

3D Reconstruction

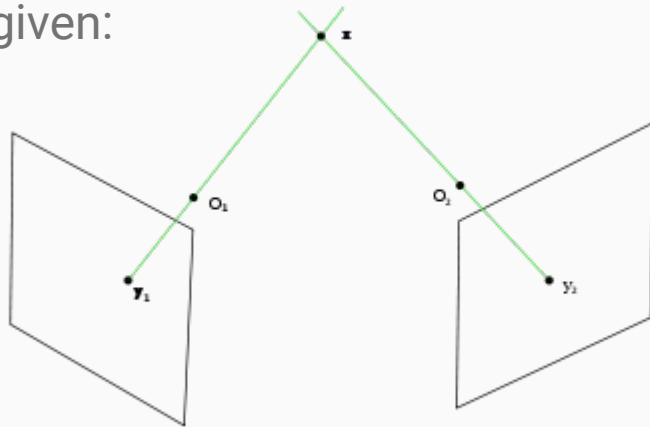
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Multiview Reconstruction

- Triangulation
- Multiview geometry
- Epipolar geometry
- Stereo Vision
- Homography, Fundamental and Essential Matrices
- Structure from Motion pipeline

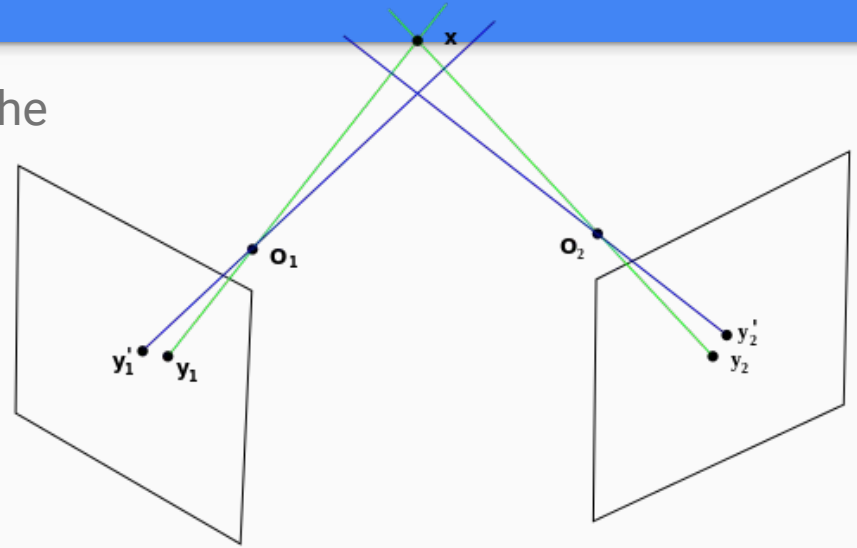
Triangulation

- Estimate the 3D position of a point given:
 - two cameras in known locations
 - The 2d projections are known
- Solution:
 - Trace the rays and find intersection



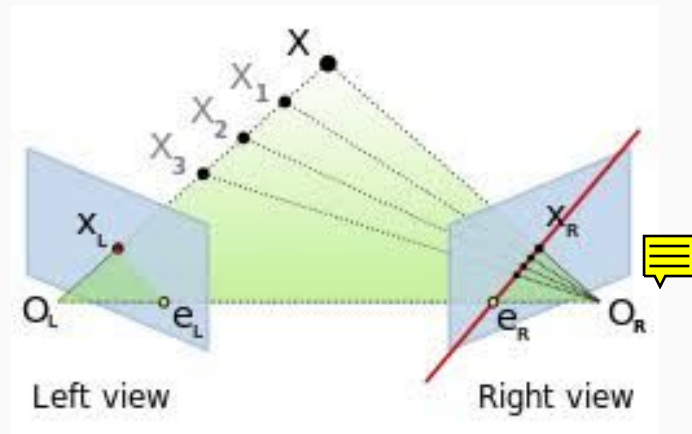
Triangulation

- In practice, accuracy in estimation of the points is limited.
- The lines will not intersect in the exact position
- Methods:
 - **Mid-point method**
 - Direct linear transformation

