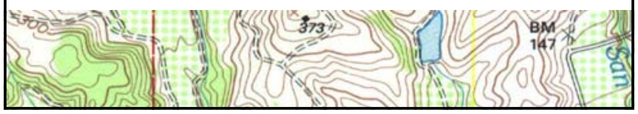
Geography 12: Maps and Spatial Reasoning

Lecture 16:
New Methods and Issues for Heights on Maps

Professor Keith Clarke



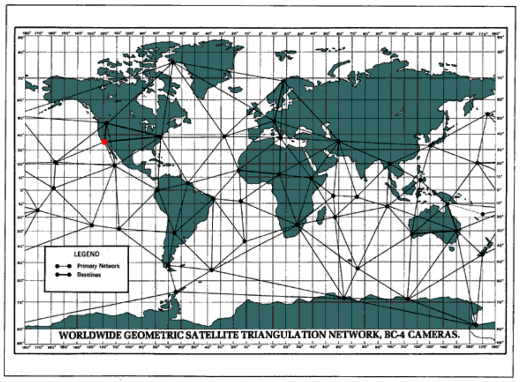
Base line

Triangulation and Plane Table

US Coast and Geodetic Survey:

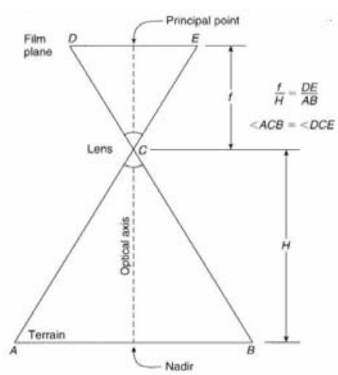
1937 national coverage

Triangulations: WGS70

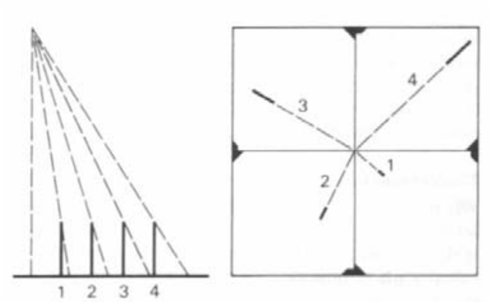


Post WWII Air photographs

Principal Point



Radial displacement around nadir

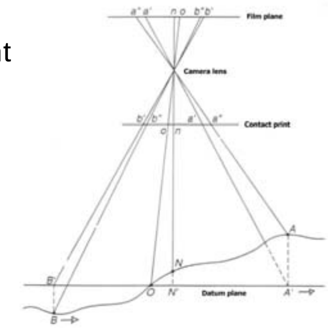


Relief Displacement

Relief Displacement

Displacement is the radial distance between where an object appears in an image to where it actually should be according to a planimetric coordinate system. Relief Displacement is caused by changes in the distance between the ground and the camera as the plane flies over the ground. The nadir point is always free of any relief displacement.

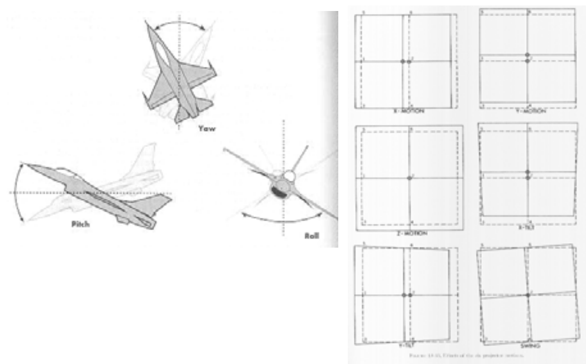
Relief Displacement is
A) Radially outward for features above the nadir elevation
B) Radially inward for features below the nadir elevation



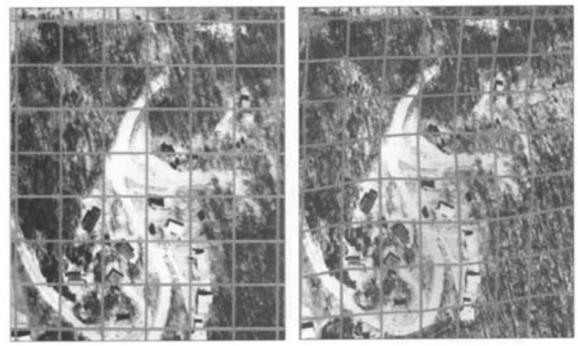
Height from displacement

Determining height from radial displacement. You can compute the actual height of an object by knowing (1) the radial distance **r** from the center of the photograph **PP** to the top of the object to be measured, (2) the measured object height **d**, and (3) the height of the aircraft **A** above the scene.

