15-463 (15-862): Computational Photography

Staff

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Web Page

• http://graphics.cs.cmu.edu/courses/15-463/

Newsgroup:

• cmu.cs.class.cs463
Today

Introduction
Overview of the course
Administrative stuff
A bit about me

Alexei (Alyosha) Efros
Relatively New faculty (RI/CSD)
   Ph.D 2003, from UC Berkeley *(signed by Arnie!)*
   Research Fellow, University of Oxford, ’03-’04

Teaching
   My second time… still learning
   The plan is to have fun and learn cool things, both you and me!
   Social warning: I don’t see well

Research
   Graphics, Vision, Machine Learning
PhD Thesis on Texture and Action Synthesis

_Smart Erase_ button in _MS Digital Image Pro_:

Antonio’s son cannot walk but he can fly😊
Some hot-off-the-press stuff

Automatic Photo Pop-up: The World Behind the Image
Computational Photography

The Story So Far…

(brief overview of prior work)
Depicting Our World

Prehistoric Painting, Lascaux Cave, France
Depicting Our World: The Middle Ages

St. John from the Gospel Book of Abbot Wedricus (1147)

Cimabue Madonna Enthroned (c.1280-1290)
Depicting Our World: Renaissance

North Doors (1424)
Lorenzo Ghiberti (1378-1455)

East Doors (1452)
Depicting Our World: Renaissance

*Piero della Francesca, The Flagellation (c.1469)*
Depicting Our World: Toward Perfection

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

Fig. 434

Lens Based Camera Obscura, 1568
Depicting Our World: Perfection!

Still Life, Louis Jaques Mande Daguerre, 1837
Depicting Our World: Perfection?
Depicting Our World: Ongoing Quest

Pablo Picasso

Marc Chagall
Depicting Our World: Ongoing Quest

David Hockney, 1985

Enter Computer Graphics...
Traditional Computer Graphics

3D geometry

physics

Simulation

GRAPHICS

projection
State of the Art

• Amazingly real
• But so sterile, lifeless, _futuristic_ (why?)
The richness of our everyday world
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
Nature

River Cherwell, Oxford
In search of realism…

Graphics is easy:
- We know how to represent geometry (polygonal meshes, splines, subdivision surfaces, CSG, etc.)
- Physics of light transport worked out (ray tracing, radiosity, Monte Carlo techniques, etc.)
- Good progress in participating media (e.g. subsurface scattering)
- Learned it all in 15-462!

Graphics is still hard:
- We want to model our world (visual realism!)
- How do we create enough geometry?
- How do we find reflectance properties for all materials?
- Is it feasible? It is even needed? (human perception)
- Can we use texture maps?
- Where do we get all this DATA?

Capture it from the real world – Computational Photography!
Virtual World vs. the Real World

Traditional Graphics: we played in our little sandbox

Comp. Photography: Now we are ready to embrace the world!
Virtual Real World

Campanile Movie

http://www.debevec.org/Campanile/
Programming Project 1

Images of the Russian Empire -- colorizing the Prokudin-Gorskii photo collection
Programming Project 2

Photo Mosaics

Full screen panoramas (cubic):  http://www.panoramas.dk/
Programming Project 3

Automatic Mosaic Stitching
Programming Project 4
Face warping and morphing
Programming Project 5

Fun with Image Stacks
Programming Project 6

Tour Into the Picture
Final Project

Something cool!!!
Administrative Stuff

Grading
- Programming Projects (60%)
- Midterm + Quizzes (20%)
- Final Project (20%)

Late Policy
- Five late days total, to be spent wisely

Cheating
- Let’s not embarrass ourselves

Hardware/Software
- Graphics cluster, Wean 5336 (should have card access and login by now)
- MATLAB!!!
General Comments

Prerequisites

- Linear algebra
- Some computer graphics or vision (or talk to me)

Emphasis on programming projects!

- Building something from scratch (Matlab!)
Cameras

Really cool
Not too expensive nowadays (<$250)

Canon A520