281 Live Session

Week 8 — 2023/3/1

Agenda

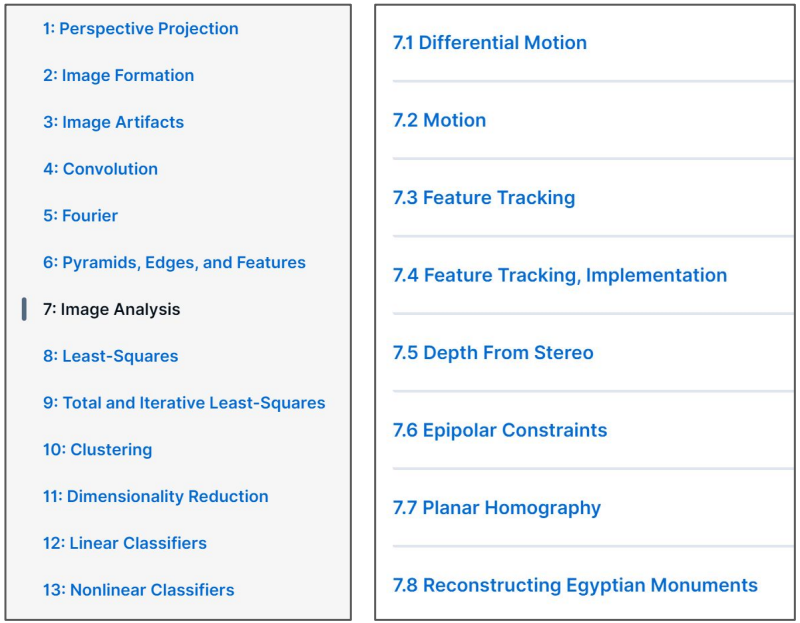
Review Image Analysis

Preview of Assignment 5

Exercise on Feature Tracking

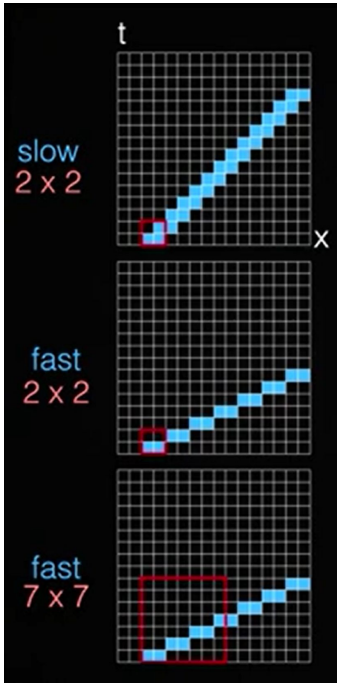
Blobworld paper assignment

Discussion Questions



- List two ways to extract motion vectors from a video
- How are object speed and frame rate related?
- What is the value being plotted in a depth-from-stereo image?
- How do we use epipolar constraints?
- What is unique about the geometry of planar surfaces in images?
- What is a homography transformation matrix?
- What is the free parameter in a homography matrix?

