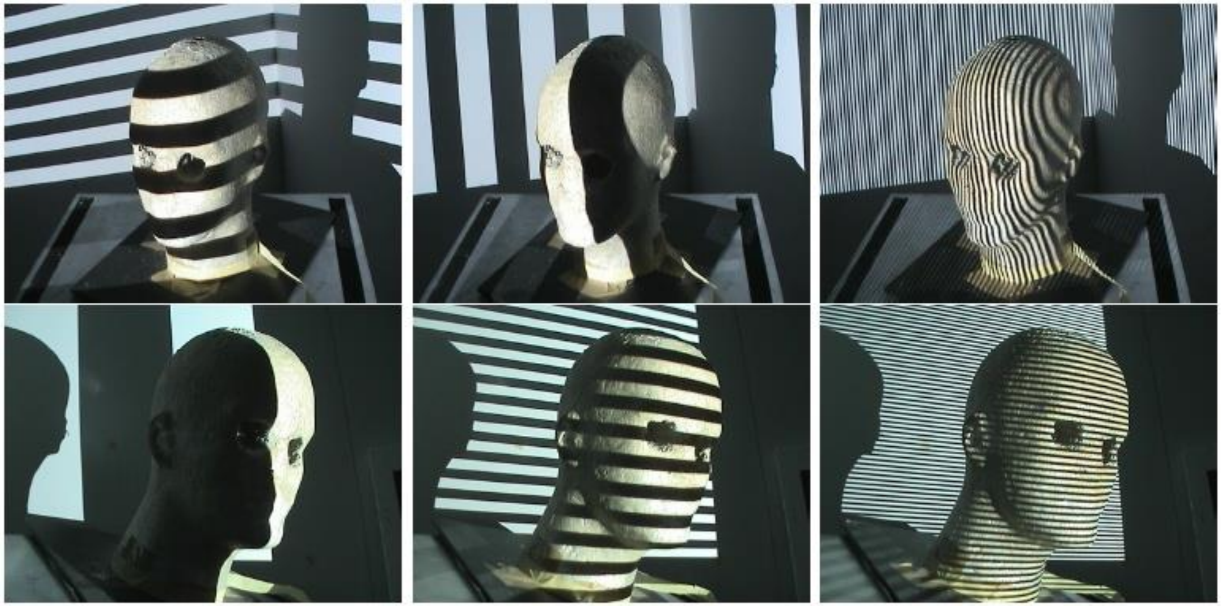


Project Ideas

Guido Gerig

CS 6643, Computer Vision

Spring 2016

Final Project 3D CV

- Work on your own.
- Select a 3D vision method (examples given in slides).
- Develop a project that goes from input data to a 3D solution.
- Develop/use code, generate images (or make use of existing test images), show some substantial effort towards your own solution.
- Write a final report (min 6 pages) describing your project, approach, algorithms, input data, results, limitations, problems, critical discussion.
- Short presentation (5-10Min, ev. demo) and discussion in the last week of classes.
- Report and presentation clearly need to reflect contributions of own coding versus using pieces of existing code libraries.

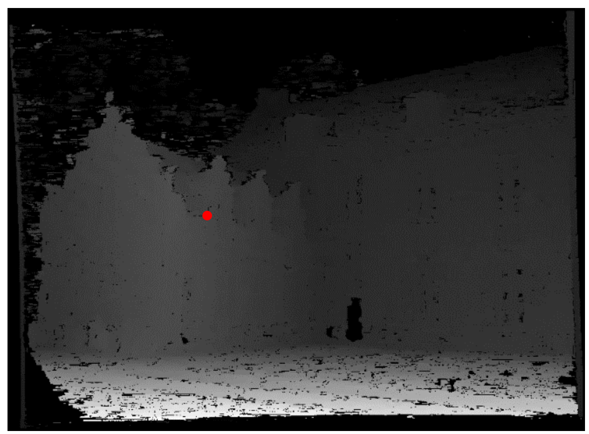
3D from Stereo

Disparity map

image $I(x,y)$

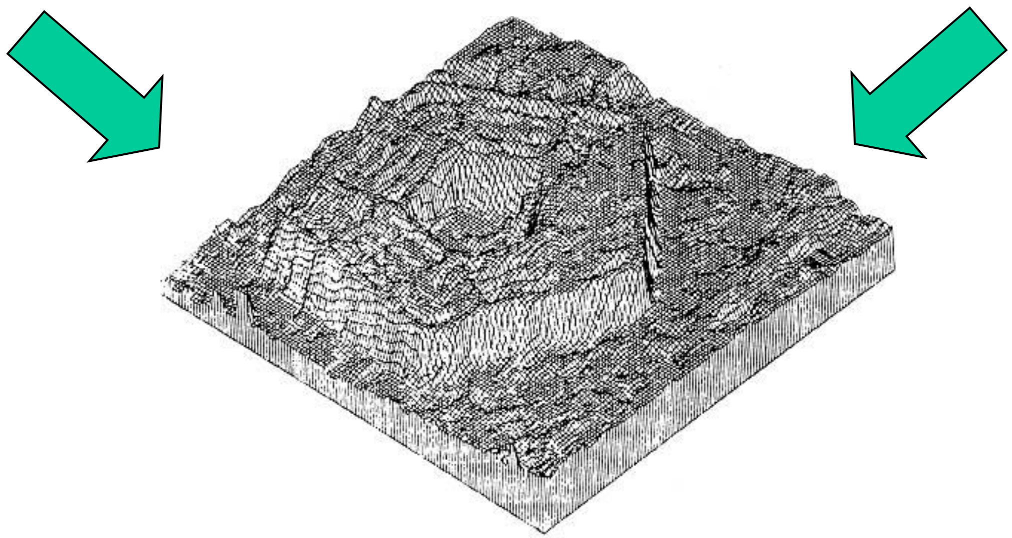
Disparity map $D(x,y)$

image $I'(x',y')$



$$(x',y')=(x+D(x,y),y)$$

Dynamic Programming (Ohta and Kanade, 1985)

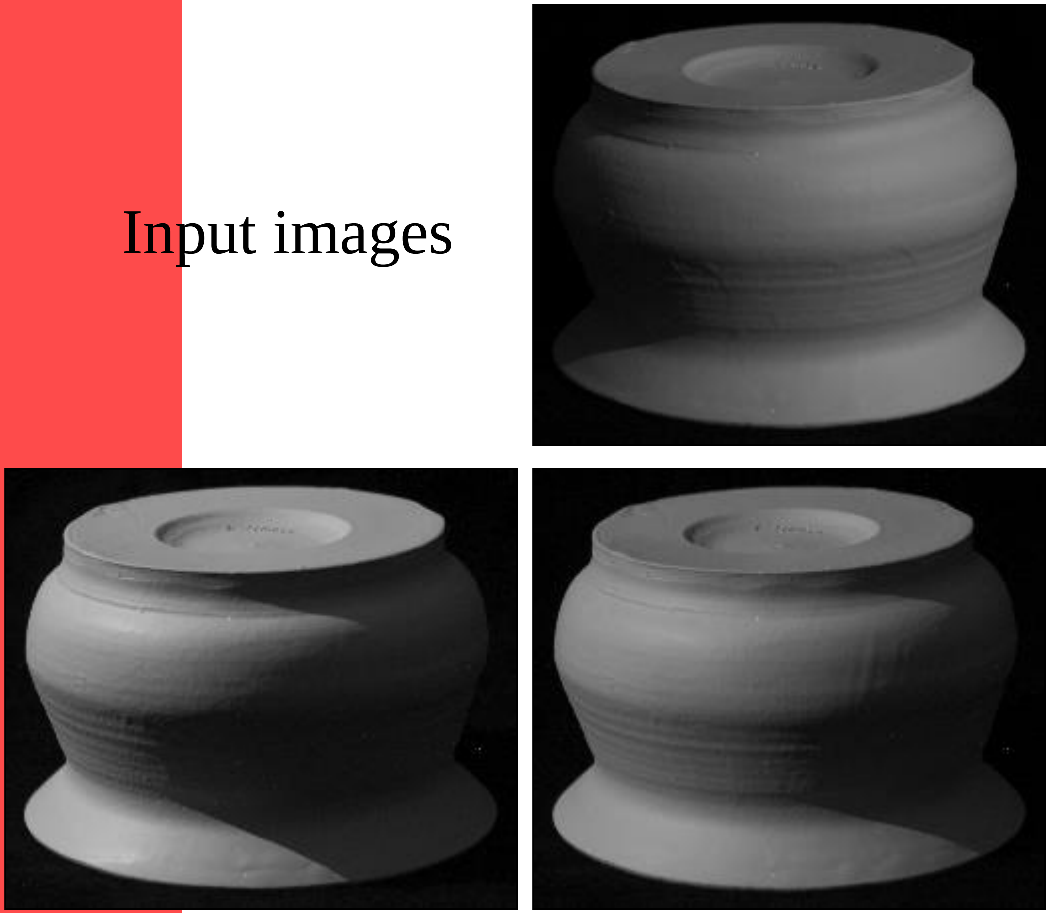


Reprinted from "Stereo by Intra- and Intet-Scanline Search," by Y. Ohta and T. Kanade, IEEE Trans. on Pattern Analysis and Machine Intelligence, 7(2):139-154 (1985). © 1985 IEEE.

