Staff

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Today

Introduction
Administrative Stuff
Overview of the Course
About Me

• Li Zhang (张力)
  – Last name pronounced as Jung
  – www.cs.wisc.edu/~lizhang

• Research
  – Computer Vision
  – Computer Graphics

• Teaching
  – CS766 Computer Vision
  – CS559 Computer Graphics
Previous Research Focus

- 3D shape reconstruction
Previous Research Focus

• 3D shape reconstruction

Four examples of recovered 3D shapes of a moving face from six video streams
Previous Research Focus

• 3D shape reconstruction
• Application

Entertainment: Games & Movies

Medical Practice: Prosthetics
Previous Research Focus

• 3D shape reconstruction
• Application

Biology: genotype ⇔ phenotype
Please tell me about you

Who you are?
Why you are taking this class?
What do you want to learn?

<table>
<thead>
<tr>
<th>Name</th>
<th>Honors Type</th>
<th>Audit</th>
<th>Program</th>
<th>Current Level</th>
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Prerequisites

- Prerequisites—*these are essential*
  - Data structures
  - A good working knowledge of C++/Java programming
    - (or willingness/time to pick it up quickly!)
  - Linear algebra
  - Vector calculus

- Course does *not* assume prior imaging experience
  - no image processing, graphics, etc.
Administrative Stuff

• 1 written assignment
  – 5% (this week)

• 3 programming projects
  – 15%, 2-3 weeks each

• Paper presentation
  – 15%, over a month

• 1 final project
  – 35%, 5 weeks, open ended of your choice, but needs
    – project proposal after 1 week
    – progress report after 3 weeks
    – Final presentation after 5 weeks
Administrative Stuff

• **Computer account:**
  – Everyone registered in this class will get a Computer Systems Lab account to do project assignments.

• **Email list:**
  – compsci766-1-f08@lists.wisc.edu
Questions?
Every picture tells a story

Goal of computer vision is to write computer programs that can interpret images
Can computer match human perception?

- Yes and no (but mostly no!)
  - computers can be better at “easy” things
Can computer match human perception?

- Yes and no (but mostly no!)
  - computers can be better at “easy” things
  - humans are much better at “hard” things
Computer Vision vs Human Vision

• Can do amazing things like:
  • Recognize people and objects
  • Navigate through obstacles
  • Understand mood in the scene
  • Imagine stories

• But still is not perfect:
  • Suffers from Illusions
  • Ignores many details
  • Doesn’t care about accuracy of world
Computer vision vs Human Vision

What we see

What a computer sees

Srinivasa Narasimhan’s slide
Components of a computer vision system

- Camera
- Lighting
- Scene
- Scene Interpretation
- Computer

Srinivasa Narasimhan’s slide
Topics Covered
Cameras and their optics

Today’s Digital Cameras

The Camera Obscura

Srinivasa Narasimhan’s slide
Biological vision

Human Eye

Mosquito Eye
A tiny camera

PHOTO: FRAUNHOFER INSTITUTE FOR BIOMEDICAL ENGINEERING
A tiny camera

PHOTO: FRAUNHOFER INSTITUTE FOR BIOMEDICAL ENGINEERING
Project 1: High Dynamic Range Imaging

- Cameras have limited dynamic range

Short Exposure

Desired Image

Long Exposure

Shree Nayar’s slide
Project 1: High Dynamic Range Imaging

Low Dynamic Range Exposures

Combination Yields High Dynamic Range
Image Processing

Fourier Transform
Sampling, Convolution

Image enhancement
Feature detection

Srinivasa Narasimhan's slide
Camera Projection
Image Transformation

Steve Seitz and Chuck Dyer, View Morphing, SIGGRAPH 1996
Project 2: Panoramic Imaging

Input images:

Output Image:
Projective Geometry
Single View Metrology

• http://research.microsoft.com/vision/cambridge/3d/default.htm
Single View Metrology

- http://research.microsoft.com/vision/cambridge/3d/default.htm
Shading and Photometric Stereo

http://www.eecs.harvard.edu/~zickler/helmholtz.html
Project 3: photometric stereo
Texture Modeling

repeated

radishes rocks yogurt

“Semi-stochastic” structures

stochastic

Alexei Efros’ slide
Texture Synthesis

Texture Synthesis

Input images:

Output Image:

Multi-view Geometry

- Binocular Stereo (2 classes)
- Multiview Stereo (1 class)
- Structure from Motion (2 classes)

http://phototour.cs.washington.edu/
Applications

- [http://photosynth.net/default.aspx](http://photosynth.net/default.aspx)
Face Detection and Recognition
Motion Estimation

Hidden Dragon Crouching Tiger
Motion Estimation

Application

Andy Serkis, Gollum, Lord of the Rings
Segmentation

http://www.eecs.berkeley.edu/Research/Projects/CS/vision/bsds/
Segmentation

Application

Medical Image Processing
Matting

Input  Matting  Composition
Light, Color, and Reflection
Capturing Light Field

Camera Arrays, Graphics Lab, Stanford University
Capturing Light Field

Applications: synthetic aperture imaging

Camera Arrays, Graphics Lab, Stanford University
Structured Light and Ranging Scanning

http://graphics.stanford.edu/projects/mich/
Structured Light and Ranging Scanning

http://graphics.stanford.edu/projects/mich/
Structured Light and Ranging Scanning

http://graphics.stanford.edu/projects/mich/
Novel Cameras and Displays

Assignment 0, Imagination

• Due next Tuesday
• Give FIVE interesting things that you may wish to do with images
  – Better Image Capture
  – Making use of images
  – Design imaging systems
Course Info

http://www.cs.wisc.edu/~cs766-1/