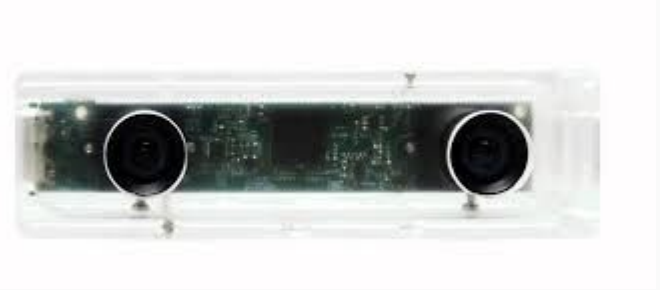


Epipolar Geometry

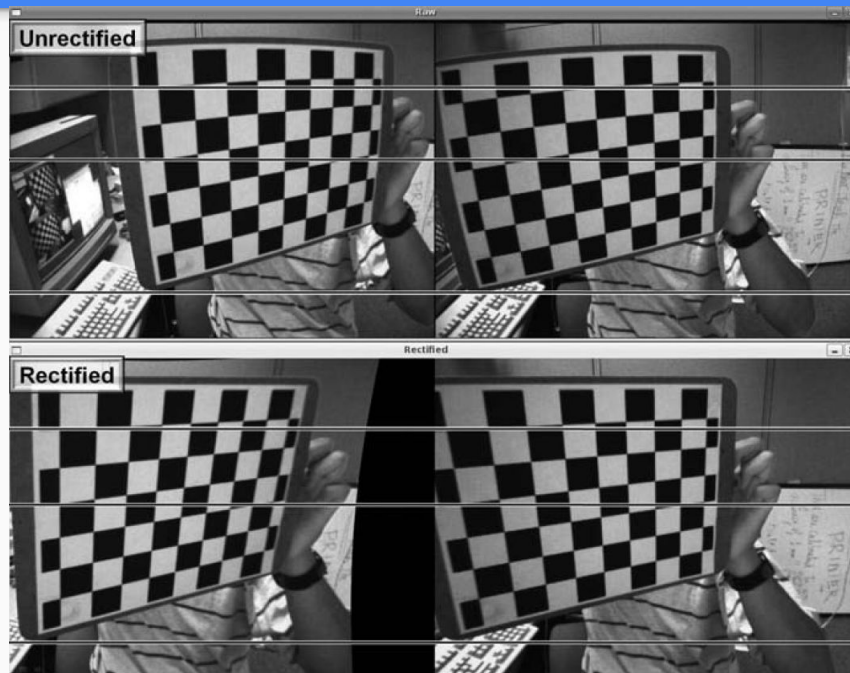
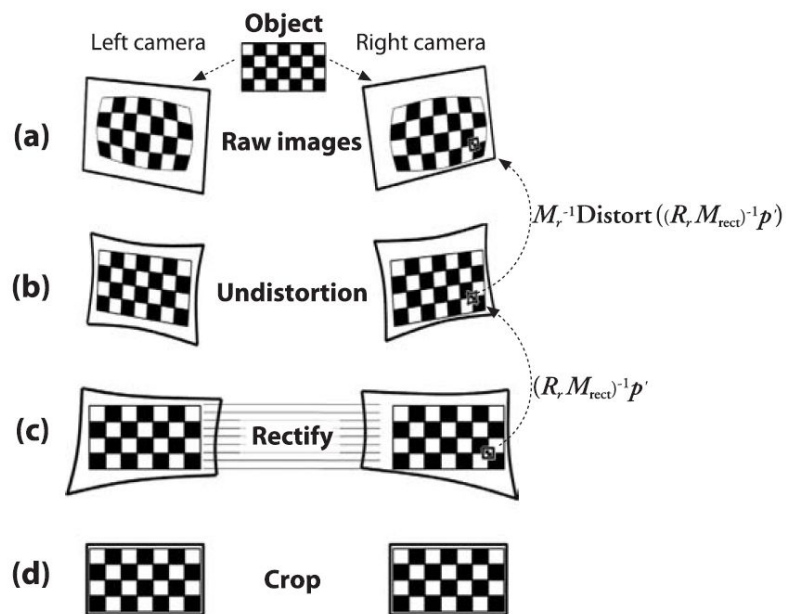
- Consider two cameras in known locations, and a 3D point whose 2D projection is known in only one camera?
- Its location in the other camera must lie on a line called epipolar line