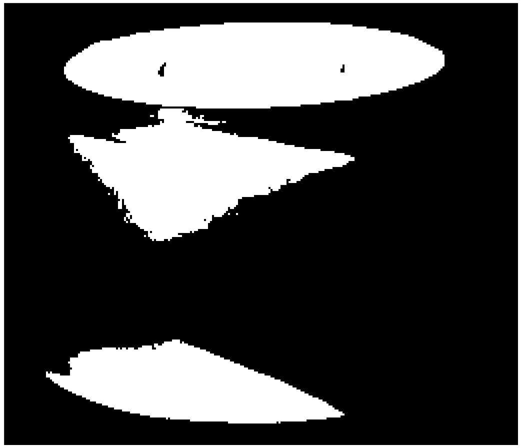
Shape from Shading

Ceramic Pot Data

Input images

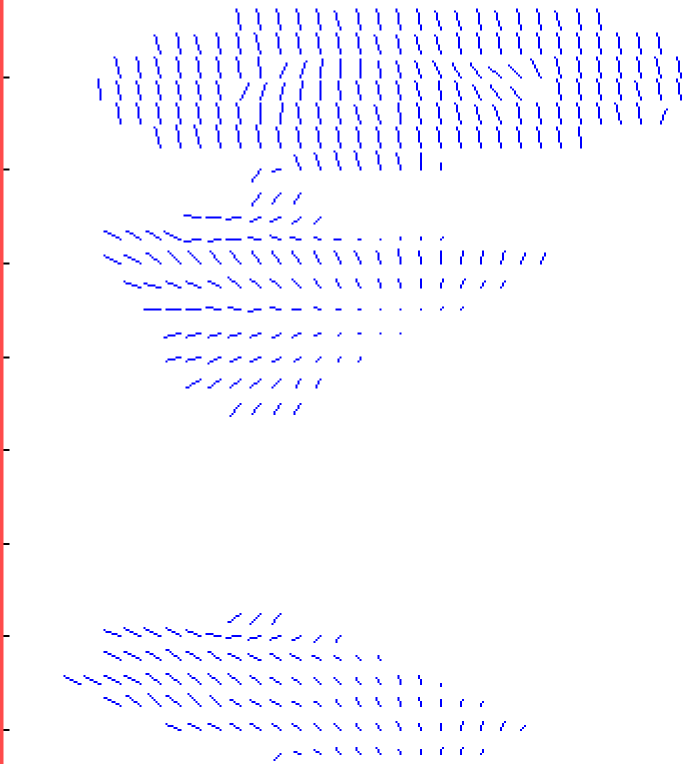


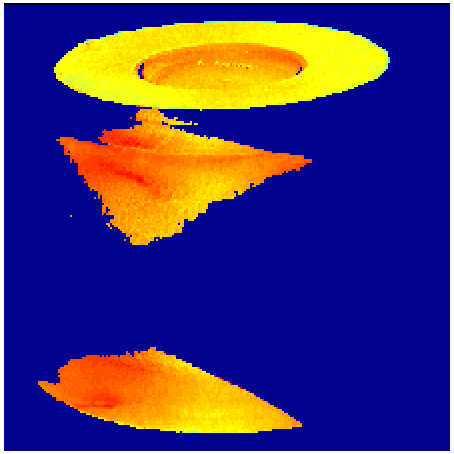
Usable Data Mask



Ceramic Pot Results

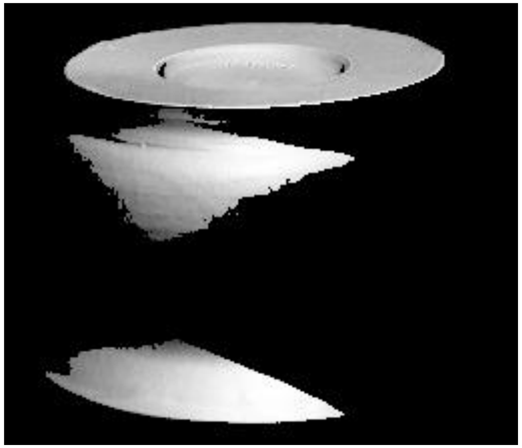
Needle Diagram:





Albedo

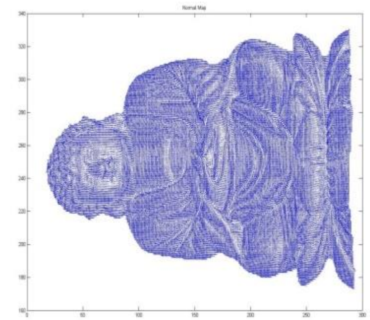
Re-lit:



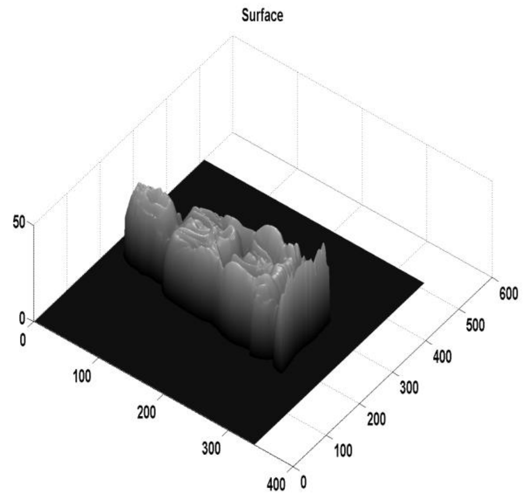
Results – Lord Buddha Images – Pre-Processed Images
Guozhen Fan and Aman Shah

