Computational Photography

End of Semester

- Today is the last lecture of new material
- Quiz on Friday 4/29
  - Sample problems are posted on website
- Final Project Presentations
  Tues May 3rd, Fri May 6th, Tues May 10th
  - 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:
  - Both 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

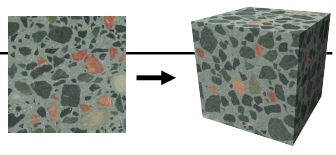
Final Presentation Schedule

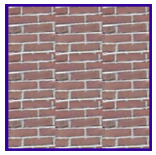
Tues May 3rd	*Fri May 6th*	*Tues May 10th*
2:00 Evan & Jay	2:00 Griff & Eric	2:00 Mike A. & Florian
2:25 Mike S.	2:25 Greg	2:25 James D.
2:40 Lore & Mary	2:40 Ram & Pat	2:40 Mark & Justin
3:05 David	3:05 Jason	3:05 James Z.
3:20 Zach & Geoff	3:20 Andrew & Sylvia	3:20 Tim & Mel
3:45 done!	3:45 done!	3:45 done!

Total time (including setup & questions):
15 min (individual), 25 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."

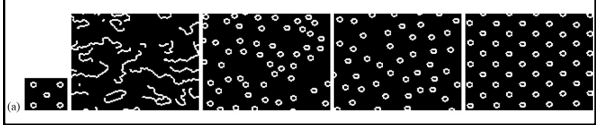


Image-Based Modeling and Photo Editing

Oh, Chen, Dorsey, & Durand, SIGGRAPH 2001

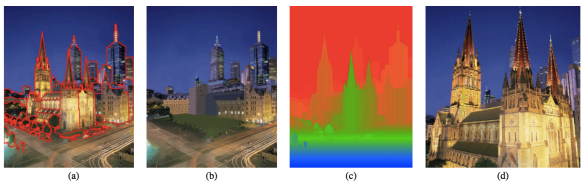


Figure 1: St Paul's Cathedral in Melbourne. (a) Image segmented into layers (boundaries in red). (b) Hidden parts manually clone brushed by the user. (c) False-color rendering of the depth of each pixel. (d) New viewpoint and relighting of the roof and towers.

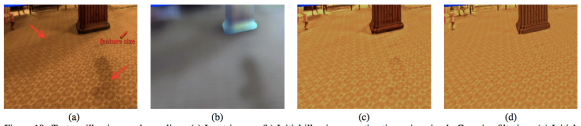


Figure 10: Texture-illuminance decoupling. (a) Input image. (b) Initial illuminance estimation using simple Gaussian filtering. (c) Initial texture estimation, note the artifacts corresponding to shadow boundaries. (d) Texture computed using bilateral filtering.

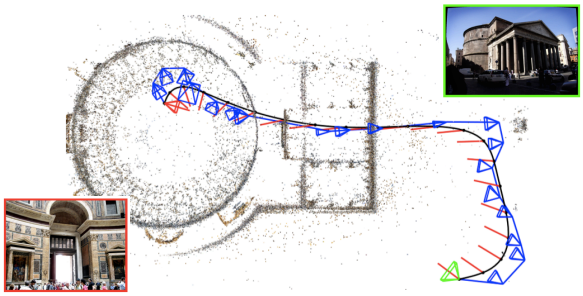
Today

- 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

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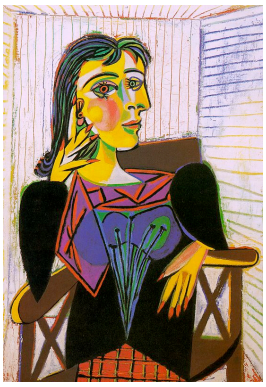
Multi-Viewpoint Panoramas

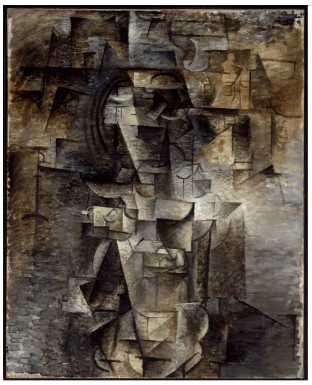
"Photographing long scenes with multi-viewpoint panoramas", Agarwala, Agrawala, Cohen, Salesin, & Szeliski, SIGGRAPH 2006

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

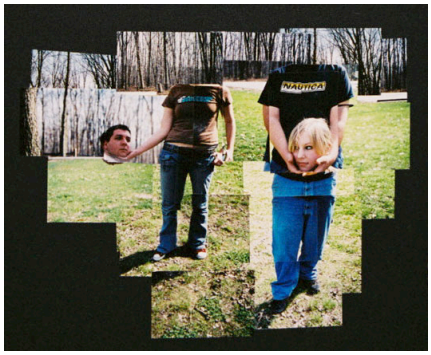
Opening Scene from Disney's Pinocchio

Photo Montage

- David Hockney

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

Questions?