Stereo Vision

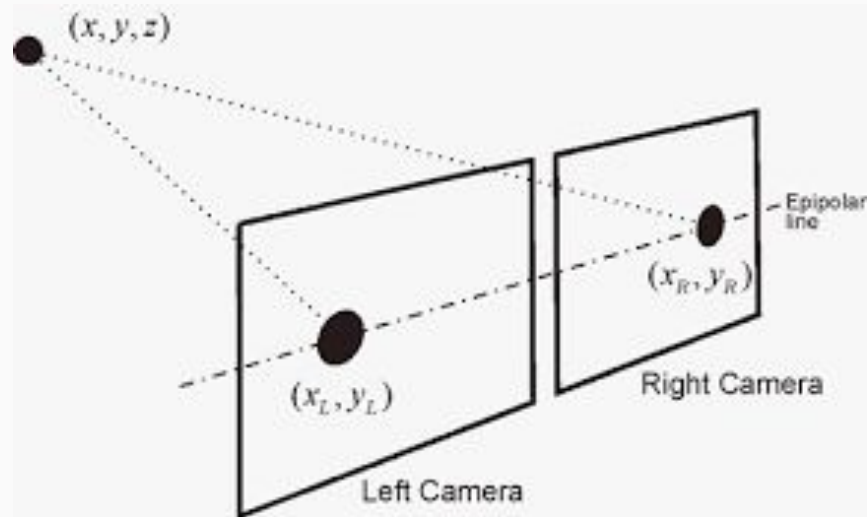


Stereo Vision

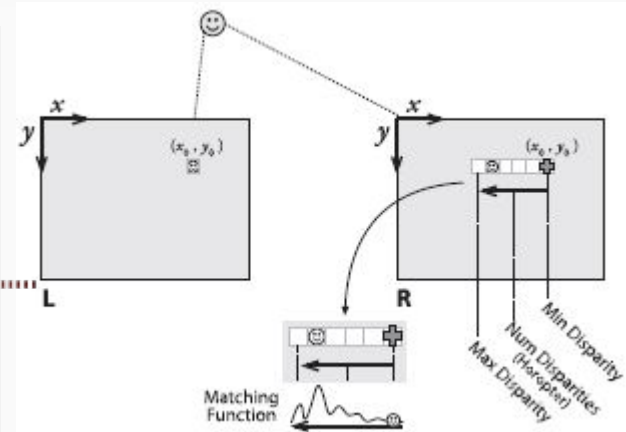
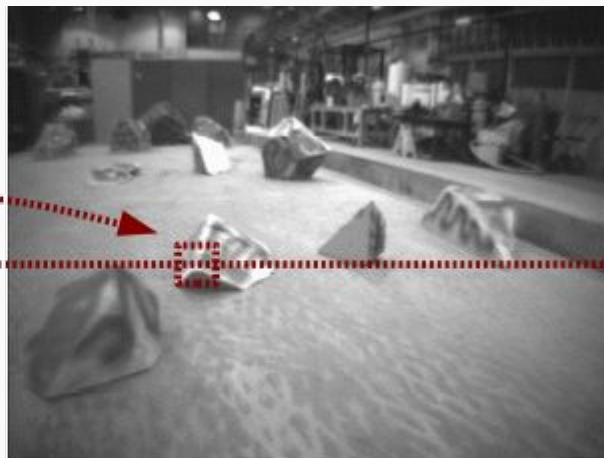
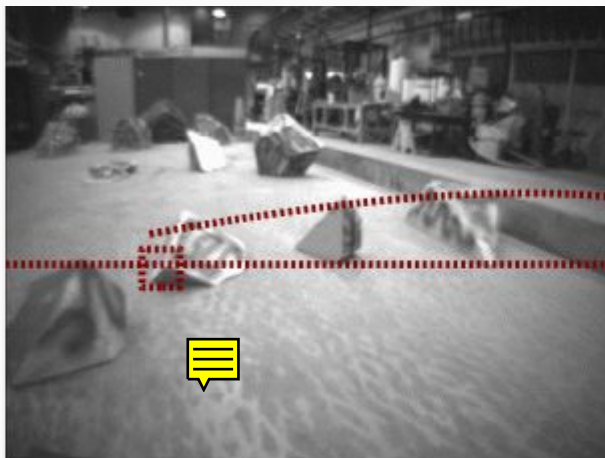