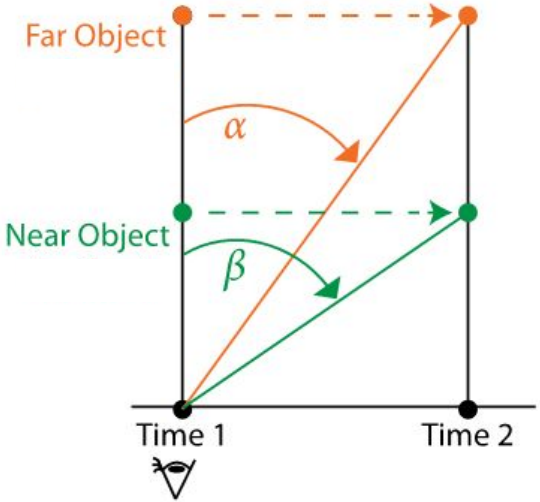
Image Analysis



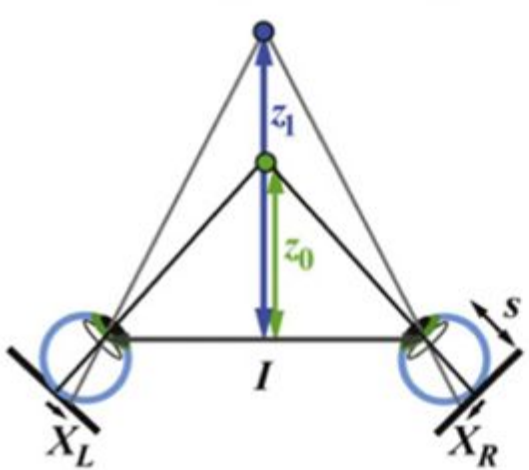
Triangulation Cues

Ambiguity is solved by 2+ observations

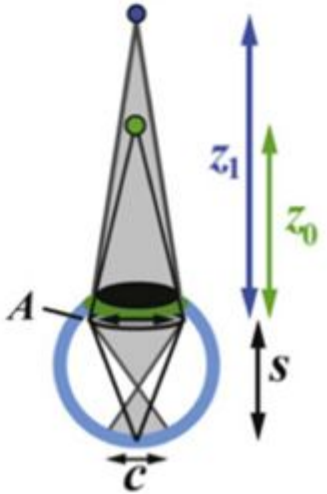
Motion Parallax



Disparity

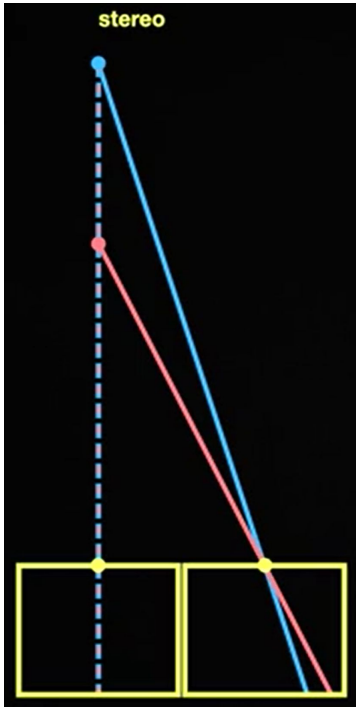


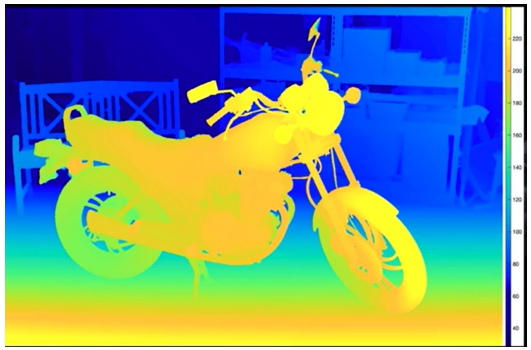
Blur

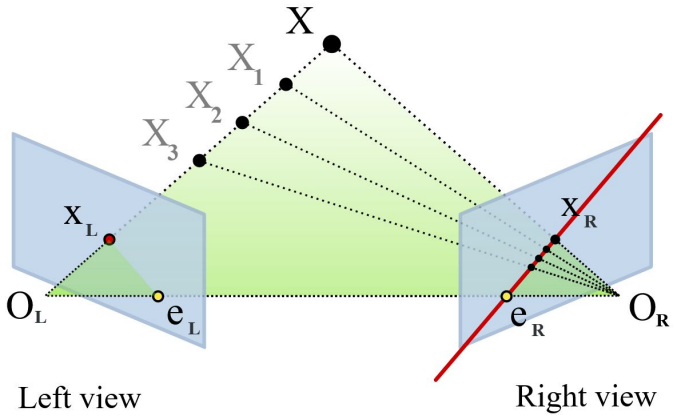


Source: Held, Cooper, & Banks (2012)

Image Analysis Overview







Left view

Right view

Understanding ‘s’

Homogeneous coordinates are ambiguous up to an unknown scale factor

$$\begin{pmatrix} x_s \\ s \end{pmatrix} = \begin{pmatrix} \lambda f & c_x \\ 0 & 1 \end{pmatrix} \begin{pmatrix} \cos(\theta) & -\sin(\theta) & t_X \\ \sin(\theta) & \cos(\theta) & t_Z \end{pmatrix} \begin{pmatrix} X_w \\ Z_w \\ 1 \end{pmatrix}$$