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

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"Environment Matting and Compositing"
Zongker, Werner, Curless, & Salesin, SIGGRAPH 1999

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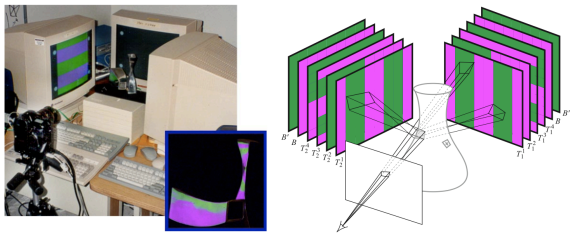
Zongker, Werner, Curless, & Salesin, SIGGRAPH 1999



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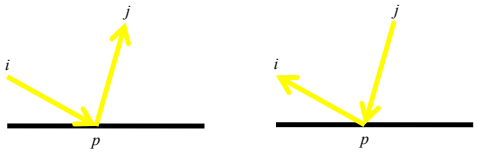
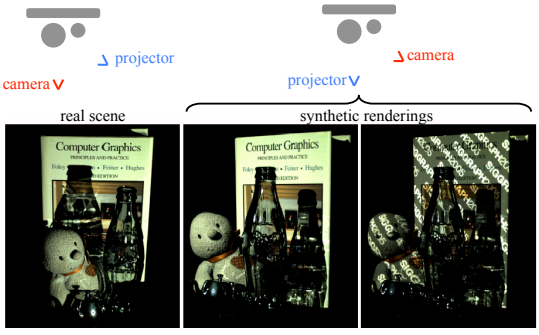
Helmholtz Reciprocity

- 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



"Dual Photography", Sen, Chen, Garg, Marschner, Horowitz, Levoy, & Lensch, *SIGGRAPH 2005*

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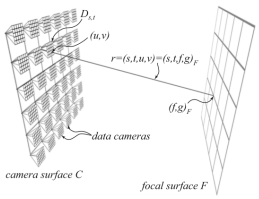
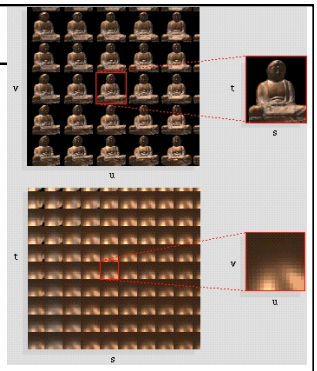
Light Fields





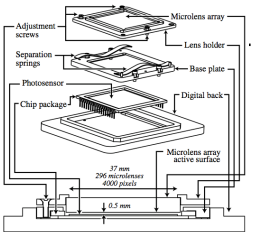
Plenoptic Modeling: An Image-Based Rendering System, McMillan & Bishop, SIGGRAPH 1995

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

Light Field Rendering, Levoy & Hanrahan, SIGGRAPH 1996

Light Field Camera

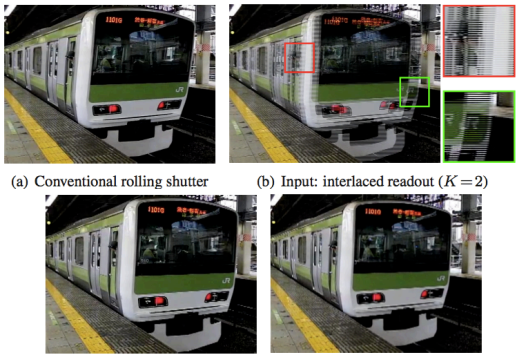
- *After* taking the photograph, we can:
  - Adjust focus
  - Change viewpoint
  - Change illumination
  - & more?



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

Reading for Today:

"Coded Rolling Shutter Photography: Flexible Space-Time Sampling" Gu, Hitomi, Mitsunaga, & Nayar, ICCP 2010



(a) Conventional rolling shutter (b) Input: interlaced readout ($K=2$)

(c) Interpolated sub-image I_1 (d) Interpolated sub-image I_2

Reading for Today:

"Coded Rolling Shutter Photography: Flexible Space-Time Sampling" Gu, Hitomi, Mitsunaga, & Nayar, ICCP 2010

- Global Shutter vs. Rolling Shutter *plus* Coded
- Interlaced vs. Staggered
- Skew Compensation
- High Speed Photography
- Interpolation of High Resolution
- High Dynamic Range
- Adaptive Row-wise Auto Exposure
- Simulation ➔ Prototype Camera Hardware