Stereo Vision

Epipolar lines are at the same height

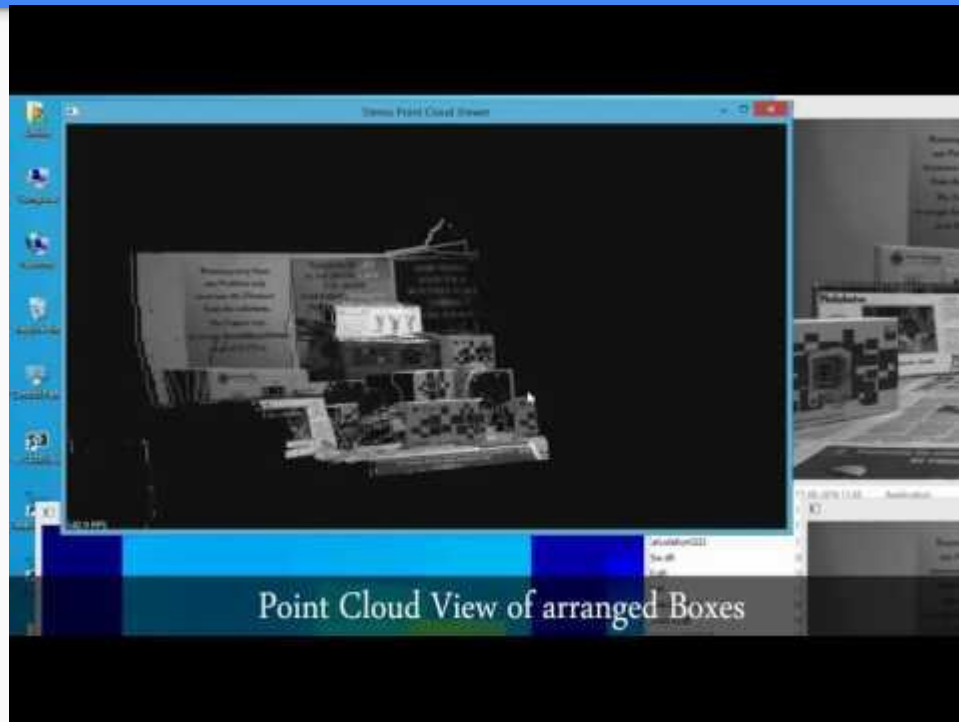


Stereo Vision



$$SAD = \sum_{i=1}^M \sum_{j=1}^N |I_l(i, j) - I_r(i - j)|$$

Stereo Vision



Stereo Vision



Structure from Motion

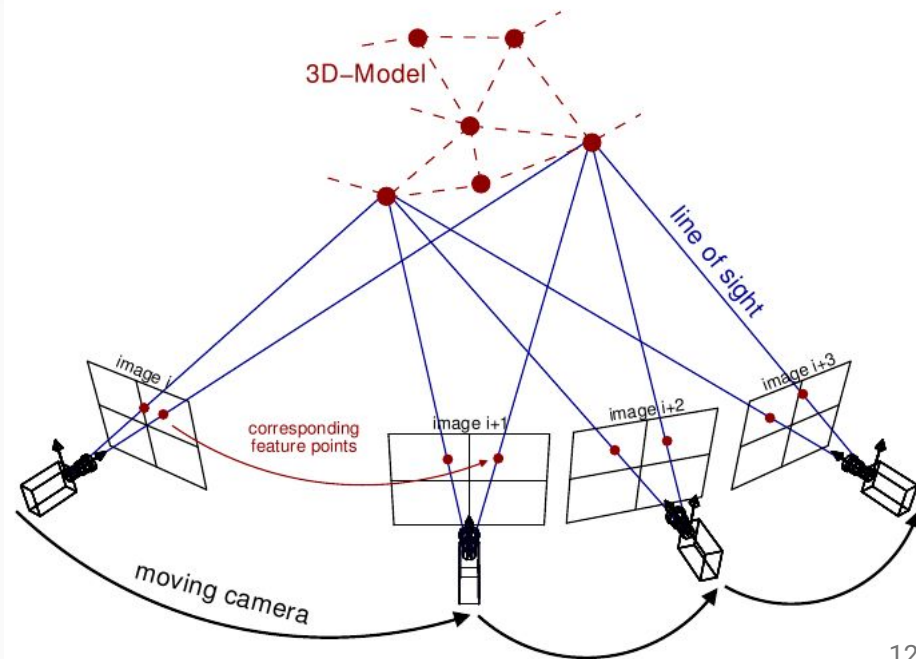