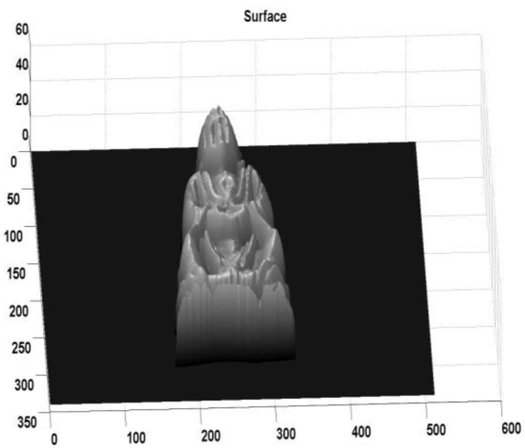
Original Image

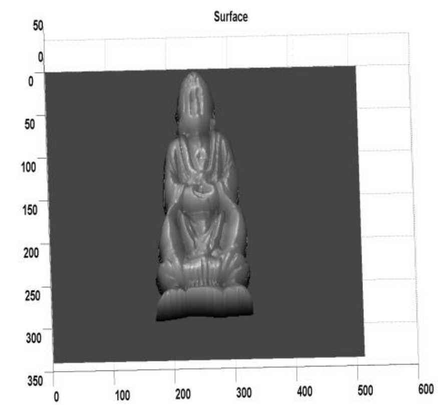
Albedo Map



Surface Normals





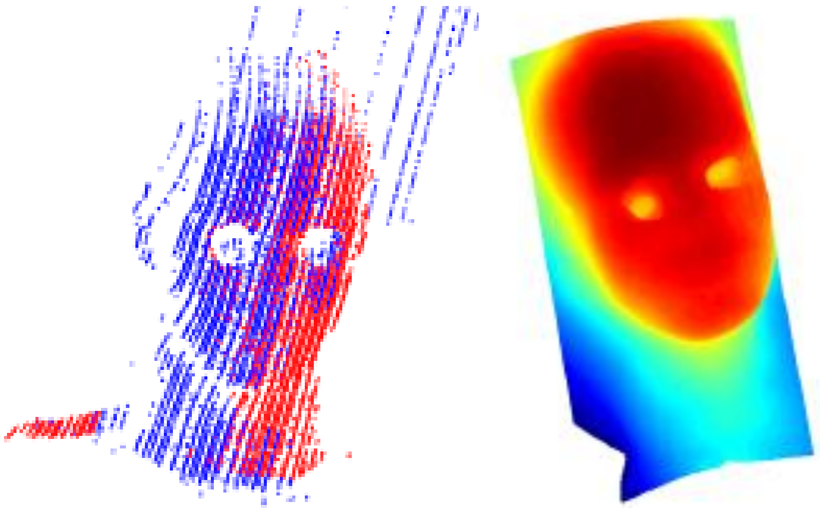


Obtained Surfaces from different angles

Structured Light

Active Vision: Structured Light

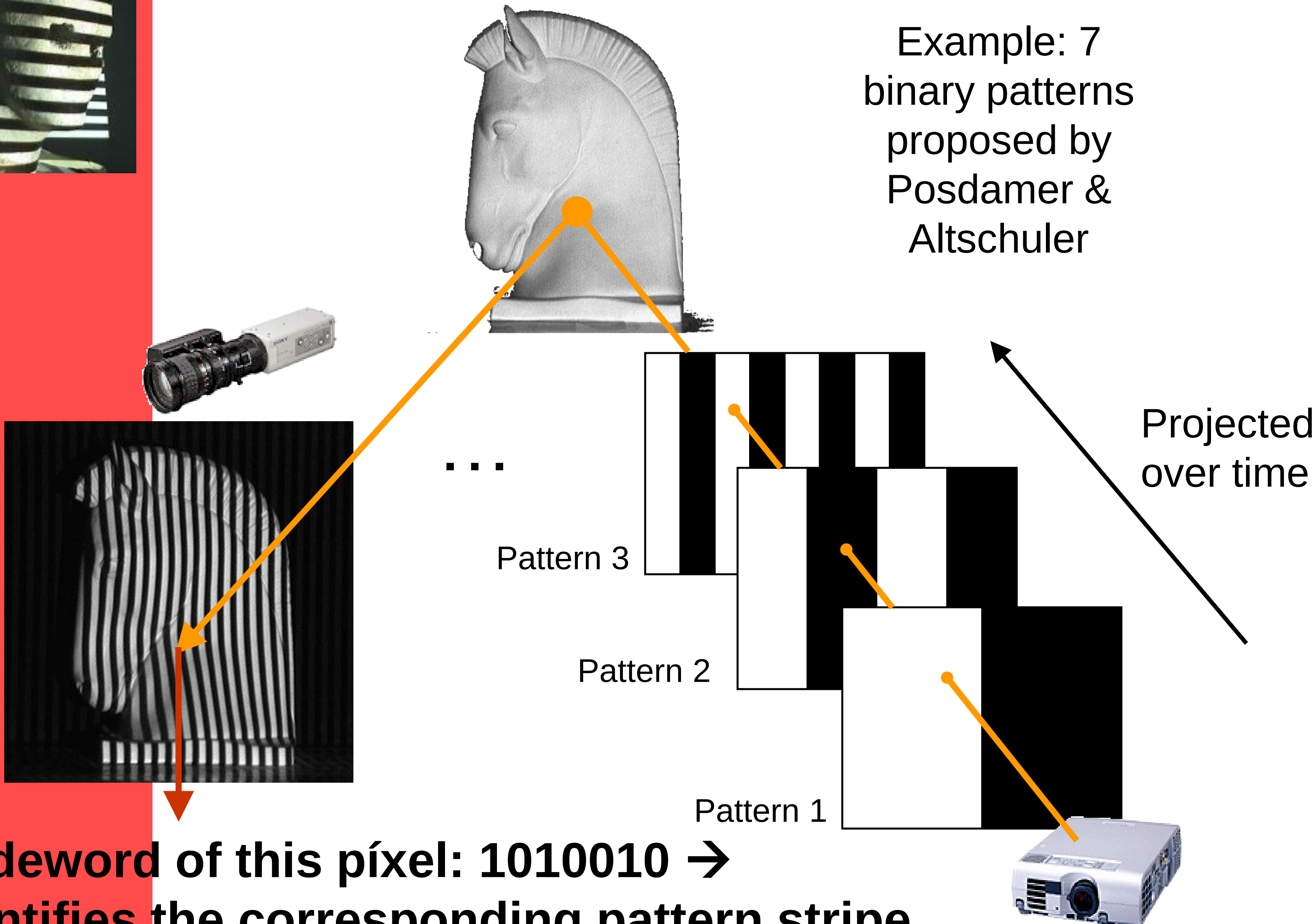
Segmentation: Binarization and coding of stripes



3D model extracted from stripe pattern

Binary Coding

Example: 7 binary patterns proposed by Posdamer & Altschuler

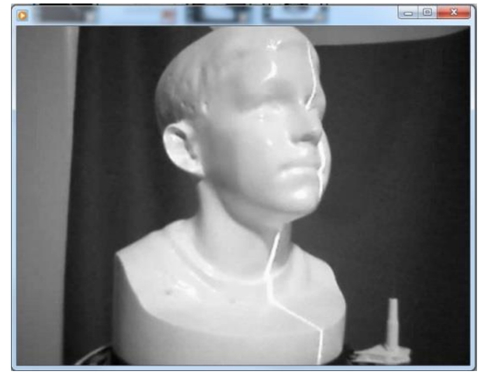


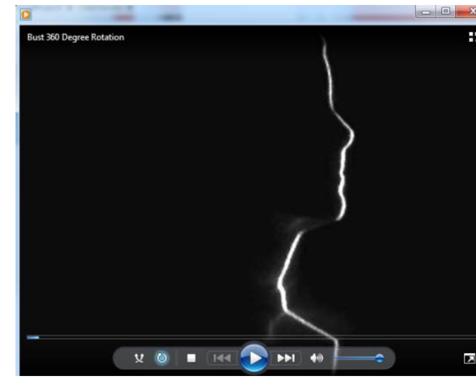
Codeword of this píxel: 1010010 → identifies the corresponding pattern stripe

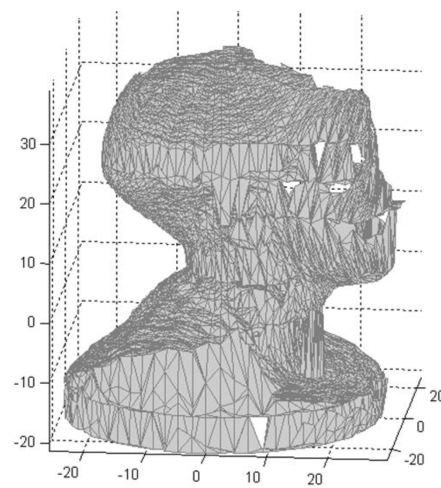
“Cheap and smart” Solution

Example: Bouguet and Perona, ICCV’98

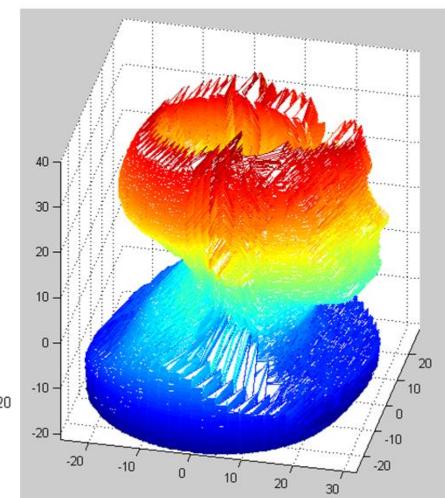
Structured Light Using a Rotating Table
James Clark, 3D CV F2009





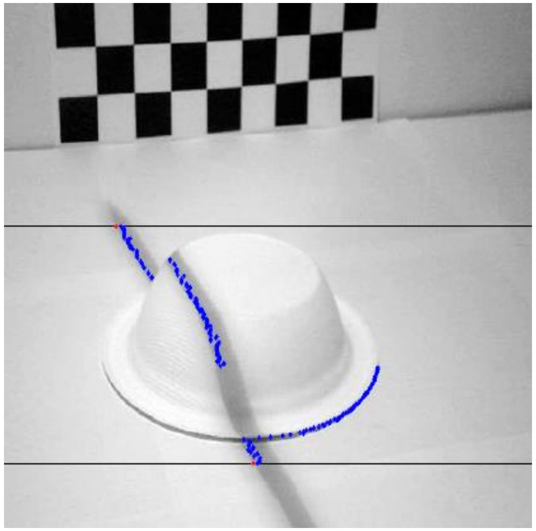


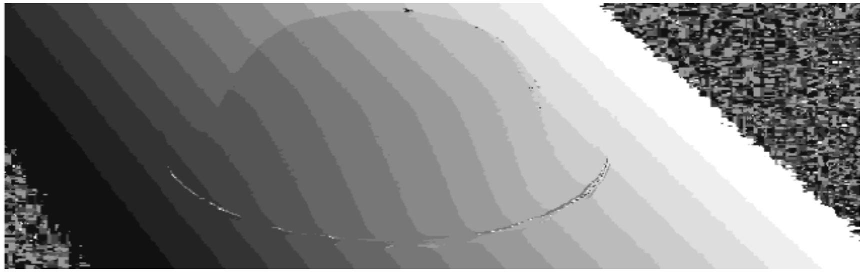
Height Strip Mesh



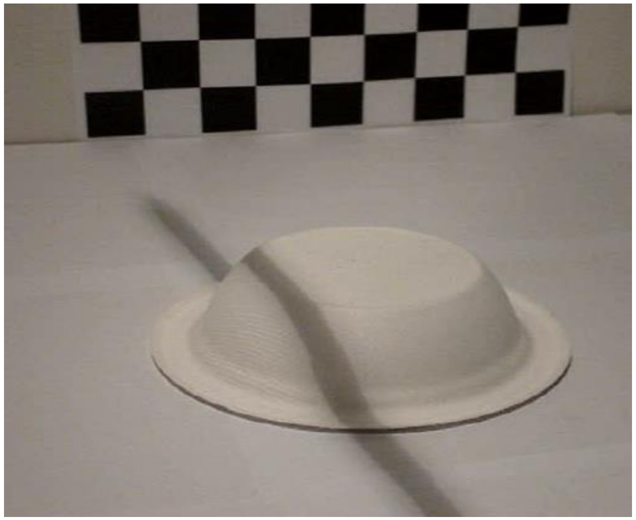
Localized Mesh

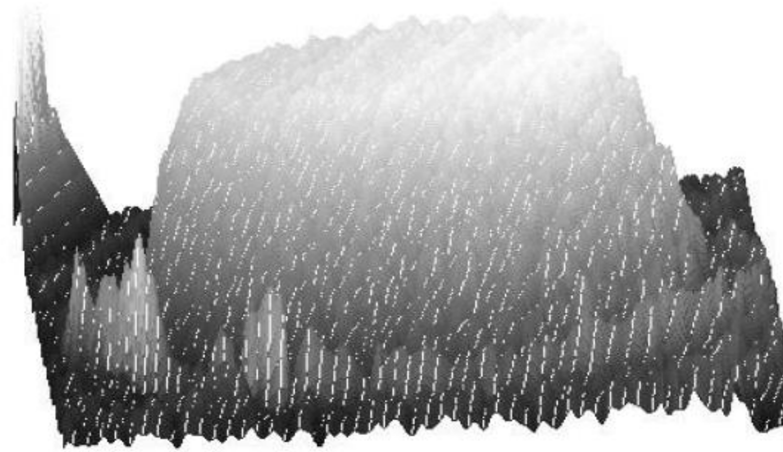
Structured Light
Anuja Sharma, Abishek Kumar

