Photogrammetry

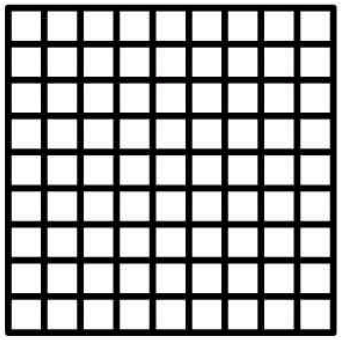
$$(r,c) = f(f, l, h)$$

Direct

(l, s)

or

(r, c)

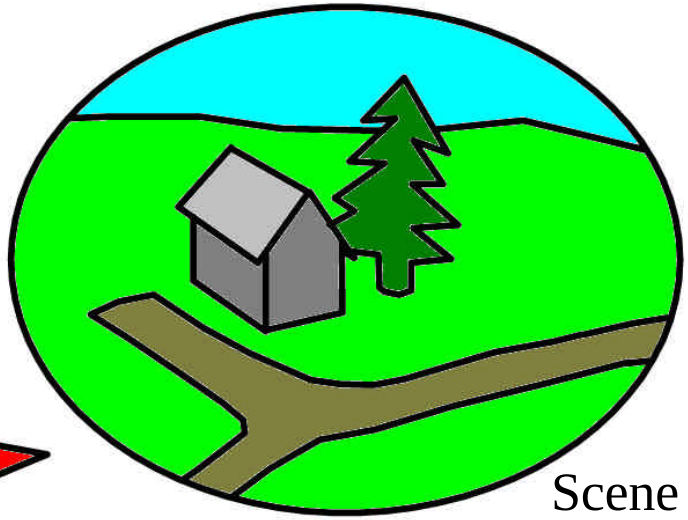


Digital Image (2D)

(f, l, h)

or

(X, Y, Z)



Scene (3D)

Inverse

Some Important Aspects of Photogrammetry

- Sensors, Physics & Geometry of Image Formation
- Imagery / Data
- Platforms / Platform Motion
- Data Extraction, Collection, Compilation Systems
- Processing Techniques (Interaction & Overlap with Remote Sensing, Computer Vision, etc.)
- Applications / Consumers

Sensors 1

Still frame camera

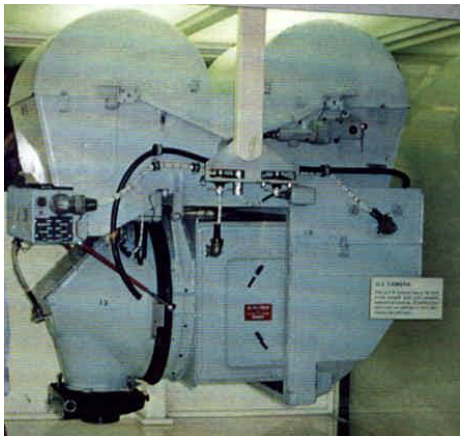
Aerial frame film camera

Motion imagery / video camera

Aerial frame cluster (digital)

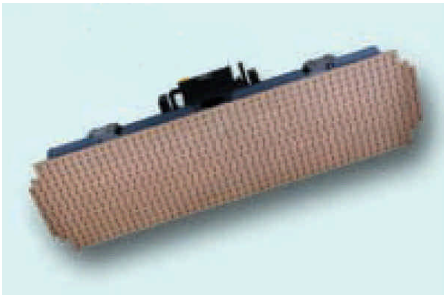
Aerial linear array, digital pushbroom

LIDAR scanning range and intensity imager



Aerial panoramic film camera, Hycon-B

Spaceborne linear array, pushbroom, quickbird

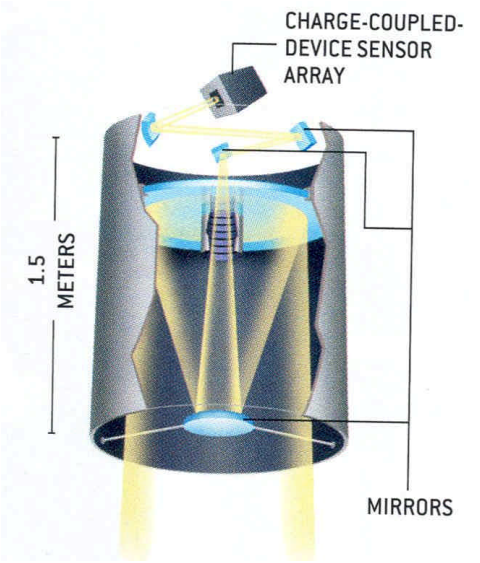


Synthetic aperture radar (SAR) antenna (active system, X-band)

