallax and measuring distance [[Las Cumbres Observatory](#)]
- What is the transit of Venus? [[Physics World](#)]
- Parallax in observing stars [[Khan Academy](#)]