3D Reconstruction from matches

Initialization: Essential/Homography

Uncalibrated camera

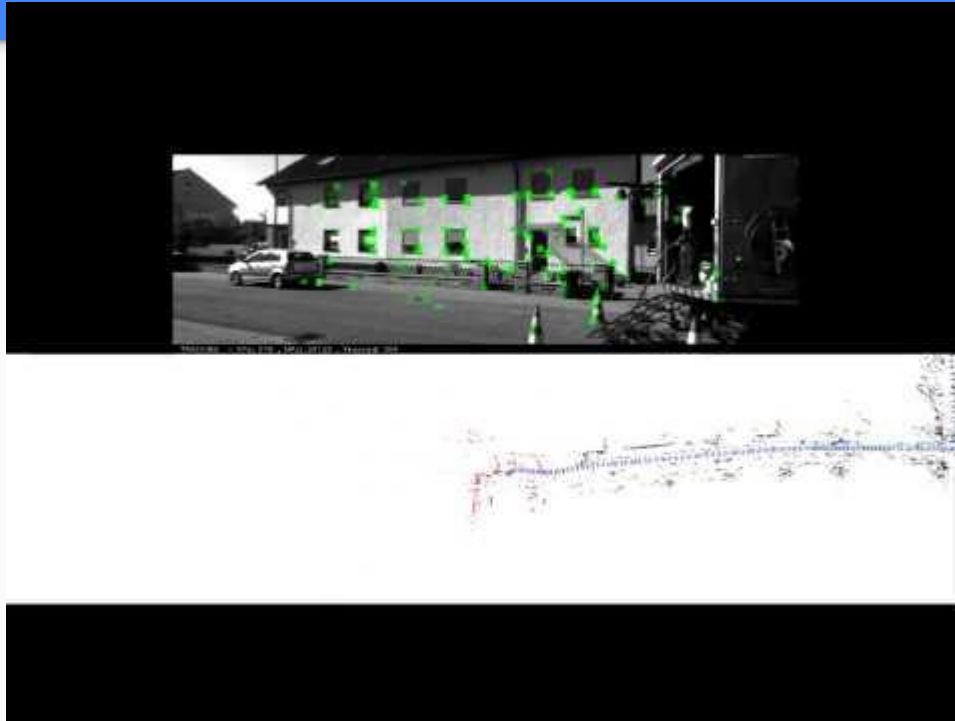
Global optimization SBA

Up to a scale factor

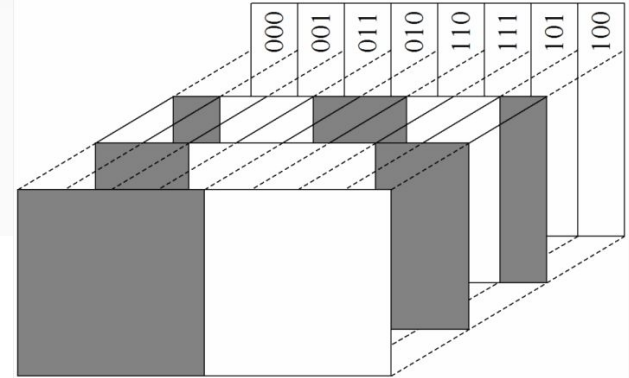
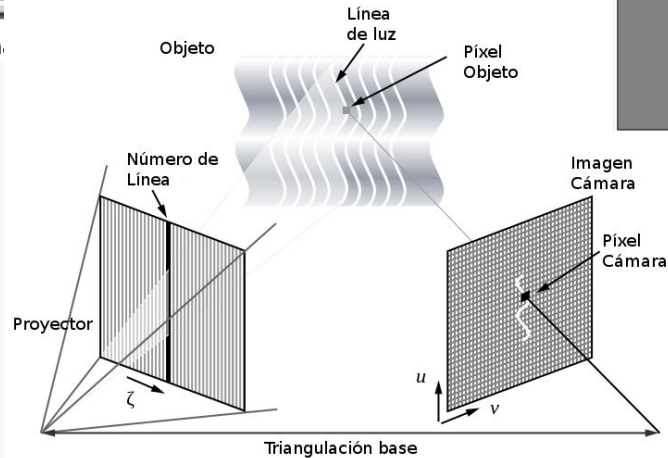
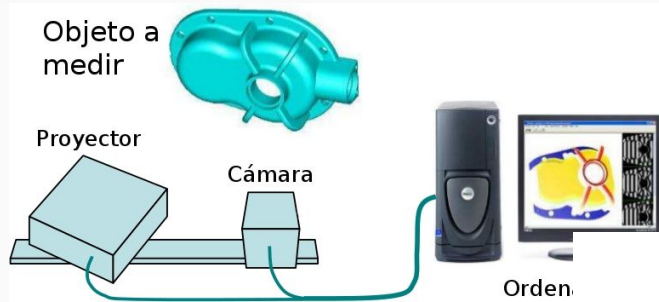