Sensors 2

Thermal infrared camera

Hyperspectral whiskbroom scanner



IKONOS or Quickbird telescope / camera

Ultrasound transducer

MRI scanner

Images 1

Conventional aerial photograph 23x23 cm

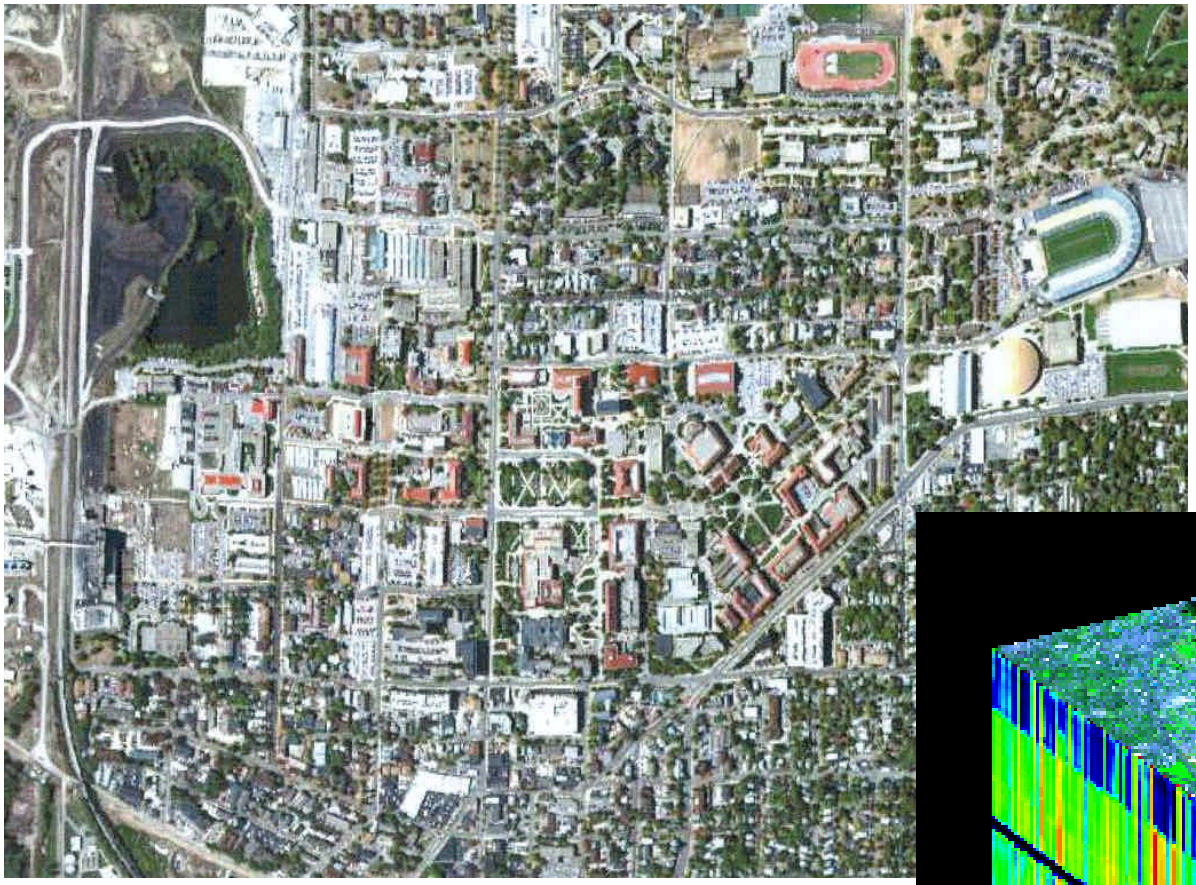
Video frames

Panoramic image of NYC

Airborne pushbroom, raw and corrected

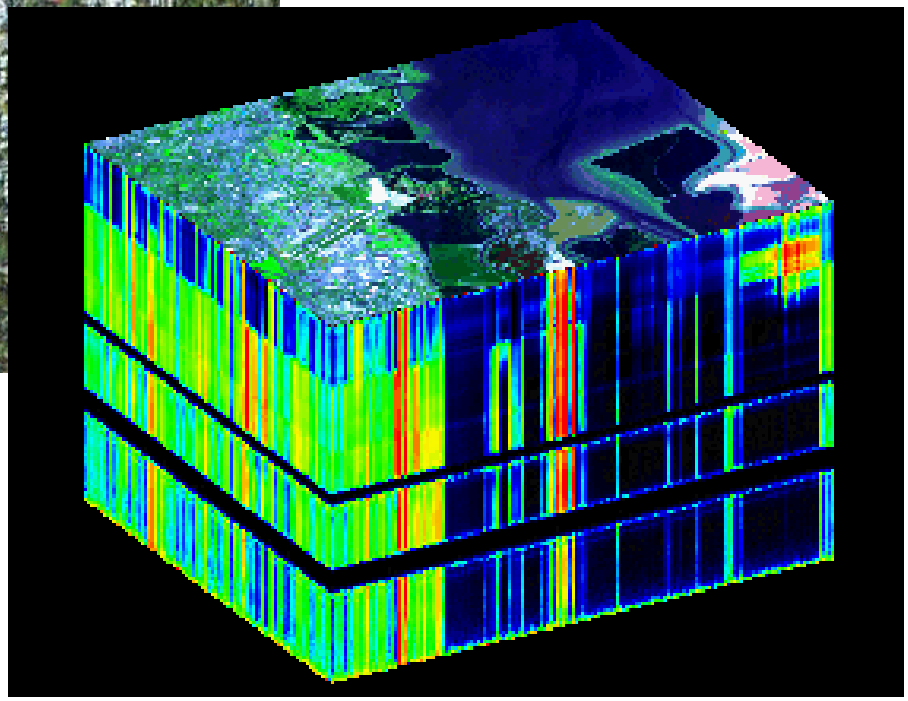
