Computational Photography

End of Semester

- Today is the last lecture of new material
- Quiz on Friday 4/30
  - Sample problems are posted on website
- Final Project Presentations
  Wednesday May 12 1-5pm, CII 4040
  - Attendance mandatory (please don’t be late!)
  - No laptops allowed during your classmates’ presentations
  - You will be giving each other written feedback & peer grade
  - Ask good questions (participation grade)
- Presentation 10pts (peers)
- Project Report 20pts (instructor)

Final Presentation

- Summarize prior work as necessary
  - You don’t need to discuss papers we covered in class
- Be technical:
  - What were the challenges?
  - How did you solve them?
- Live demo / video / lots of images (depends on project)
  - Use examples (both of success & failure)
- Teams of 2:
  - All should present & make it clear who did what
- Practice! & time yourself!
  - We have a tight schedule
  - I will stop you midsentence if you run over

Final Presentation Schedule: Wed May 12th

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<tr>
<th>Time</th>
<th>Name 1</th>
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<tbody>
<tr>
<td>1:00</td>
<td>eddie</td>
<td>2:15 bill</td>
<td>3:40 roy &amp; ben</td>
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<td>1:10</td>
<td>jeremy &amp; mark</td>
<td>2:25 sloan &amp;</td>
<td>3:55 stephen</td>
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<td>1:25</td>
<td>jeff h.</td>
<td>2:40 chris</td>
<td>4:05 matt n. &amp;</td>
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<td>1:35</td>
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<td>4:20 matt t.</td>
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<td>josh</td>
<td>3:05 ryan</td>
<td>4:30 rob &amp; byron</td>
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<td>devon &amp; derek</td>
<td>3:15 lincoln &amp;</td>
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Total time (including setup & questions):
- 10 min (individual), 15 min (team of 2)

Last Time?

- Texture Synthesis
- Markov Model
- Image Completion
- Volumetric Texture Synthesis

“I spent an interesting evening recently with a grain of salt.”

Today

- Structure From Motion
- Multi-viewpoint Rendering
- Matting & Compositing
- Helmholtz Reciprocity
- Light Fields
Structure From Motion

• Input: Sequence of frames (e.g., video) of a moving object (or moving camera)
• Output: Approximate geometry of object & camera pose for each frame
• How?
  – Automatically detect features in each frame
  – Determine correspondences between features
  – Infer camera calibration & object geometry
• Humans do it all the time… but it’s a hard problem!

Photo Tourism

Finding Paths through the World's Photos,
Snavely, Garg, Seitz, & Szeliski, SIGGRAPH 2008
Photo tourism: Exploring photo collections in 3D,
Snavely, Seitz, & Szeliski, SIGGRAPH 2006

Today

• Structure From Motion
• Multi-viewpoint Rendering
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• Helmholtz Reciprocity
• Light Fields

Reading for Today:

“Photographing long scenes with multi-viewpoint panoramas”, Agarwala, Agrawala, Cohen, Salesin, & Szeliski, SIGGRAPH 2006

Multi-Viewpoint Panoramas

• Like many non-photorealistic rendering methods, this paper aims to mimic the style of a particular artist or style of art
• Well designed user interface:
  – Most components automated
  – User can adjust dominant plane, view selection, seams, & inpainting

Portrait of Dora Maar
Pablo Picasso

Portrait of a Woman
Pablo Picasso
Multi-Perspective Rendering

J. Yu & L. McMillan
“A Framework for Multiperspective Rendering”
Eurographics Symposium on Rendering 2004

Opening Scene from Disney’s Pinocchio

Photo Montage

• David Hockney

http://www.hockneypictures.com/photos/photos_collages_05_large.php

Questions?

Zac Bubnick  http://www.princetonol.com/groups/aid/lessons/high/cubismphoto.htm

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• Light Fields

Reading for Today:

“Environment Matting and Compositing”
Zongker, Werner, Curless, & Salesin, SIGGRAPH 1999
Today

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- Light Fields

Helmholtz Reciprocity

- BRDF is symmetric: % of light reflected from direction $i$ off surface point $p$ to direction $j$ is the same as the % of light reflected from direction $j$ off surface point $p$ to direction $i$

![Helmholtz Reciprocity diagram]

Light Fields

Plenoptic Modeling: An Image-Based Rendering System, McMillan & Bishop, SIGGRAPH 1995

Dynamically reparameterized light fields, Isaksen, McMillan, & Goertler, SIGGRAPH 2000

Light Field Rendering, Levoy & Hanrahan, SIGGRAPH 1996

Light Field Camera

- After taking the photograph, we can:
  - Adjust focus
  - Change viewpoint
  - Change illumination
  - & more?

![Light Field Camera diagram]

“Dual Photography”, Sen, Chen, Garg, Marschner, Horowitz, Levoy, & Lensch, SIGGRAPH 2005

Light Field Photography with a Hand-Held Plenoptic Camera, Ng, Levoy, Bredif, Duval, Horowitz, & Hanrahan, Stanford Tech Report, 2005
Questions?