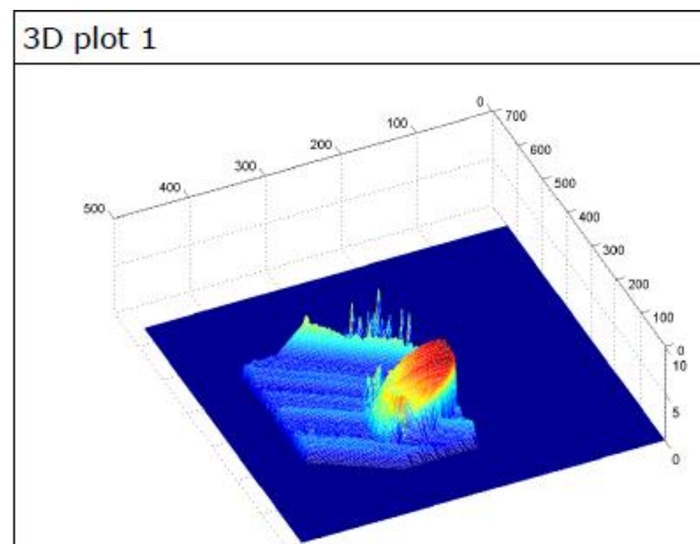




Structured Light
Anuja Sharma, Abishek Kumar

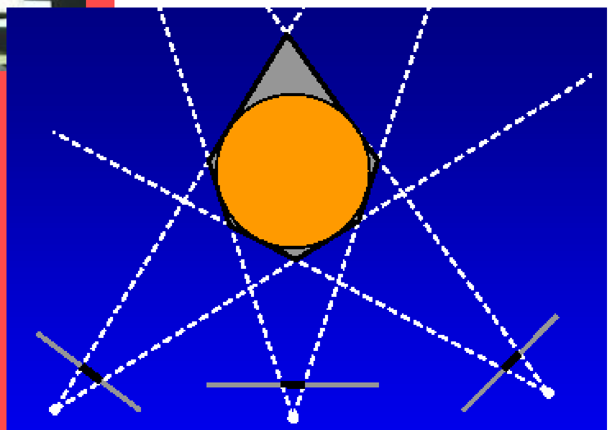


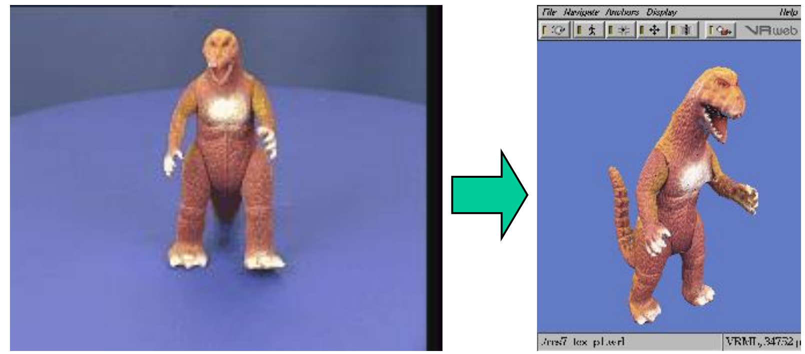


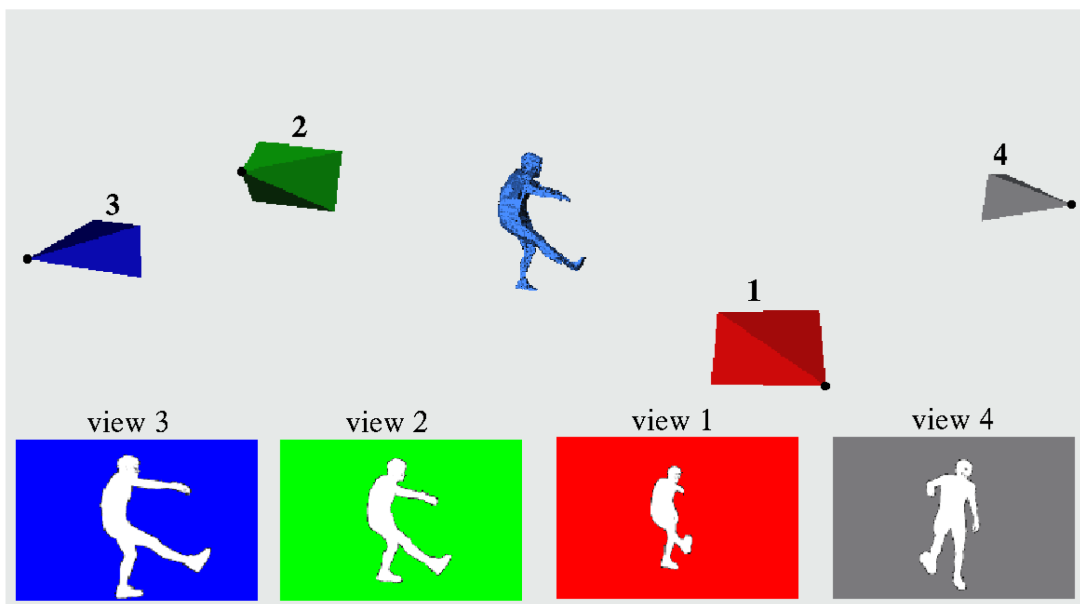


Shape from Silhouettes

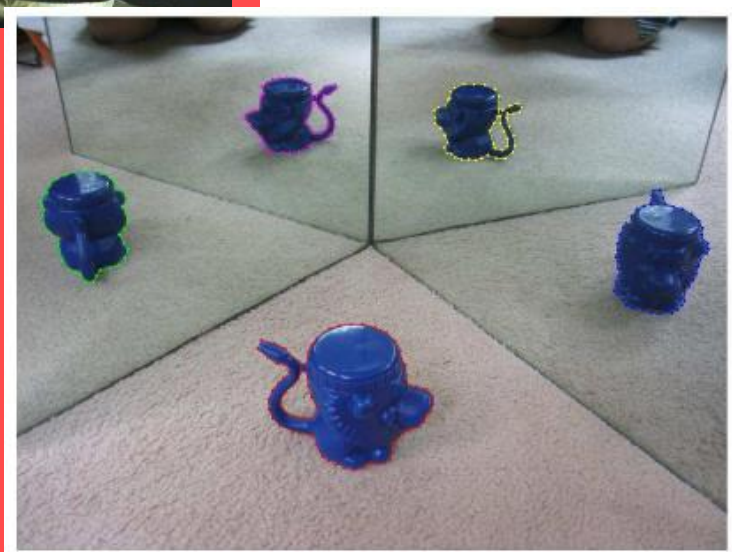
3D Shape from Silhouettes

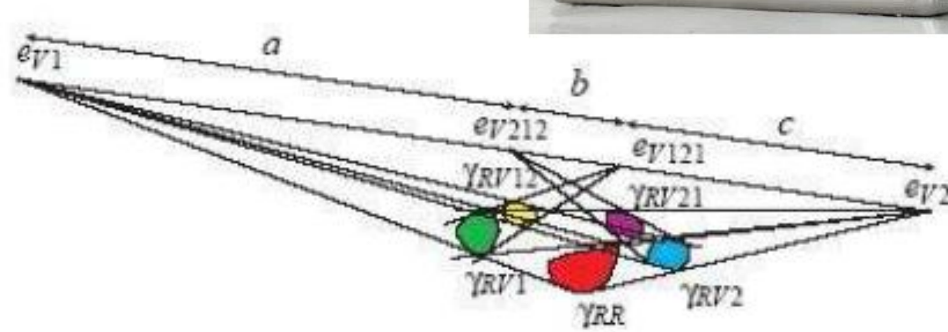






3D shape from silhouettes



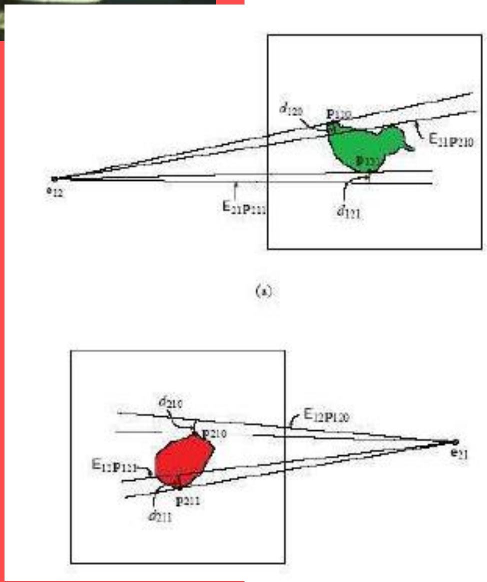


Forbes et al., ICCV2005

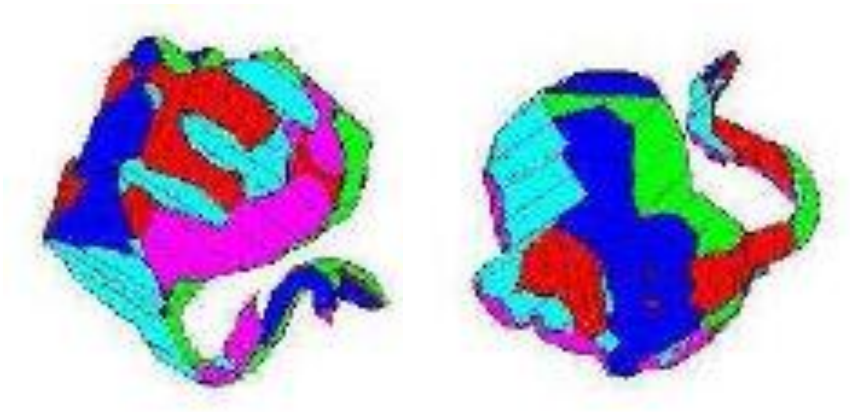
Christine Xu, Computer Vision Student Project

Think about the geometry
-> calculate relationship between silhouettes

3D shape from silhouettes



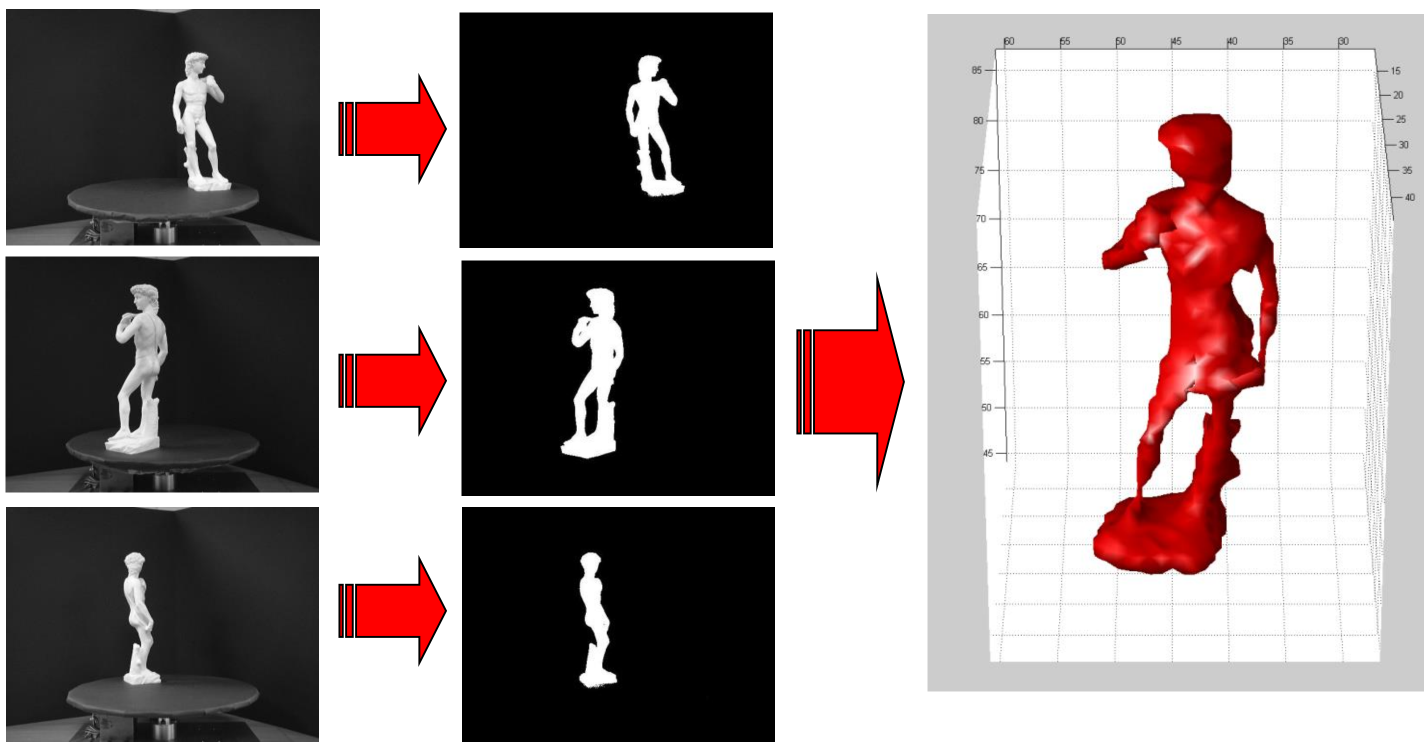
Build 3D model



Visualize 3D model from arbitrary viewing angles