Quickbird 61cm image

Images 2

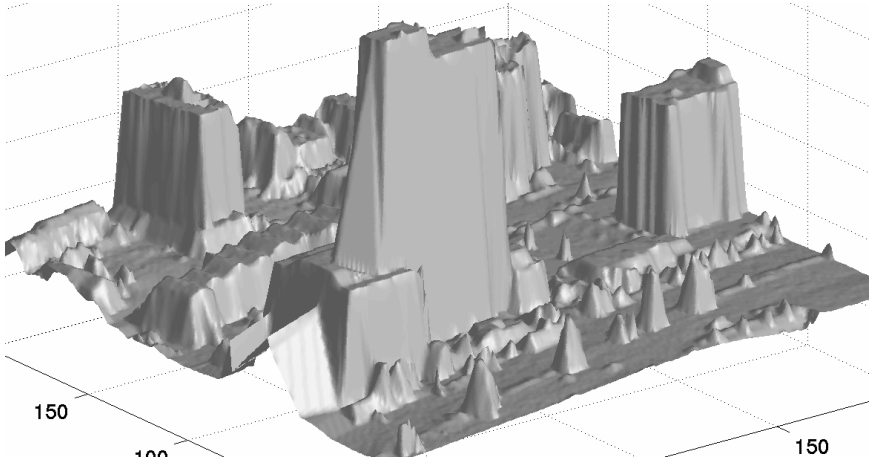


Hymap hyperspectral, 200 spectral channels for each pixel, we choose 3 (RGB) for display here – You cannot learn much by "looking" at such data

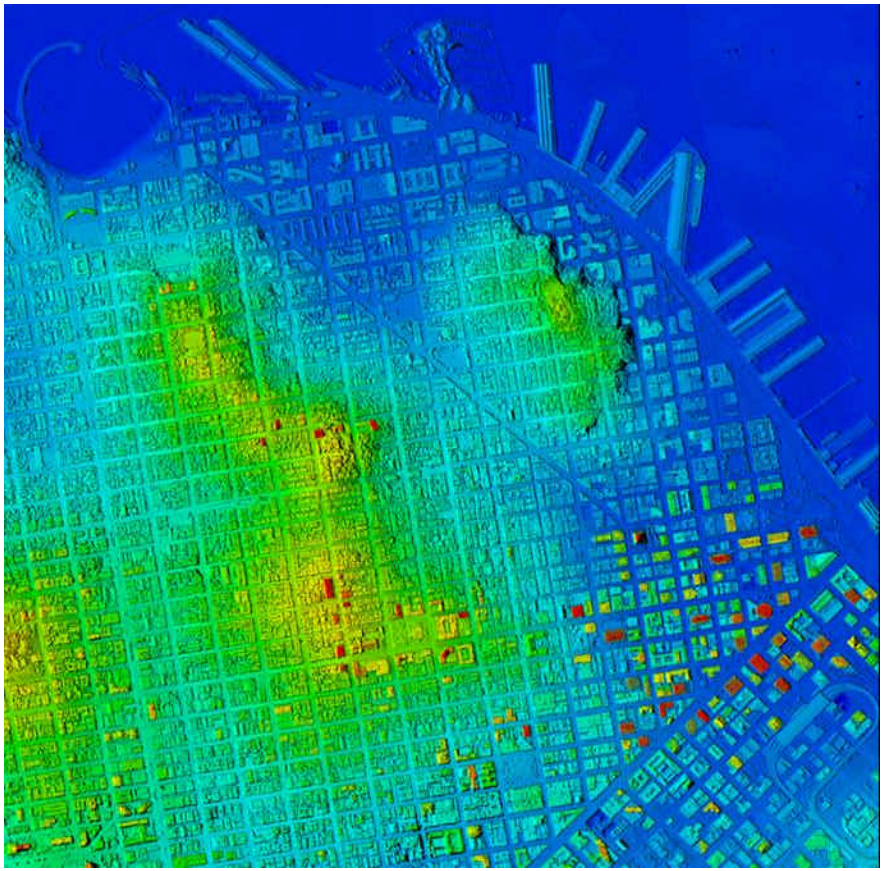
Hyperspectral Data Cube, each pixel has 200 intensity values