Reference axes



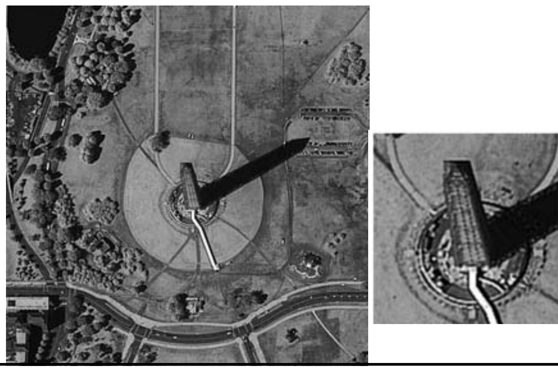
Orthorectification



Ground truth

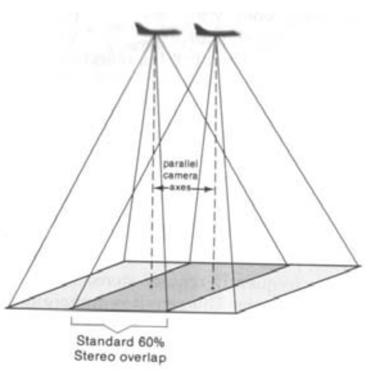
Orthorectified

Buildings easy, terrain hard!

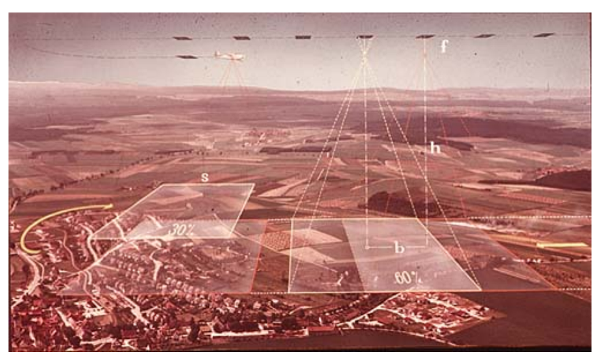


Unless, there are two images

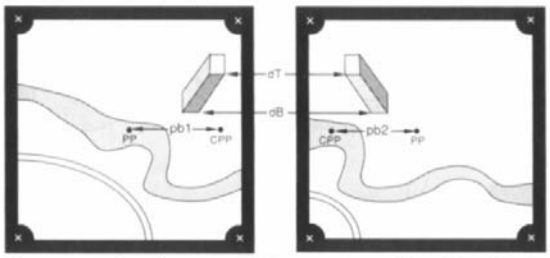
Stereo geometry (Conjugate PP)



Flight line geometry/overlap

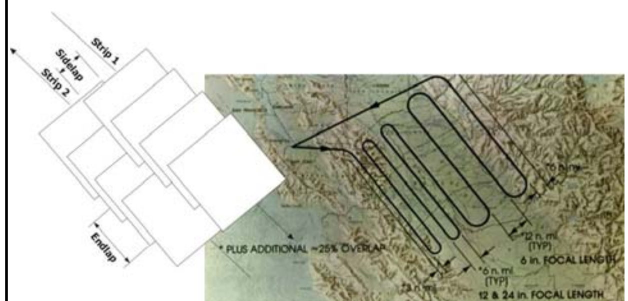


Height from parallax

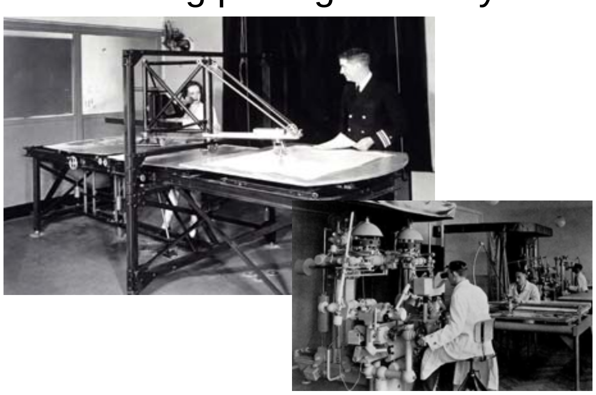


Computing height using differential parallax. The height of an object **H** can be determined if you know the differential parallax **dp**, absolute or average parallax **P**, and the height of the aircraft **A** above the scene.