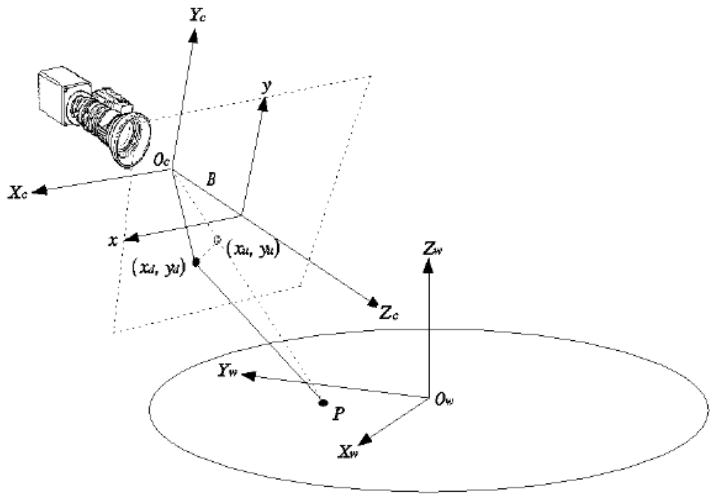
Example

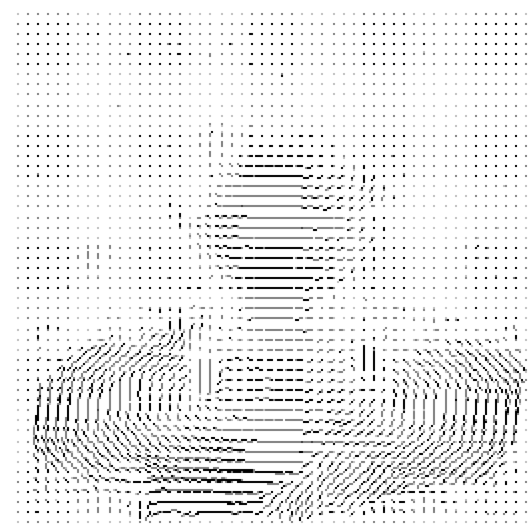
- Compute visual hull with silhouette images from multiple calibrated cameras
- Compute Silhouette Image
- Volumetric visual hull computation
- Display the result



Shape from Rotation

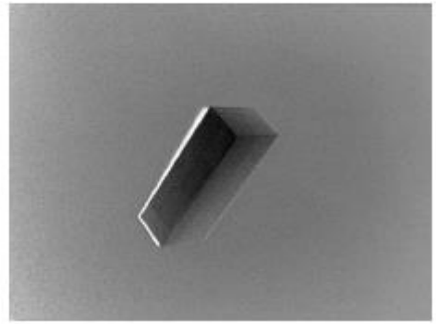
Turntable Approach

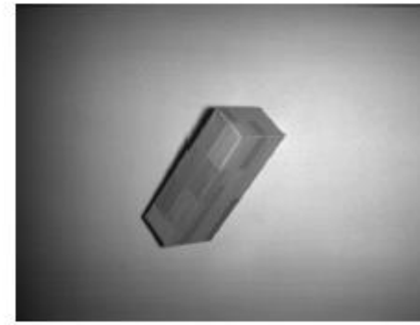




Range Sensor Data Processing to get 3D Shapes

Input Data: Depth Maps

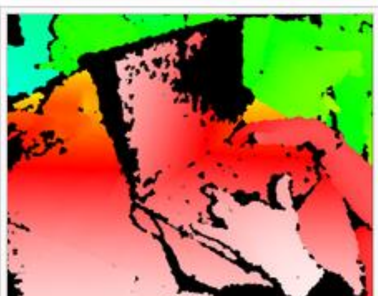




Range Image (left) and gray level image (right)

This infrared image shows the laser grid Kinect uses to calculate depth

A slide from Microsoft's E3 Conference showing a diagram of the technologies in Kinect