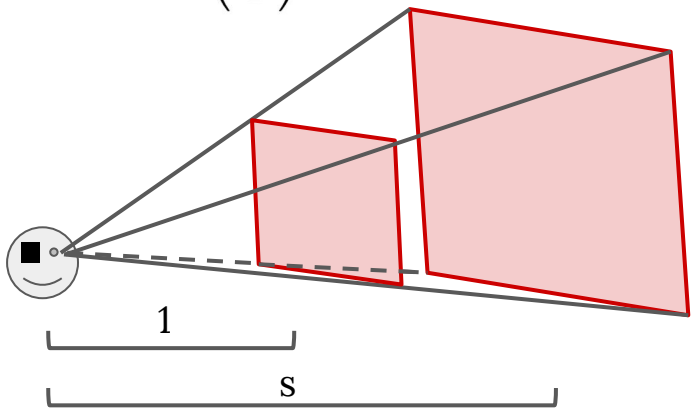


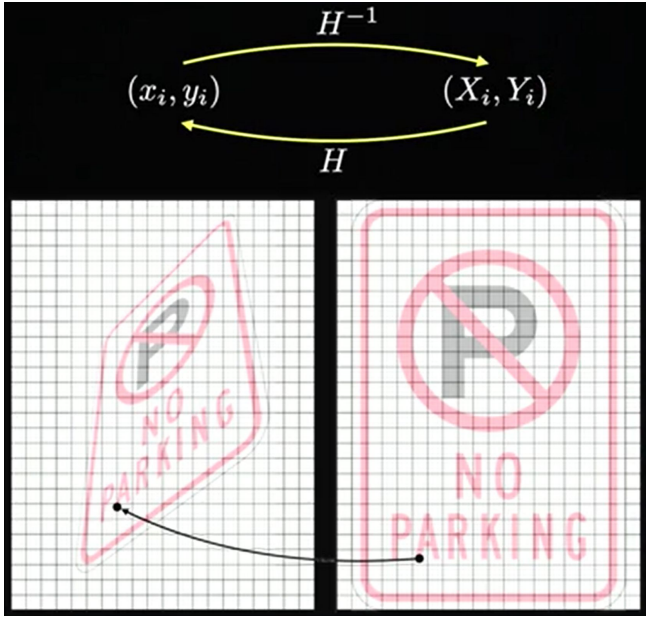
Image Analysis Overview

$$\vec{p} \times H\vec{P} = \vec{0}$$

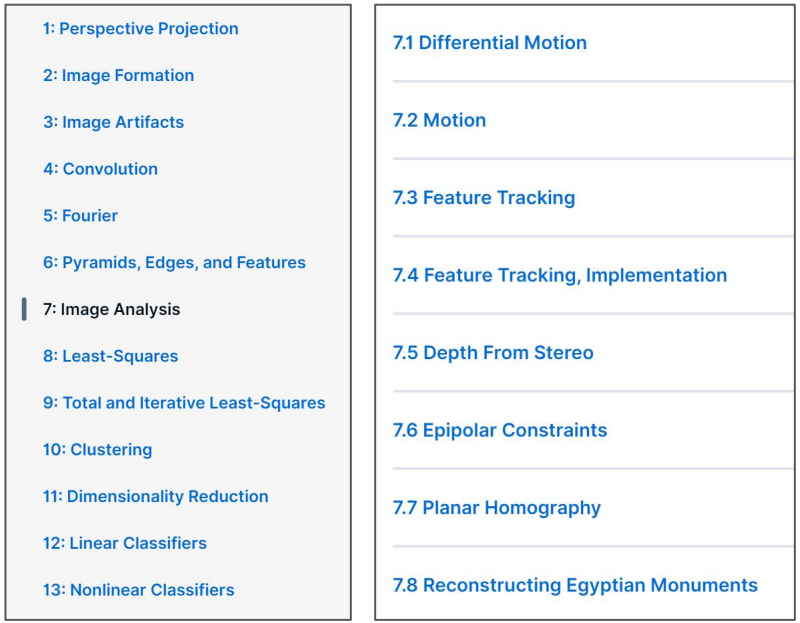
$$\begin{pmatrix} x_s \\ y_s \\ s \end{pmatrix} \times \begin{pmatrix} h_1 & h_2 & h_3 \\ h_4 & h_5 & h_6 \\ h_7 & h_8 & h_9 \end{pmatrix} \begin{pmatrix} X_w \\ Y_w \\ 1 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$

$$\begin{pmatrix} x_s \\ y_s \\ s \end{pmatrix} \times \begin{pmatrix} h_1X_w + h_2Y_w + h_3 \\ h_4X_w + h_5Y_w + h_6 \\ h_7X_w + h_8Y_w + h_9 \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$

$$\begin{pmatrix} y_s(h_7X_w + h_8Y_w + h_9) - s(h_4X_w + h_5Y_w + h_6) \\ s(h_1X_w + h_2Y_w + h_3) - x_s(h_7X_w + h_8Y_w + h_9) \\ x_s(h_4X_w + h_5Y_w + h_6) - y_s(h_1X_w + h_2Y_w + h_3) \end{pmatrix} = \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}$$