Laser Scanning, LIDAR, Range Imaging



Perspective view of “point cloud”, shaded by assumed illumination model

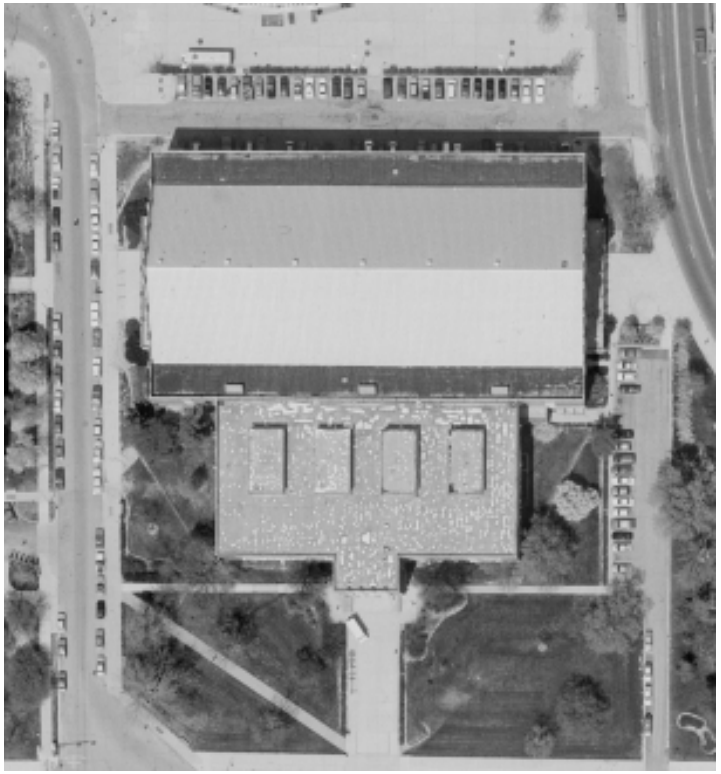


Range image, color coded by elevation, red=high, blue=low