The depth map is visualized here using color gradients from white (near) to blue

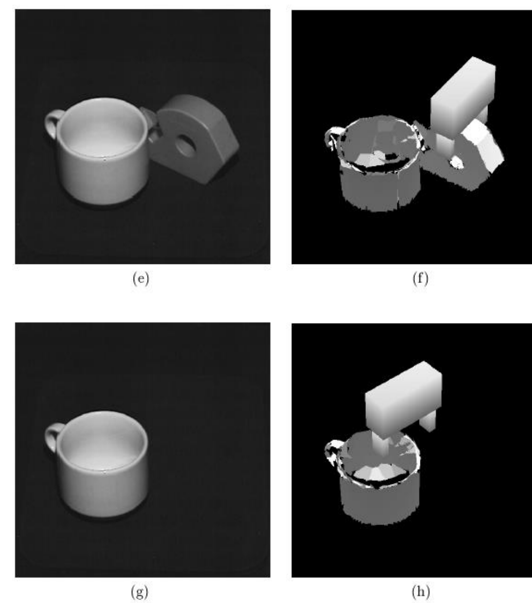
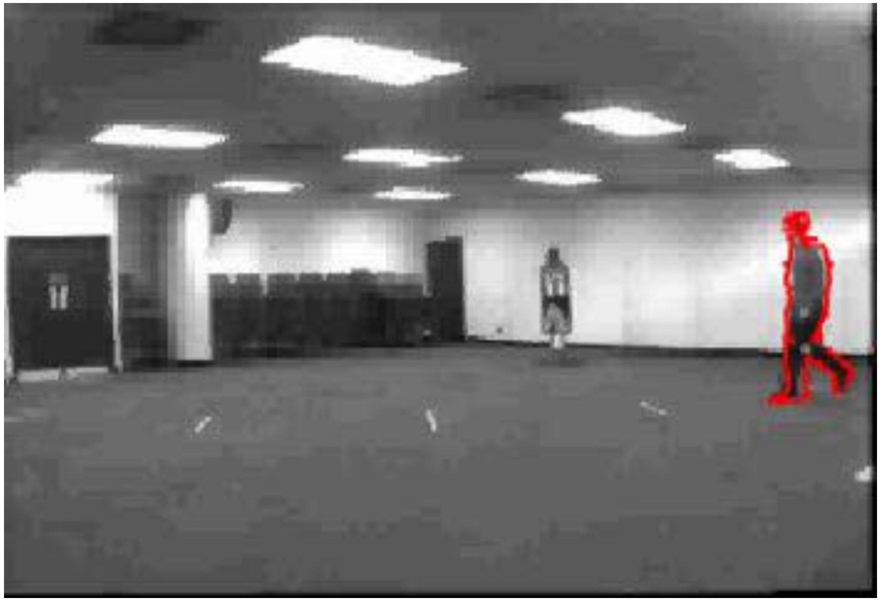


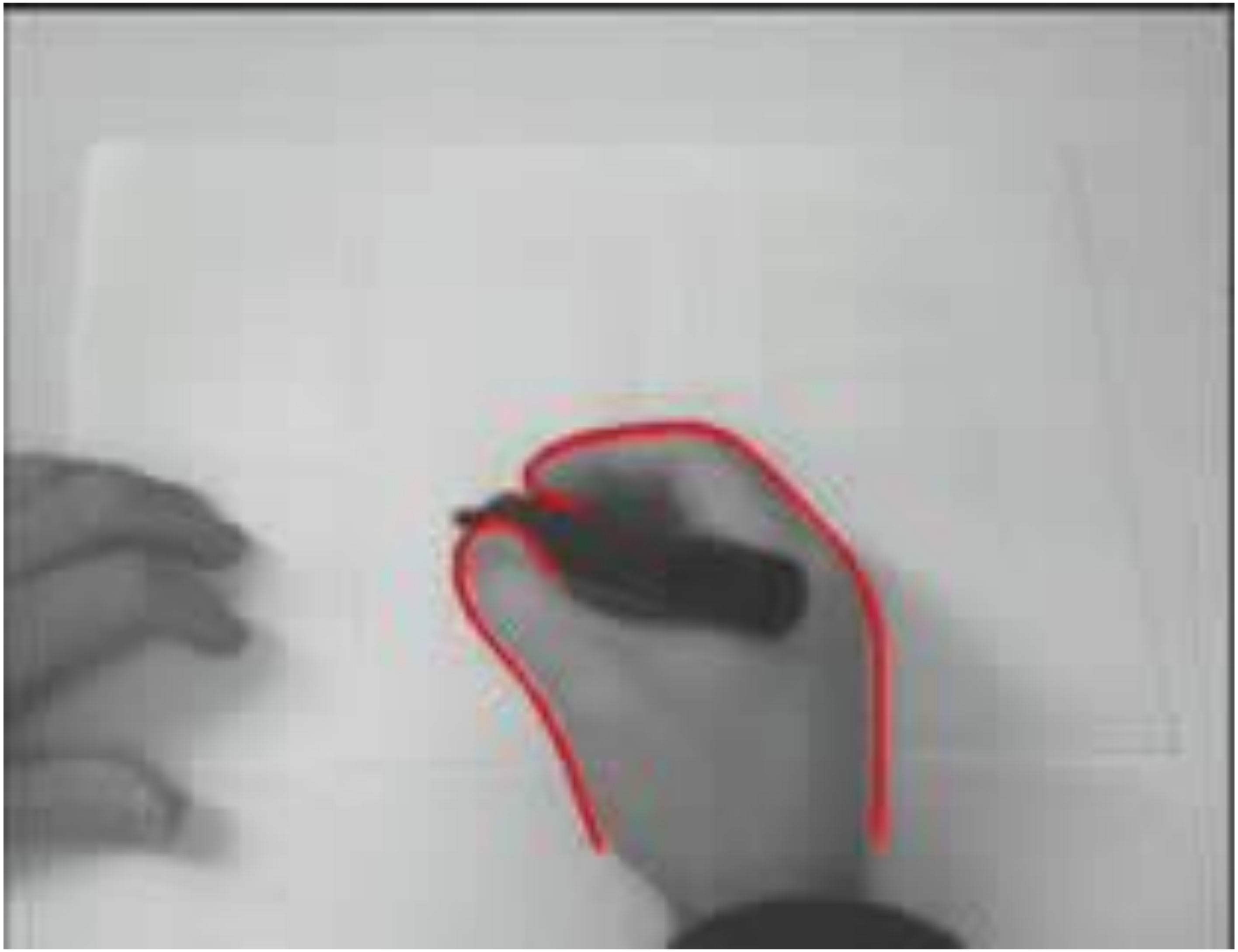
Figure 9: Continuation of the example scene consisting of four objects. (e) and (f) grasping the Scotch tape roller, and (g) and (h) grasping the coffee cup.

Object Tracking

Object Tracking



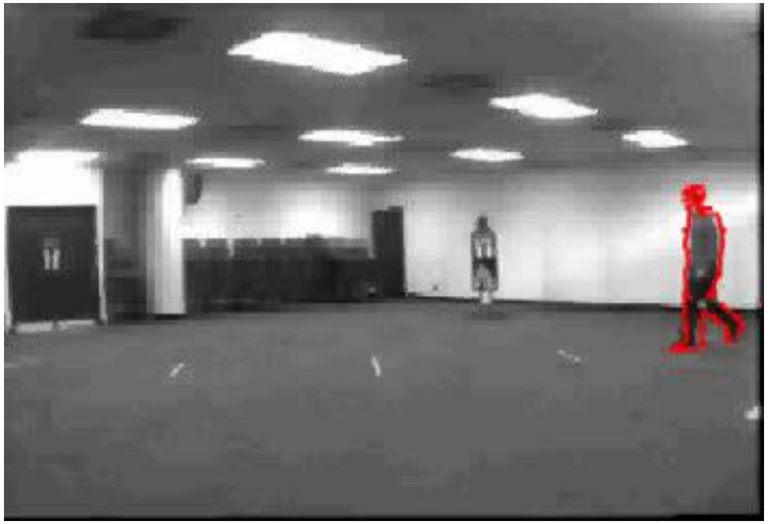
Object Tracking: Using Deformable Models in Vision



Object Tracking: Using Deformable Models in Vision: II

Unifying Boundary and
Region-based information for
Geodesic Active Tracking

Object Tracking III



Spatiotemporal Volumes

Figure 3.3: Visualization of a spatio-temporal volume and a spatio-temporal cut plane. On the left, a 10 second video is presented as a spatio-temporal volume. The front of the volume shows the first frame, the right side shows the right-most vertical line through time, and the top shows the top-most scanline through time. On the right, the volume has been rotated and been cut using two planar cuts. The first, parallel to the front face, has shortened the video. The second has revealed a different scanline which shows the motion of people walking during the duration of the video.

