

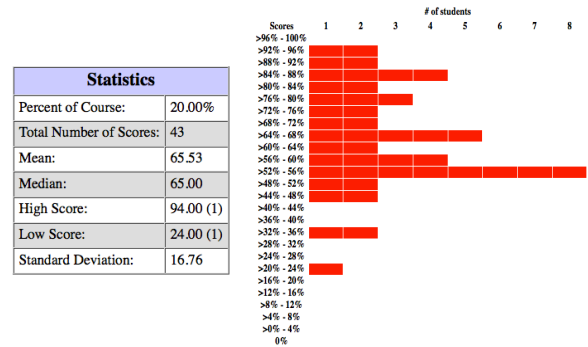
Stereo Vision I

Introduction to Computer Vision
CSE 152
Lecture 13

CSE152, Spring 2011

Intro Computer Vision

Midterm Stats



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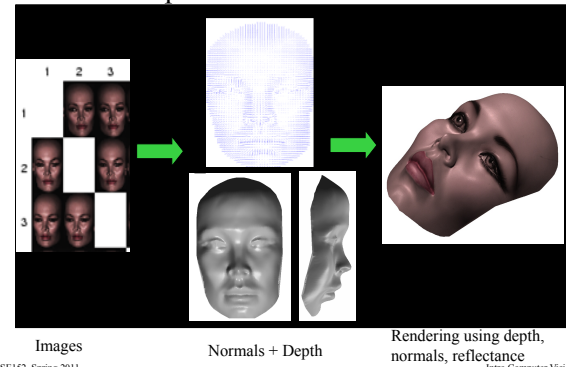
Shape-from-X (i.e., Reconstruction)

- Methods for estimating 3-D shape from image data. X can be one (or more) of many cues.
 - Stereo** (two or more views, known viewpoints)
 - Motion** (moving camera or object)
 - Shading
 - Changing lighting (**Photometric Stereo**)
 - Texture variation
 - Focus/blur
 - Prior knowledge/context
 - structured light/lasers

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Example: Helmholtz Stereo Depth + Normals + BRDF

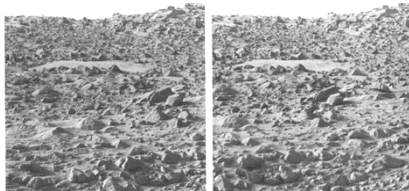


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Binocular Stereopsis: Mars

Given two images of a scene where relative locations of cameras are known, estimate depth of all common scene points.

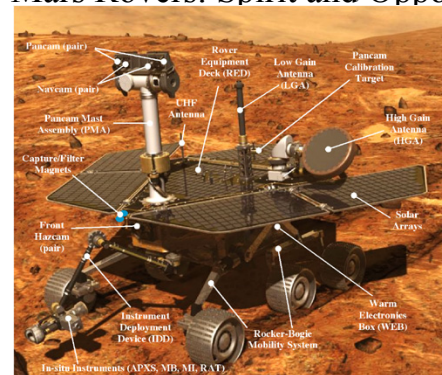


Two images of Mars

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Mars Rovers: Spirit and Opportunity

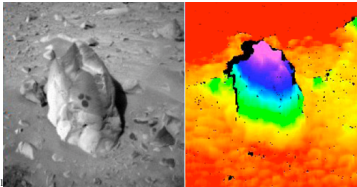
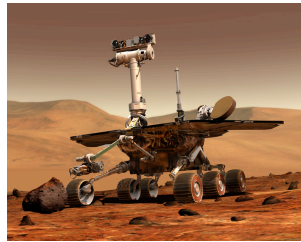


Four pairs of stereo cameras

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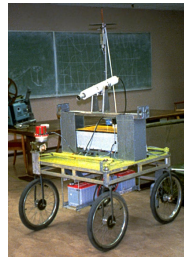
Mars Exploratory Rovers: Spirit and Opportunity



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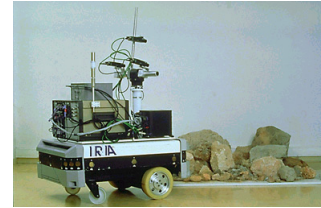
An Application: Mobile Robot Navigation



The Stanford Cart,
H. Moravec, 1979.

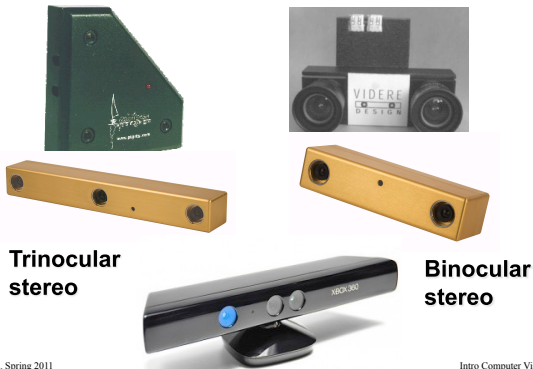
Courtesy O. Faugeras and H. Moravec.
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The INRIA Mobile Robot, 1990.



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Commercial Stereo Heads



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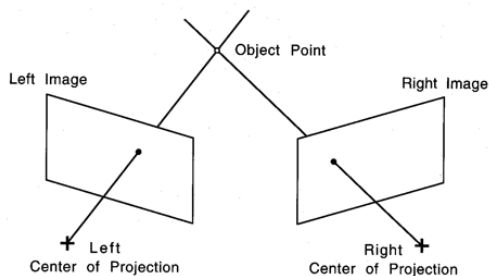
Need for correspondence



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Triangulation



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Stereo Vision Outline

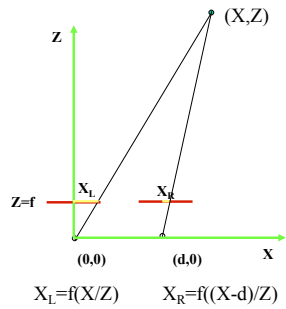
- Offline: Calibrate cameras & determine “epipolar geometry”
- Online
 1. Acquire stereo images
 2. Rectify images to convenient epipolar geometry
 3. Establish correspondence
 4. Estimate depth

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BINOCULAR STEREO SYSTEM

Estimating Depth\
2D world with 1-D image plane



Two measurements: X_L, X_R
Two unknowns: X, Z

Constants:

Baseline: d
Focal length: f

$$X = \frac{d X_L}{(X_L - X_R)}$$

$$Z = \frac{d f}{(X_L - X_R)}$$

Disparity: $(X_L - X_R)$

$$X_L = f(X/Z)$$

$$X_R = f((X-d)/Z)$$

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(Adapted from Hager)

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