LIDAR can provide Point Cloud and Intensity

Lidar Intensity

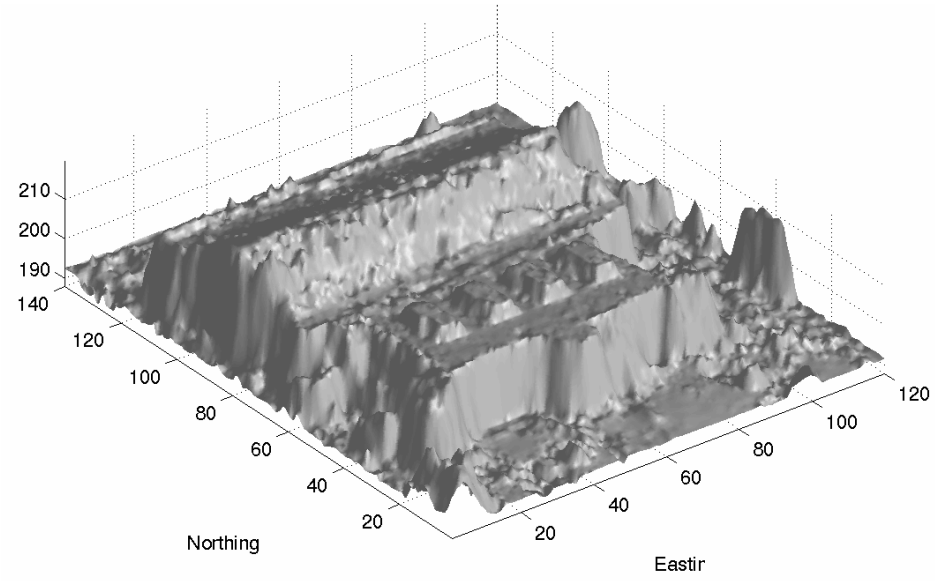
Wavelength ~1000 nm



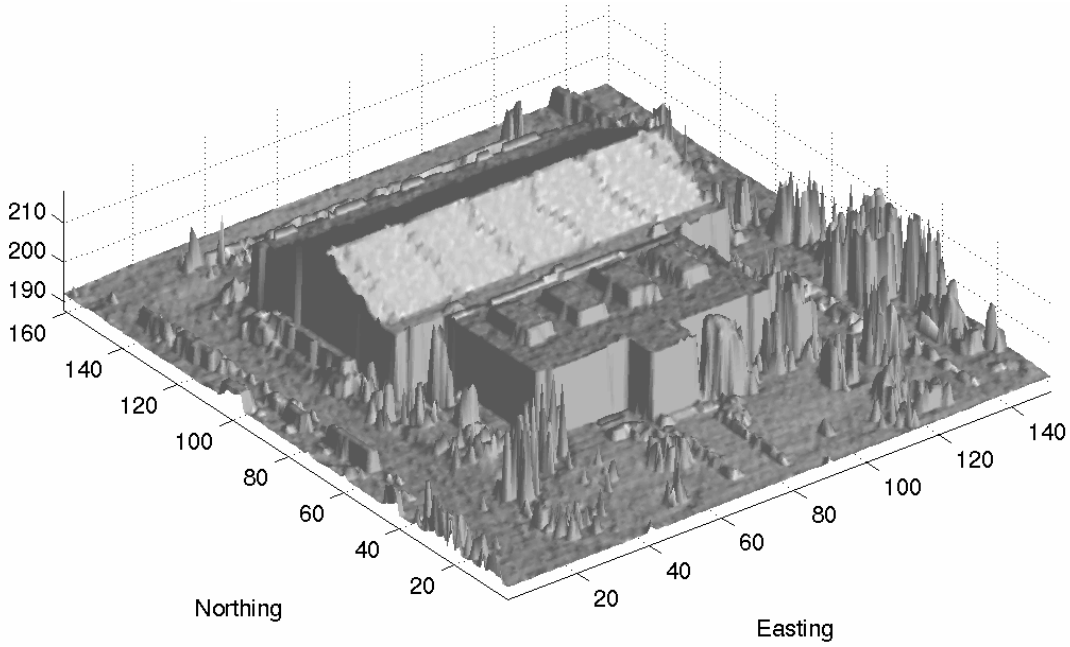
Panchromatic frame

DEM Comparison

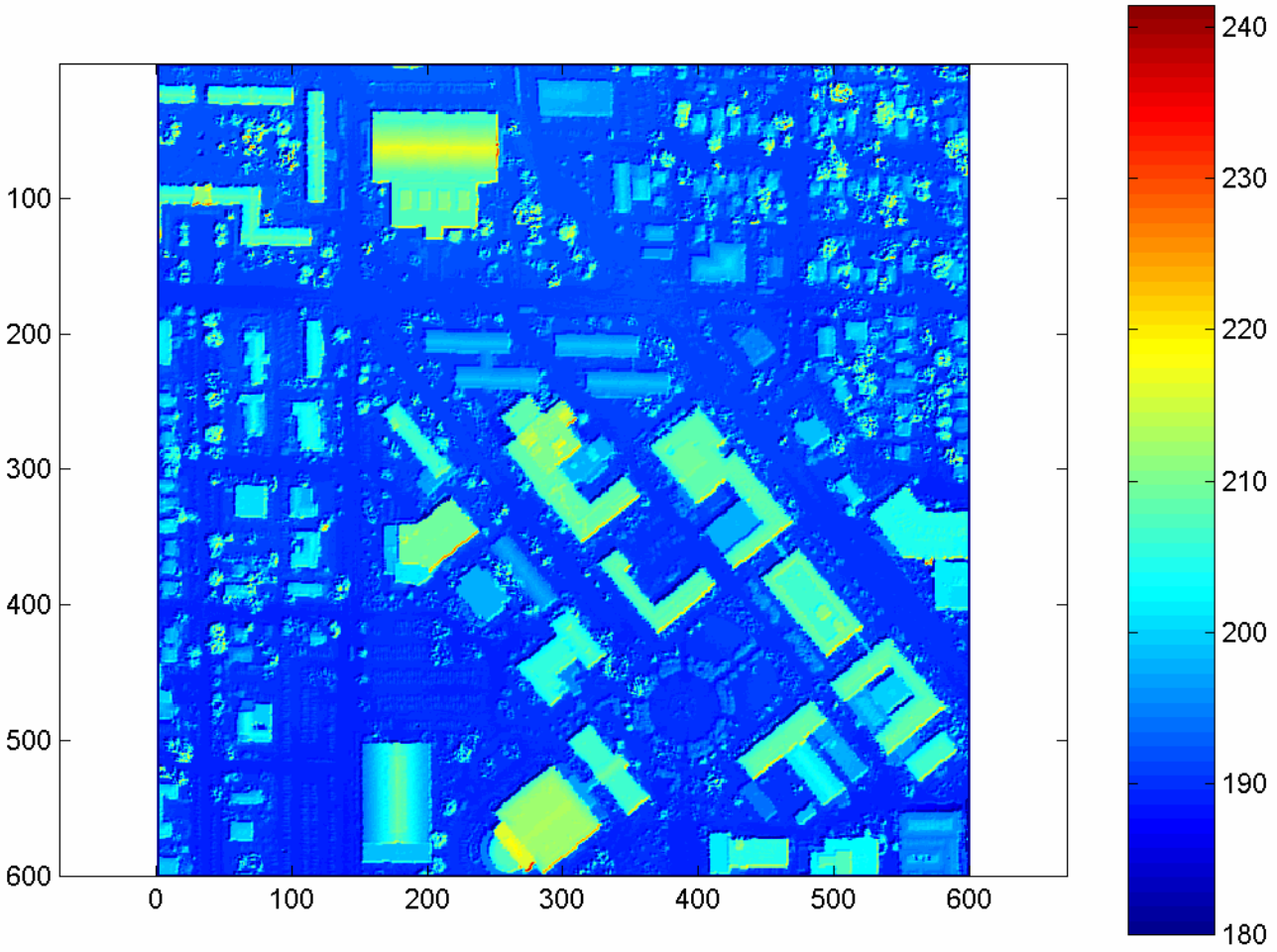
ATE