Motion Tails

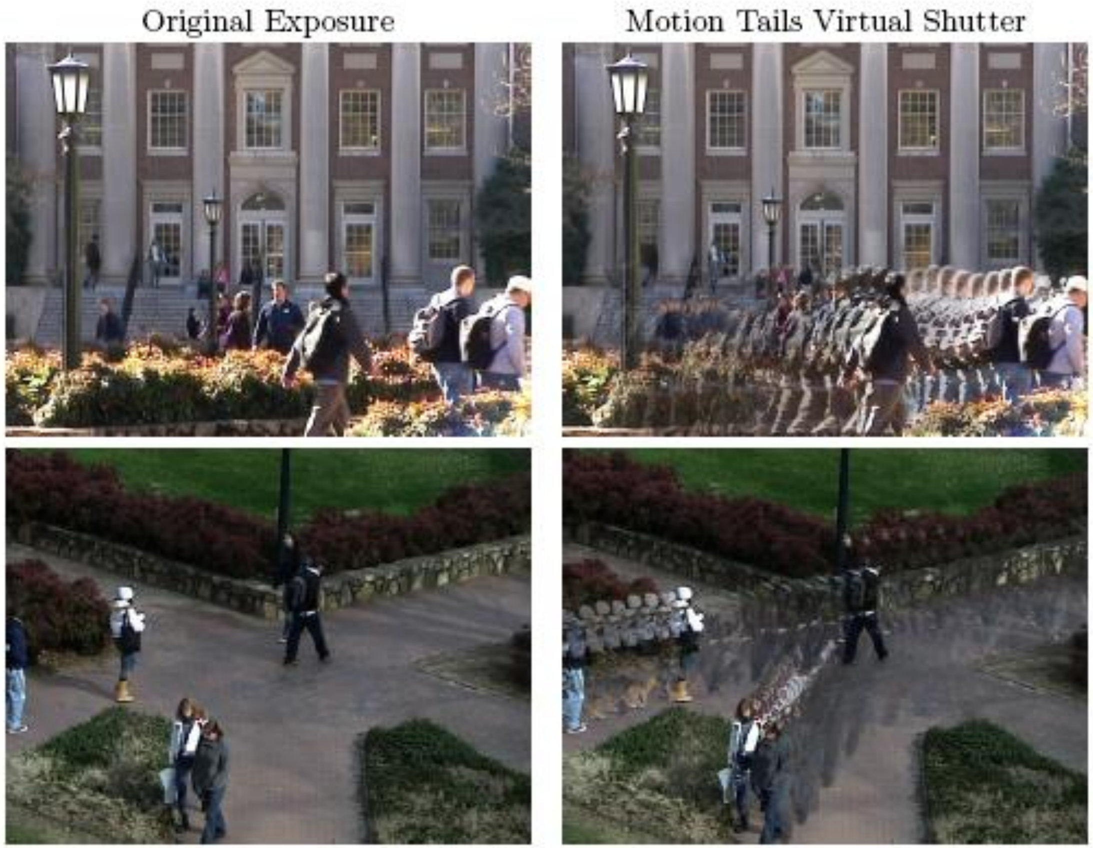
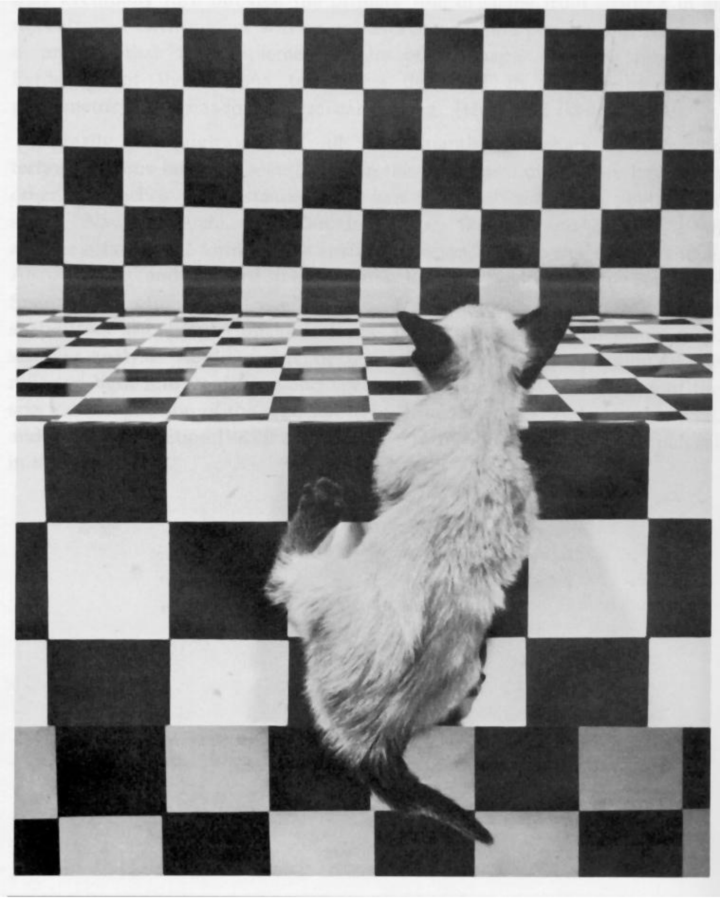


Figure 5.9: Two examples of using motion tails to depict dense motion paths between sampled time-lapse frames. The building front result (above) uses uniform sampling, while the crowded sidewalk (below) is non-uniformly sampled.

3D from Texture

Shape from Texture



Shape from Texture

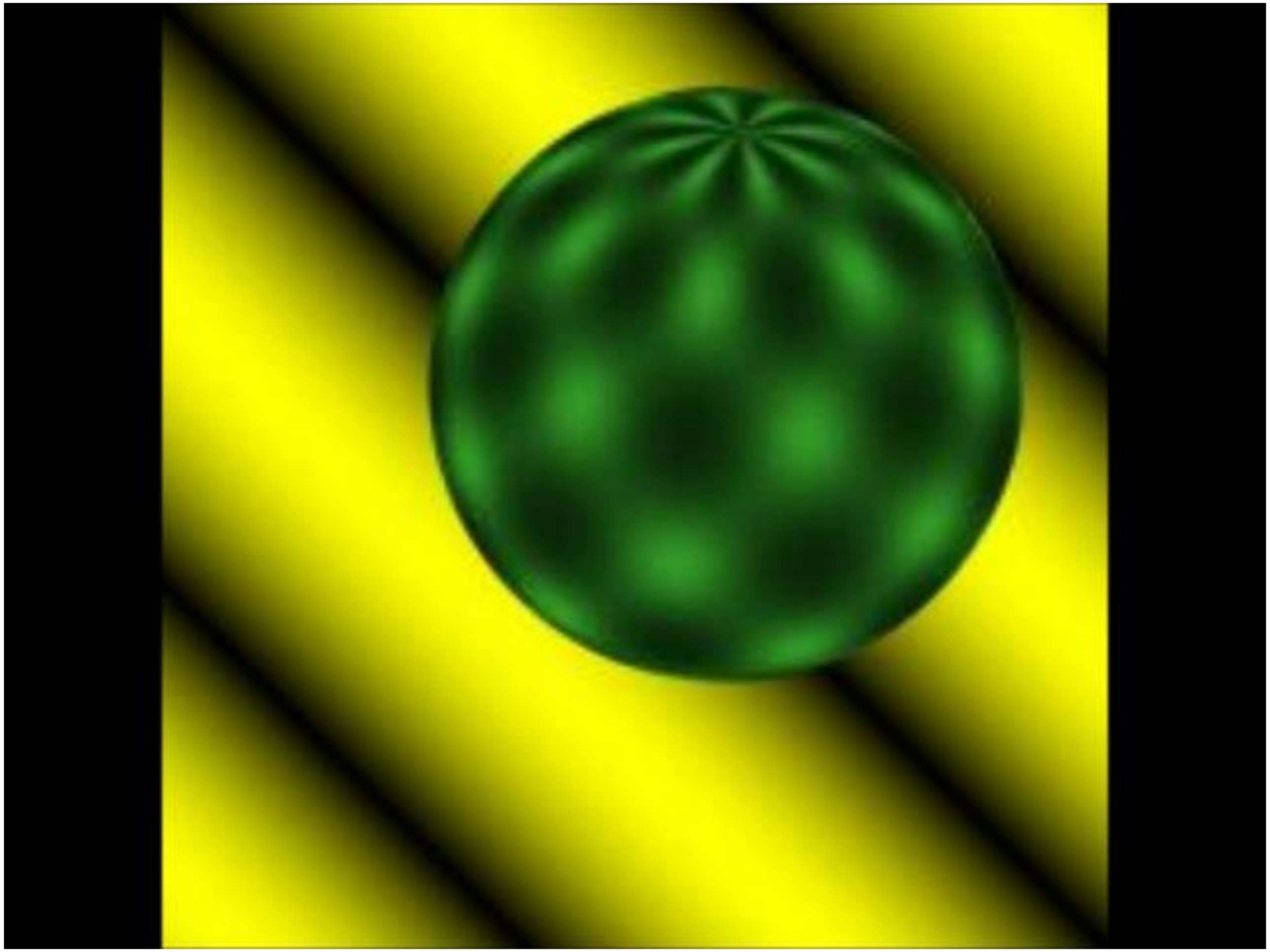
Images from: http://www.betterphoto.com/gallery/dynoGall2.asp?catID=355, and google images