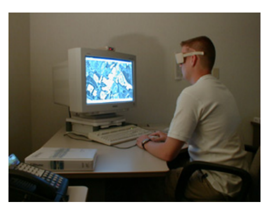
Flight planning map



Analog photogrammetry



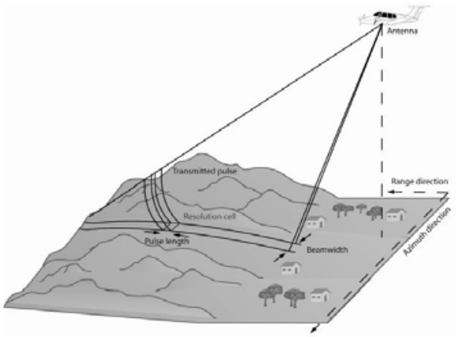
Softcopy photogrammetry



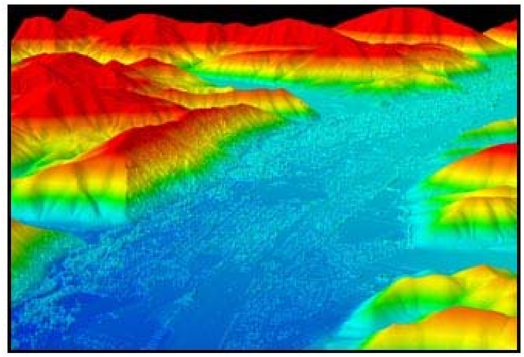
Intergraph Workstations

Wild Heerbrug BC2
Analytical Stereoplotter

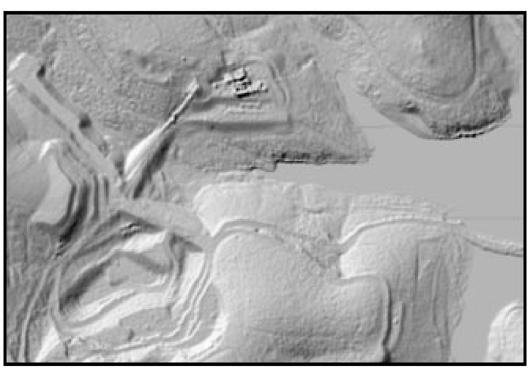
How SAR works



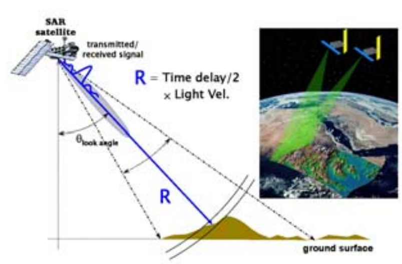
Terrain Model from IFSAR (Hailey, ID)