LIDAR



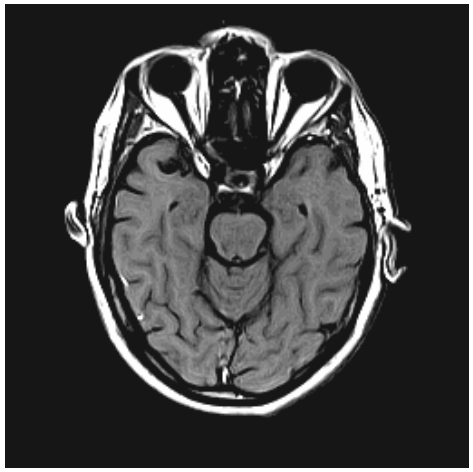
Filtered Height Data from Lidar



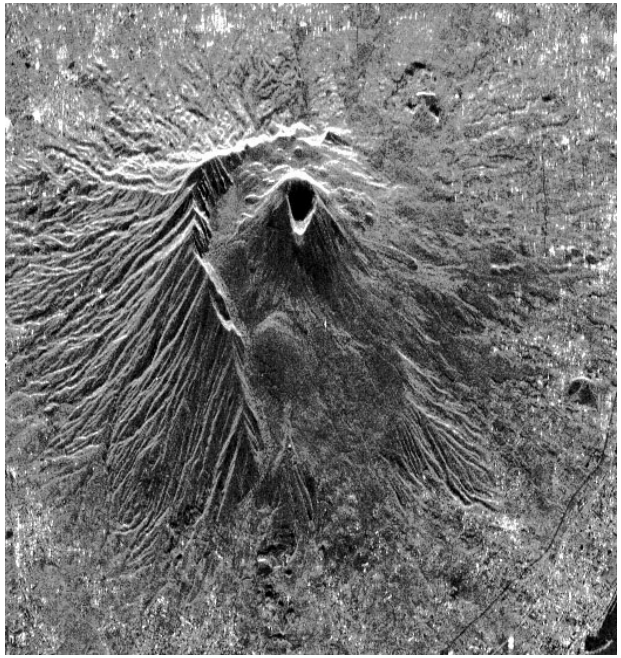
Images 3

Balloon photo, Boston ca. 1859

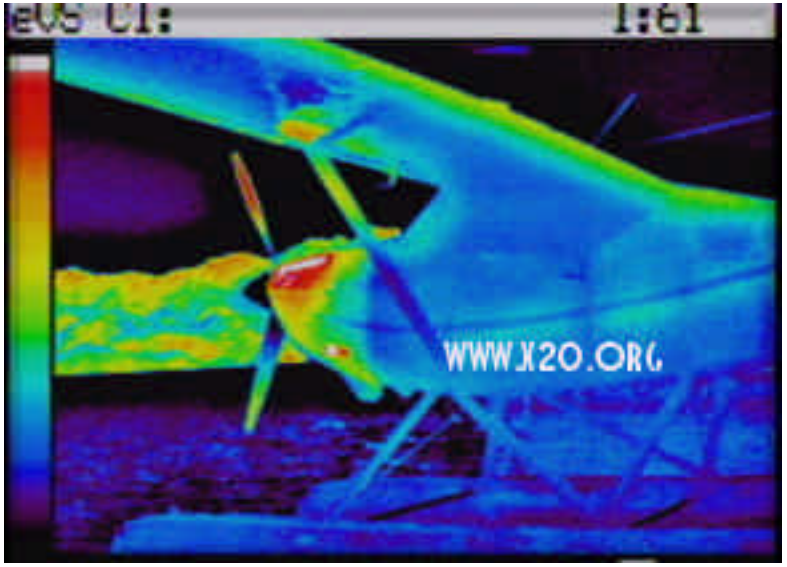
Russian KVR-1000 Film