Discussion Questions

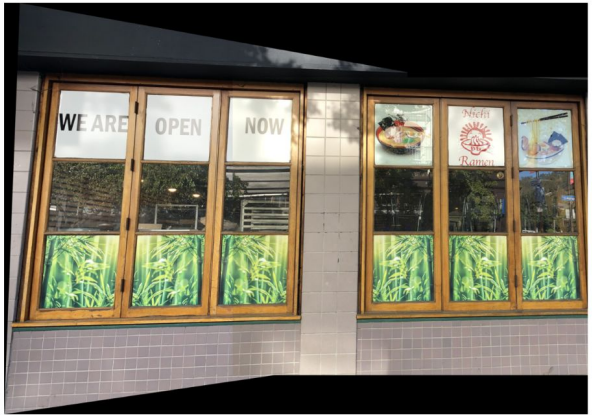


- List two ways to extract motion vectors from a video
- How are object speed and frame rate related?
- What is the value being plotted in a depth-from-stereo image?
- How do we use epipolar constraints?
- What is unique about the geometry of planar surfaces in images?
- What is a homography transformation matrix?
- What is the free parameter in a homography matrix?

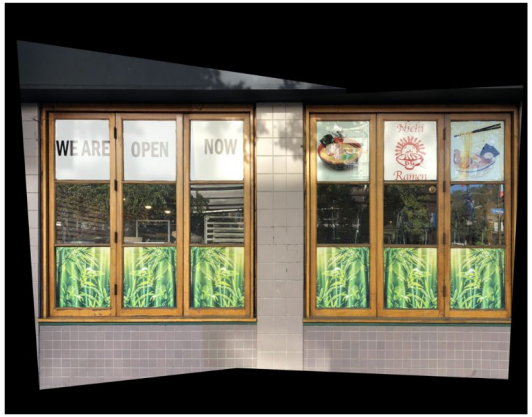
Assignment 5 – Image Stitching

1. estimate homography

2. stitch



3. rectify

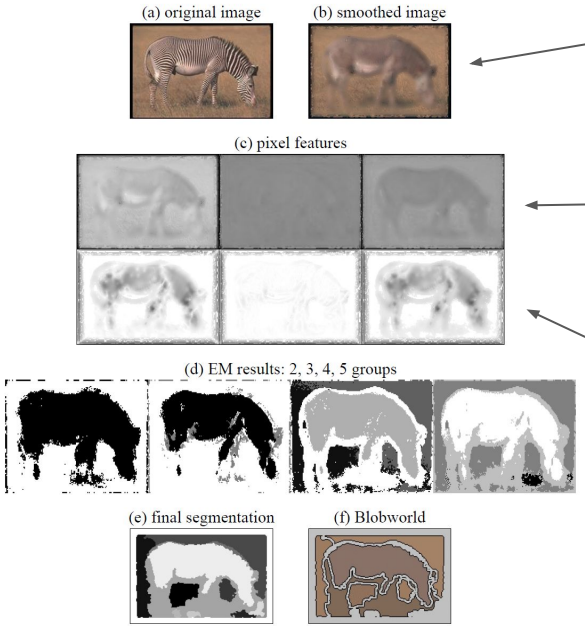


Group Exercise — Feature Extraction

Blobworld Paper

Carson, Chad, Serge Belongie, Hayit Greenspan, and Jitendra Malik. "Blobworld: Image segmentation using expectation-maximization and its application to image querying." *IEEE Transactions on pattern analysis and machine intelligence* 24, no. 8 (2002): 1026-1038.

http://www.cse.psu.edu/~rtc12/CSE586/papers/emCarson99blobworld.pdf



Texture smoothing using *scale selection* preserves only important contours

Top row features:
Luminance, Red-Green, Blue-Yellow

Second row features:
Anisotropy, Polarity, Contrast

Upcoming ToDo's

Final project proposal due March 13th

Assignment 5 due March 14th

Read Blobworld paper for next week

Watch Async lectures for Unit 8