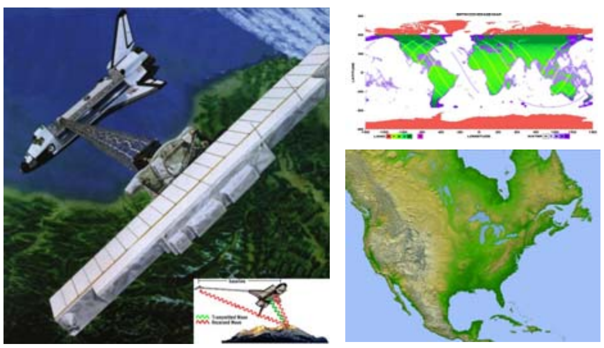
IFSAR DEM



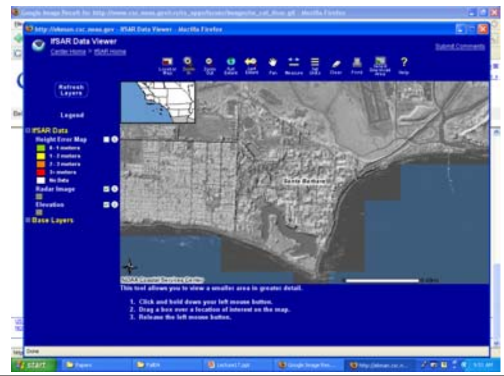
SAR from Space



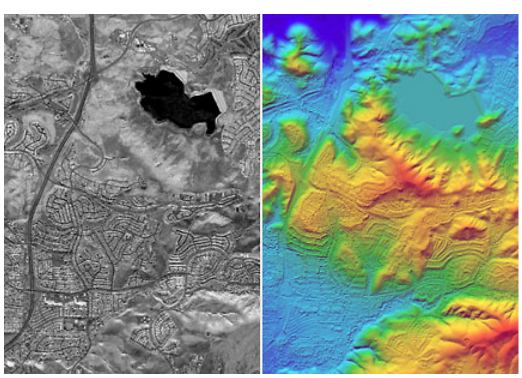
SRTM: Global topo map



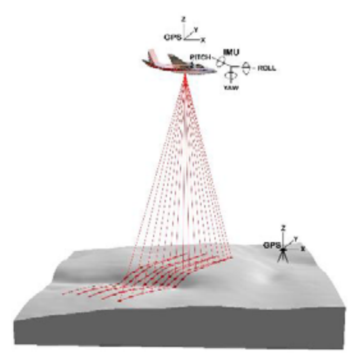
NOAA Southern Cal. IFSAR viewer



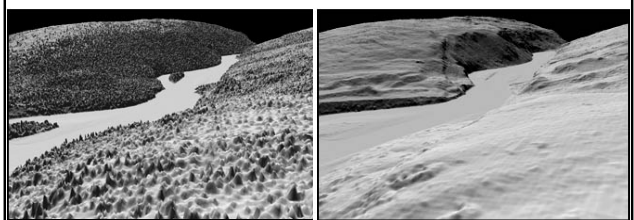
IFSAR: Thousand Oaks, CA



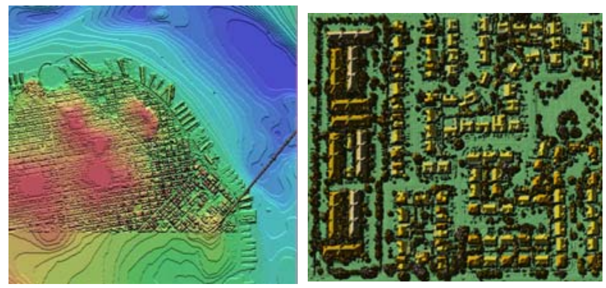
How Lidar works



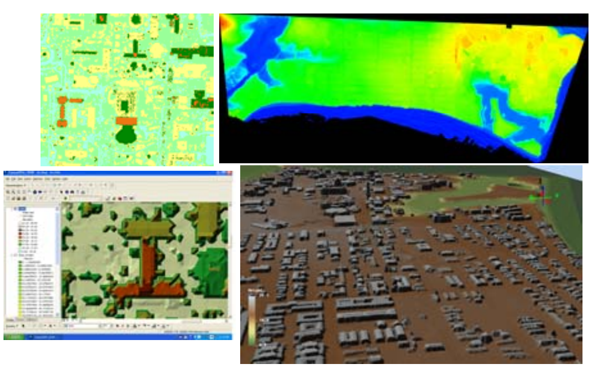
LIDAR first and last pulse



LIDAR terrain detail



3D Models LiDAR



LiDAR data

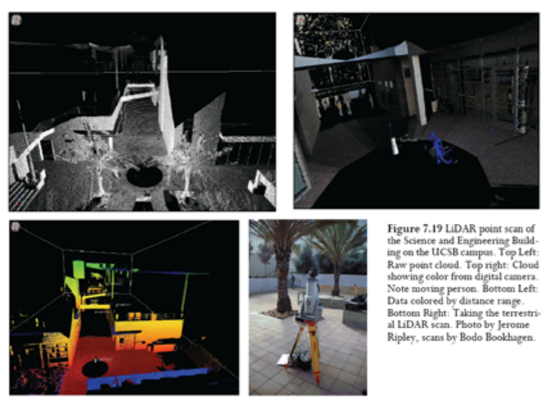
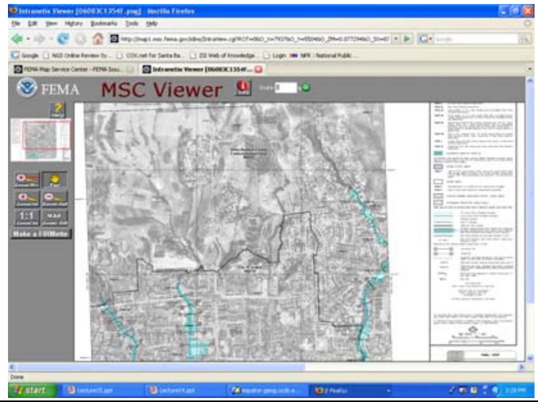


Figure 7.19 LiDAR point scan of the Science and Engineering Building on the UCSB campus. Top Left: Raw point cloud. Top right: Cloud showing color from digital camera. Note moving person. Bottom Left: Data colored by distance range. Bottom Right: Taking the terrestrial LiDAR scan. Photo by Jerome Ripley, scans by Bodo Bookhagen.

Critical height issue: Floods/Sea Level

FEMA: D-FIRMs



Summary

- First generation topographic mapping used triangulation and plane table
- Second generation used stereo photogrammetry
- New generation uses IFSAR and LIDAR
- Unprecedented accuracy
- What surface to map?