MRI

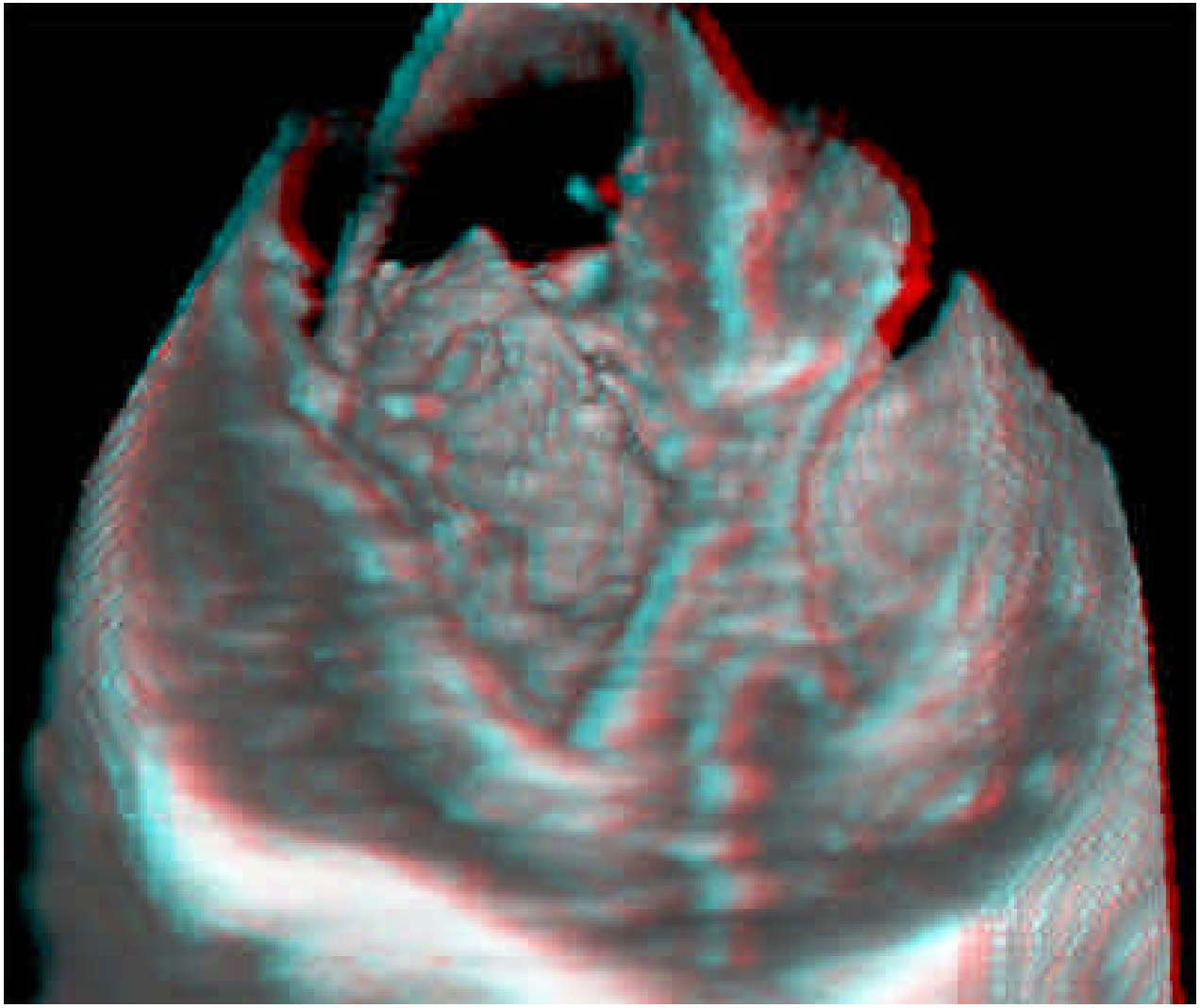


Synthetic aperture radar, SAR



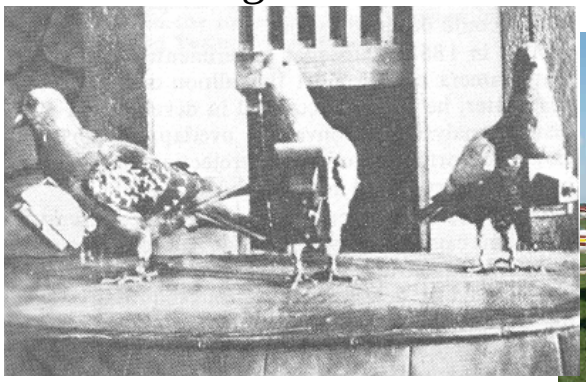
Thermal image, color coded

Anaglyph Stereo Computed Imagery from Two Ultrasound Sensors (heart valve ?)



