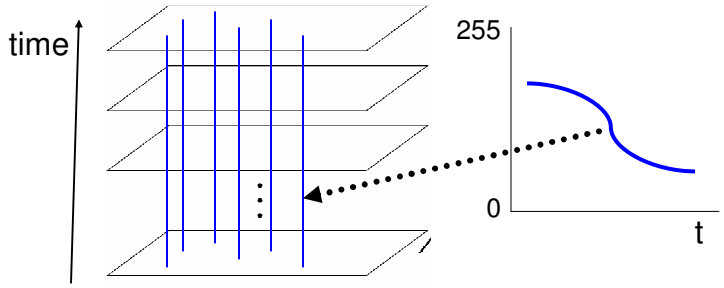
Background Subtraction

15-463: Rendering and Image Processing
Alexei Efros

Image Stack



As can look at video data as a spatio-temporal volume

- If camera is stationary, each line through time corresponds to a single ray in space
- We can look at how each ray behaves
- What are interesting things to ask?

Example

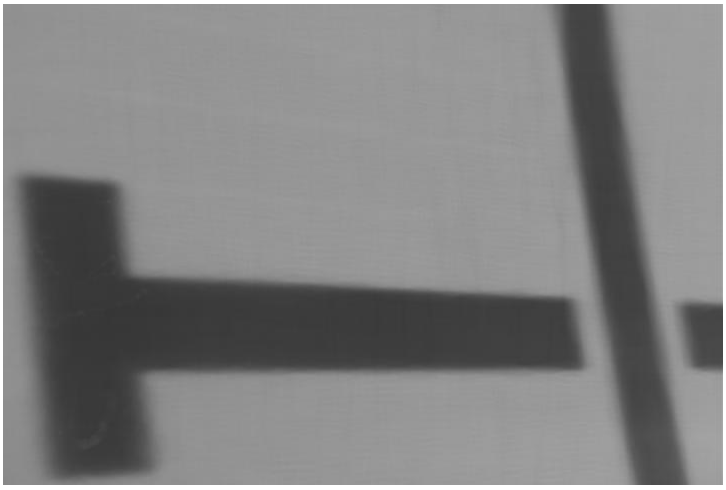
Getting the right pixels

Average image

Median Image

Input Video

Average Image



What is happening?

Average Image

What can we do with this?

Background Subtraction

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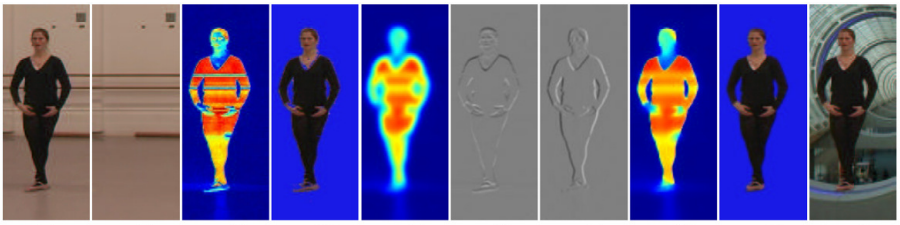
Crowd Synthesis (with Pooja Nath)

1. Do background subtraction in each frame
2. Find and record “blobs”
3. For synthesis, randomly sample the blobs, taking care not to overlap them

Background Subtraction for matting

A very hard problem.

But sometimes it works:



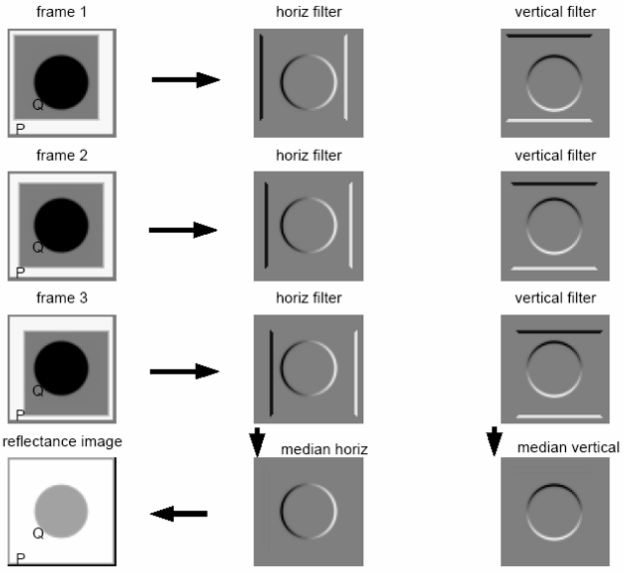
(a) (b) (c) (d) (e) (f) (g) (h) (i) (j)

