Introduction
photograph

perhaps a better photograph
Topics

Introductions
Motivation and Context
Course Mechanics
Minimize: $C(L) = \sum_{p} C_i(p,L(p)) + \sum_{p,q} C_s(p,q,L(p),L(q))$

Image Objective  Seam Objective

**Graph-cut optimization** [Li 04] [Rother 04] [Kwatra 03] [Kolmogorov 02] [Boykov 01]
Why study image manipulation and computational photography?

Depicting Our World: The Beginning

Prehistoric Painting, Lascaux Cave, France
~ 13,000 -- 15,000 B.C.
The Empress Theodora with her court.
Ravenna, St. Vitale 6th c.

Nuns in Procession. French ms. ca. 1300.
Depicting Our World: Renaissance

Paolo Uccello,
*Miracle of the Profaned Host* (c.1467-9)

Depicting Our World: Toward Perfection

Jan van Eyck, *The Arnolfini Marriage* (c.1434)
Depicting Our World: Toward Perfection

Lens Based Camera Obscura, 1568

Depicting Our World: Perfection!

Still Life, Louis Daguerre, 1837
“Still photographs are the most powerful weapon in the world.”

Eddie Adams, Pulitzer Prize winning photographer

Depicting Our World: Ongoing Quest

Pablo Picasso

David Hockney
Enter Computer Graphics...

Traditional Computer Graphics

3D geometry

physics

projection

Simulation
State of the Art (10 years ago)

The richness of our everyday world

Photo by Svetlana Lazebnik
Which parts are hard to model?

People

From “Final Fantasy”

On the Tube, London
Faces / Hair

From "Final Fantasy"

Photo by Joaquin Rosales Gomez

Urban Scenes

Virtual LA (SGI)

Photo of LA
Creating Realistic Imagery

**Computer Graphics**

- + great creative possibilities
- + easy to manipulate objects/viewpoint
- - Tremendous expertise and work for realism

**Image Manipulation & Computational Photography**

- Realism
- Manipulation
- Ease of capture

**Photography**

- + instantly realistic
- + easy to acquire
- - very hard to manipulate objects/viewpoint

River Cherwell, Oxford
Image Manipulation & Computational Photography

How can I use computational techniques to capture light in new ways?

How can I use computational techniques to breathe new life into the photograph?

How can I use computational techniques to synthesize and organize photo collections?

Virtual Real World

Campanile Movie
http://www.debevec.org/Campanile/
PatchMatch: A Randomized Correspondence Algorithm for Structural Image Editing

Connelly Barnes¹, Eli Shechtman²,³, Adam Finkelstein¹, and Dan B Goldman²

¹Princeton University
²Adobe Systems
³University of Washington

Course Mechanics
Course Objectives

1. **Build foundation** in recent image manipulation and computational photography techniques

2. **Learn to** quickly implement and debug algorithms described in papers

3. **Create a toolbox** of algorithms to use in your research

4. **Have fun** developing a cool final project

Course Wiki

http://vis.berkeley.edu/courses/cs294-69-fa11/wiki/
Make an Accounts (Wiki and Piazza)

Use piazza.com (CS294-69) as discussion board for questions about assignments

Class Participation (20%)

Discussion based course

- Do readings before class (2 or 3 papers per lecture)
- Attend lectures and actively discuss readings (no laptops, iPhones …)

Paper Presenter

- Must present paper(s) at least once this semester
- Responsible for explaining the work in some detail, answer basic questions that might come up, raise interesting issues for discussion

Paper Discussant

- Must serve as official discussant once or twice
- Responsible for helping presenter raise interesting issues or questions and answer basic questions

You will be asked to sign up for both responsibilities via email

Look over schedule to decide when to signup (earlier weeks a little easier)
Short Programming Assignments (30%)

Implement algorithms described in recent papers

• Build toolbox
• Learn to quickly implement and debug core idea
• Must demonstrate results generated by your code. Does not need to be polished or fast (unless speed is core idea of algorithm)
• Don’t care about language you use
• You must implement core algorithms from scratch. May use libraries/APIs for non-core functionality as long as you document what you used

• MATLAB is recommended (required for Assignment 0)
  Will hold special MATLAB tutorial session next Tue Sep 6

Assignment 0: Hybrid Images

Goal: Learn MATLAB by implementing Hybrid Images [Oliva 05]

Due: Mon Sep 12th by 5pm

Note: Must be done individually
Assignments 1, 2 & 3

We will mark papers on wiki that you can implement for the assignment.

Groups of 2 and 3 must implement more
if working in group talk to us about what you plan to implement.

Final Project (50%) : Up to You

Do something cool!
Should be something new (not published previously)
Can extend assignments.

Photomontage was initially developed as a class project at UW in 2003.
Cameras

Really cool
Not too expensive nowadays (<$150)

e.g. Canon A1100