Platforms

Pigeons



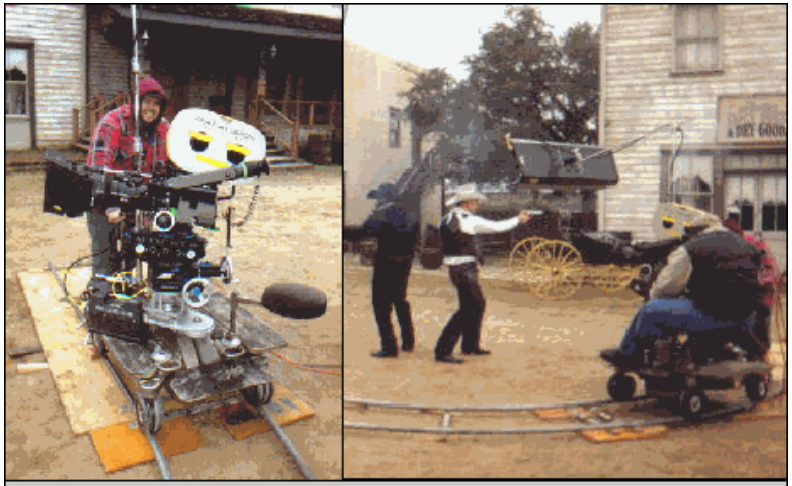
Cessna

Predator UAV

Satellite low earth orbit

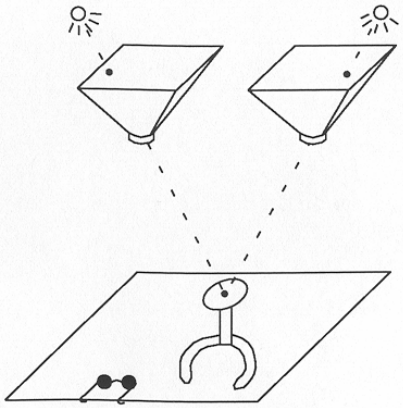
Tripod

Track & dolly for camera move

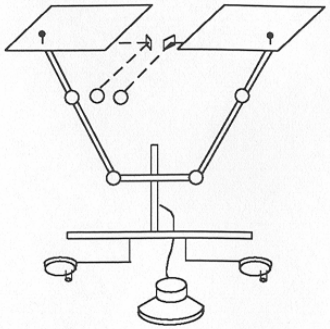


Chapman Super Peewee II with a Panavision Panaflex Camera on the set of *Westown*. Winter 2001.

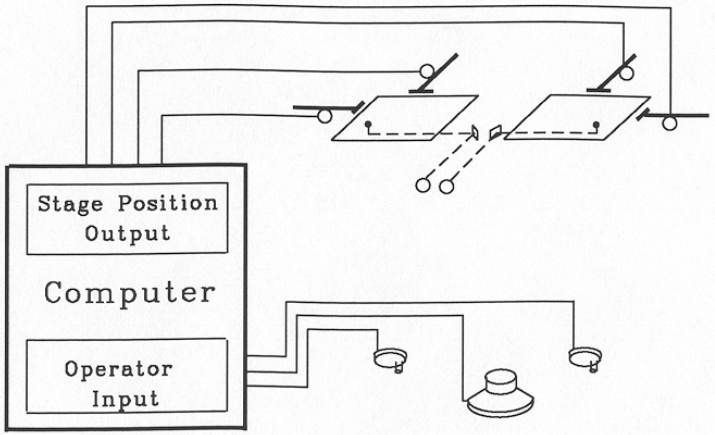
Photogrammetric Data Collection Devices - Chronological Development



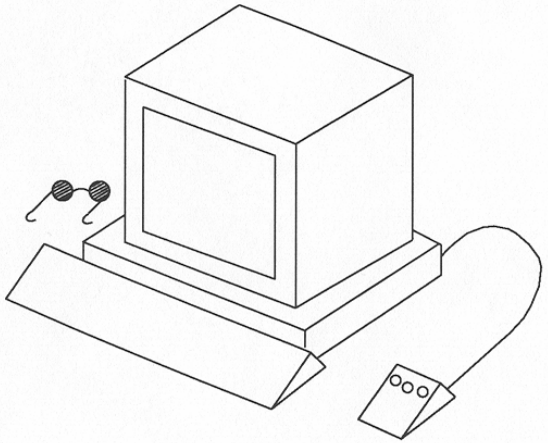
(a) Optical



(b) Mechanical



(c) Analytical



(d) Digital/Softcopy

Processing

- Point measurement
- Resection, block adjustment
- Rectification, registration
- Terrain and feature extraction
- Segmentation
- Multispectral / hyperspectral classification
- Manual, automated, semi-automated
- Analog, digital
- Optical flow analysis
- Change detection
- Automated target recognition
- Stereo viewing, interpretation and 3D data capture
- Visualization, image based rendering
- Image restoration, enhancement, super-resolution
- Data fusion
- Mosaics
- Matching and correspondence
- Compression
- Data hiding, digital watermarking

Applications

- Topographic mapping, cartography, large scale, small scale
- Land development, roadway design, earthwork computation
- Data for GIS, transportation, urban features, land use
- Reconaissance, surveillance
- Targeting
- Creation of 3D CAD models
- Image based rendering, virtual scene generation, replacement of actual camera operation
- Visualization, simulation
- Close-range: industrial, architectural, medical
- Resource management, forests, agriculture, wildlife, urbanization, environmental assessment
- Mineral, petroleum exploration