Figure 1: Background subtraction: (a) input frame, (b) background image, (c) residual image, (d) matting using a threshold on (c), (e) blurring residual with an isotropic Gaussian, (f,g) residual gradient images (x and y) obtained by background subtraction in gradient domain, (h) residual image smoothes with anisotropic diffusion using residual gradients for conduction, (i) matting using improved residual followed by simple alpha estimation, (j) compositing into a novel background.

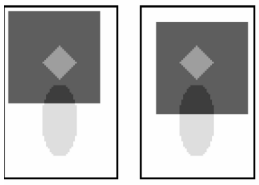
Removing Shadows (Weiss, 2001)

How does one detect (subtract away) shadows?

Averaging Derivatives

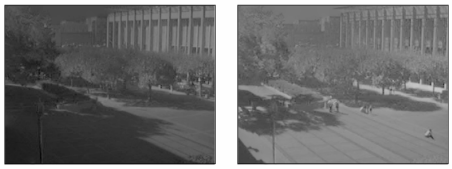


Recovering Shadows



first frame last frame

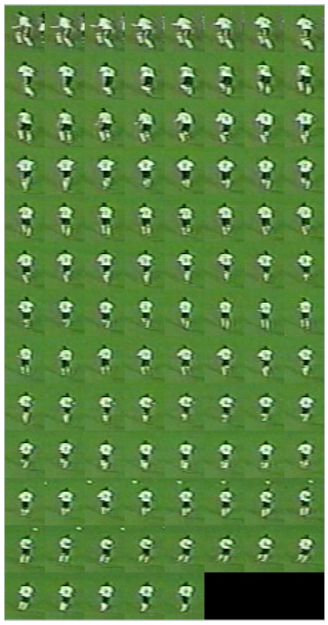
frame 1 frame 11 ML reflectance



ML illumination 1 ML illumination 2

Compositing with Shadows

Figure-centric Representation

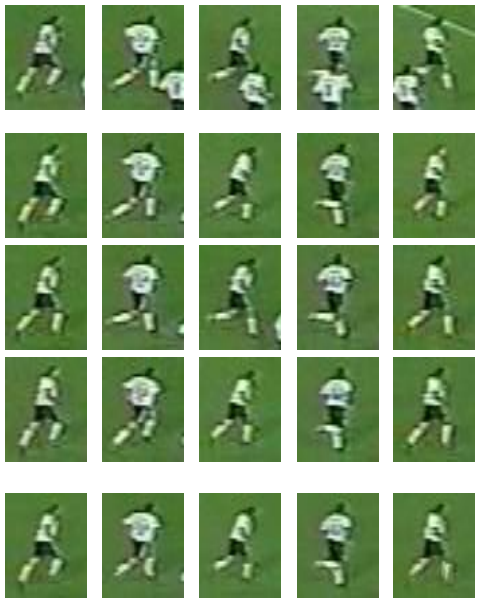


Context-based Image Correction

Input sequence

3 closest frames

median images

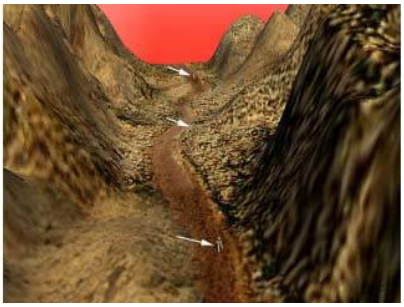


Midterm Stats

of people: 11
Total points possible: 120
Mean: 77.1
Median: 76
Max: 98
Min: 56
Std. Div: 13.2
Skewness: -0.04
Kurtosis: 1.9

The scores: [56 61 68 70 71 76 82 88 89 89 98]

Fun with Focal Length (Jim Sherwood)



http://www.hash.com/users/jsherwood/tutes/focal/Zoomin.mov

Figure 5.1

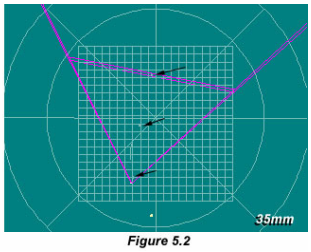


Figure 5.2