SLAM (Simultaneous Localisation and Mapping)



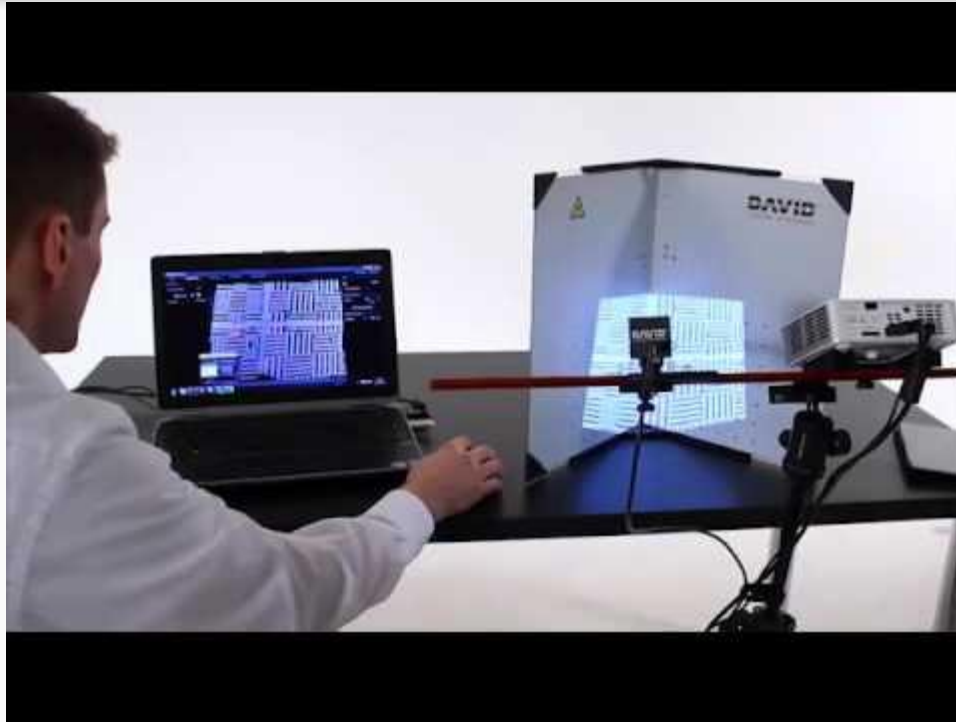
Structured Light



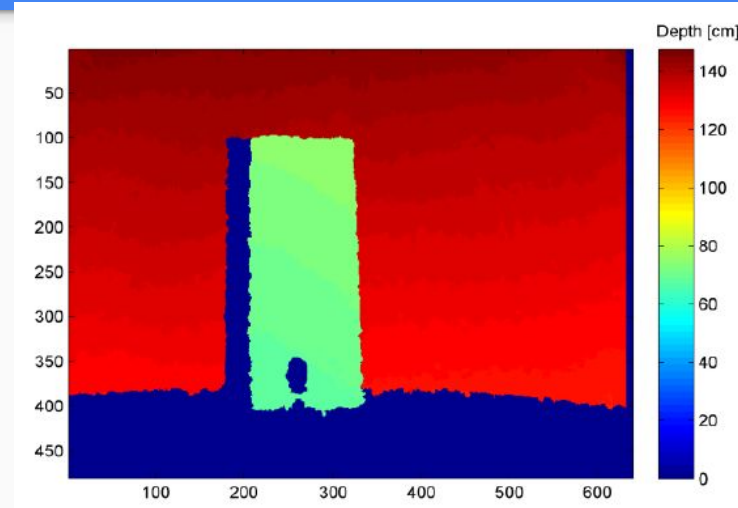
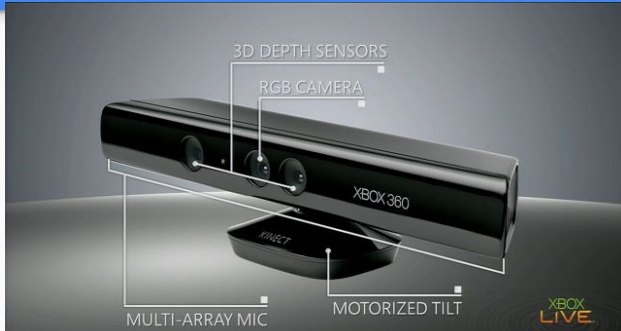
Structured Light