3D from Optical Flow

Optical Flow from dynamic Imaging

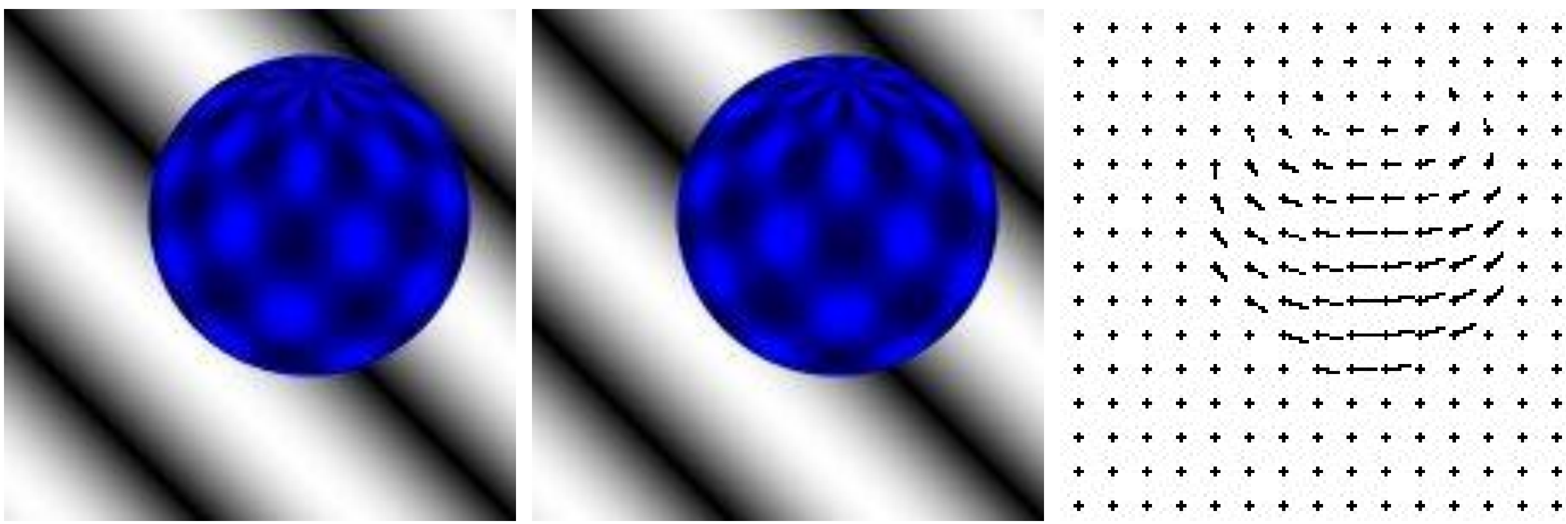
Optical Flow

- Motion of brightness pattern in the image



Optical Flow

- Motion of brightness pattern in the image
- Optical flow = Projection of Motion field into image plane
- Recover 3D motion

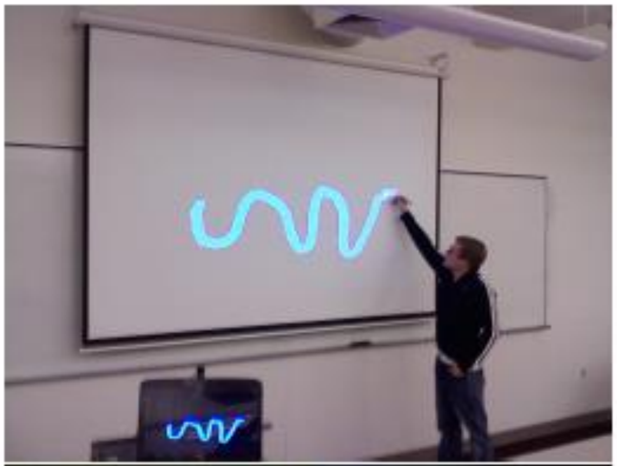


Webcam Based Virtual Whiteboard
Jon Bronson James Fishbaugh

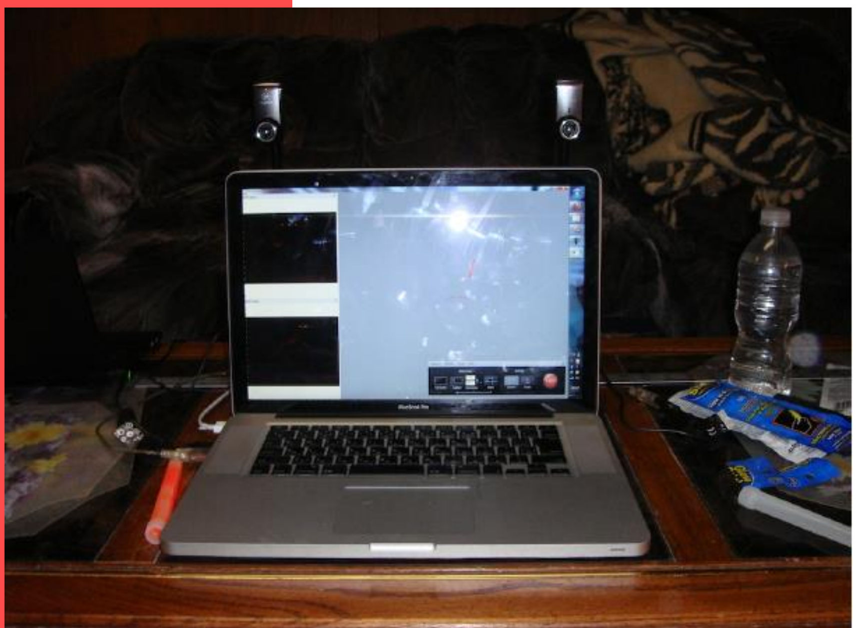
- Blackboards came first
- Whiteboards eventually followed
- Virtual Whiteboards are coming
- Basic Idea:
  - Write on any surface
  - Use no ink/chalk
  - Store all information to disk

Webcam Based Virtual Whiteboard

Jon Bronson James Fishbaugh



Real-Time 3D Glowstick Detection
Computer Vision Project 2009
Andrei Ostanin



Detecting the 3D position of glowsticks in real-time using two cameras.

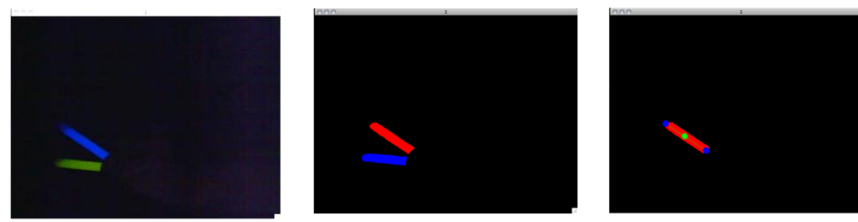
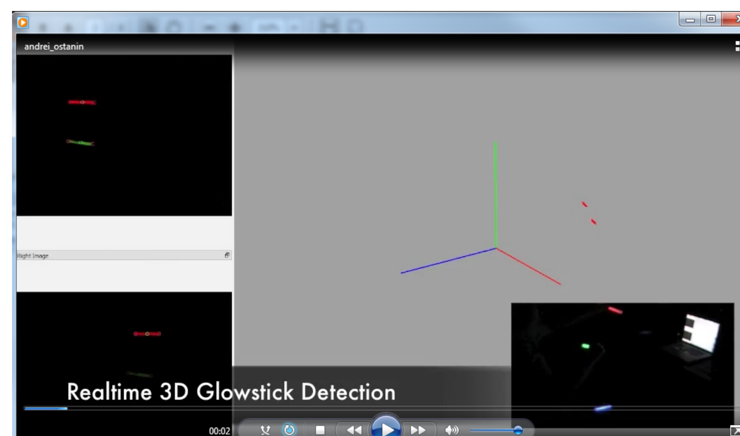
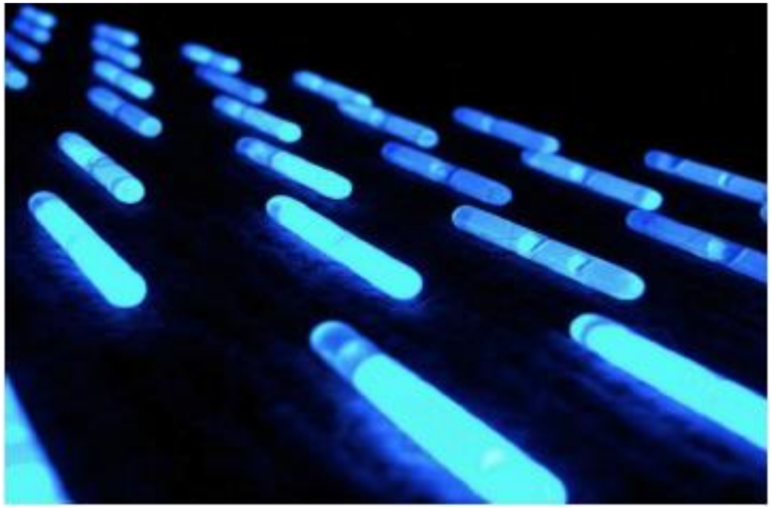


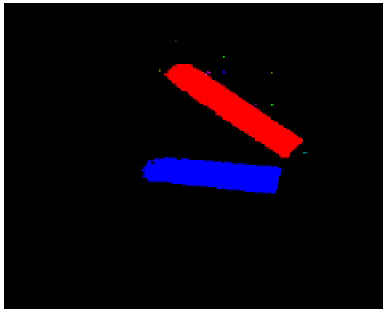
Figure 2: Camera input images.



Realtime Glowstick Detection Andrei Ostanin



- Capture the 3D position of glowsticks in real-time using two webcams
- Environment dark enough that glowsticks are easily segmented out
- Prefer speed over correctness



movie