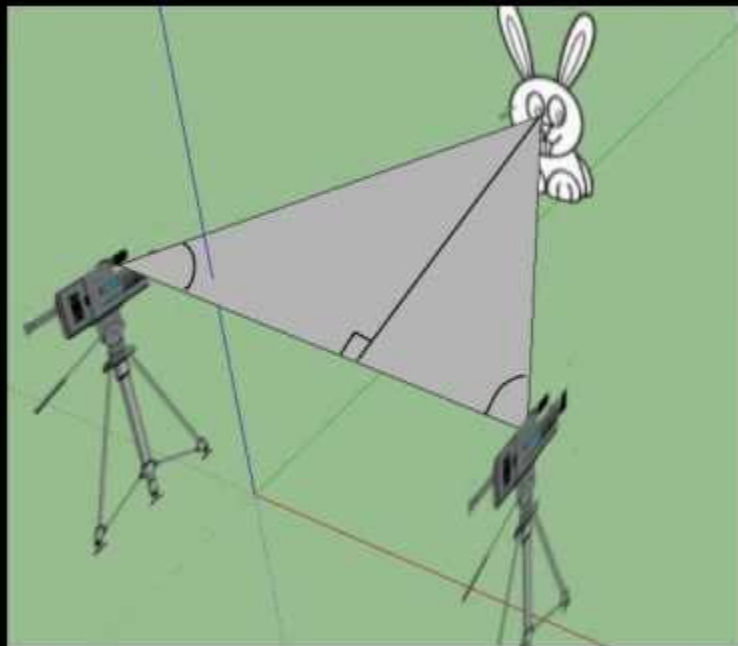


Structured Light



Structured Light

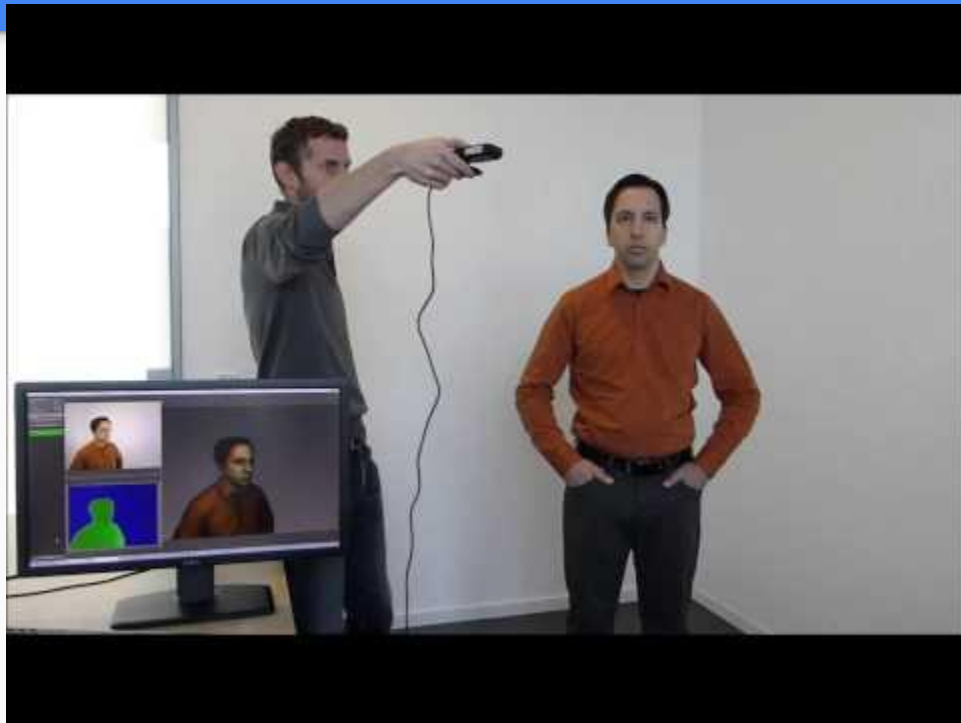






Resulting Scan







Final Mesh