Visualization of Stereoscopic Distortions: Project Proposal

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CS 294-10: Visualization

10/24/07

Traditional 3d Displays:

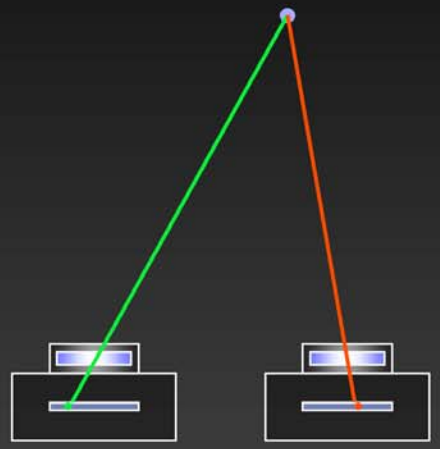
- Common theme: one image to each eye
  - Binocular disparity
  - Example: Anaglyph displays

- Problem of Interest: Stereoscopic photographs and many 3d displays suffer from distortions
- How can we quantify and predict the distortions?
  - Begin with a model

http://www.3djournal.com/001/, http://www.eyetricks.com/anaglyphs/07/04.htm, http://www.reald.com/scientific/crystaleyes_pc.asp

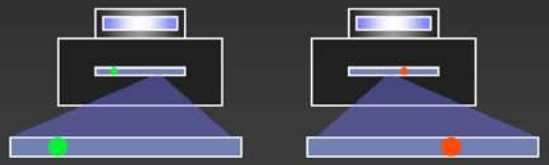
3D Displays: From Capture to Observation

1. Object space -> CCD

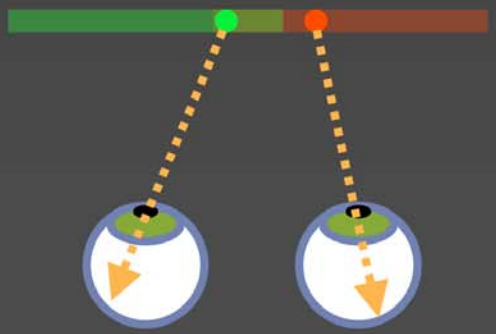


2. CCD -> Picture

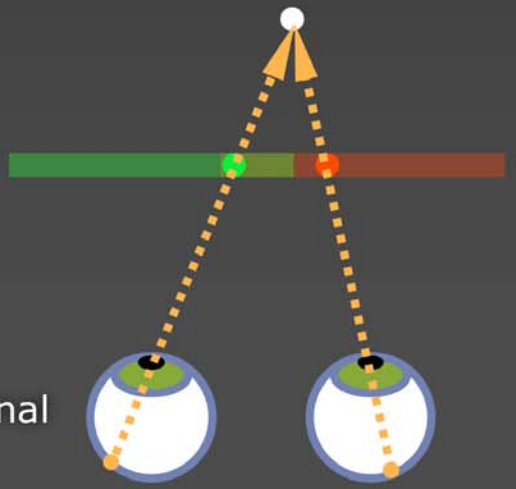
Magnification
from CCD sensor
to screen:



3. Picture -> Retinal Images



4. Retinal Images -> Interpretation



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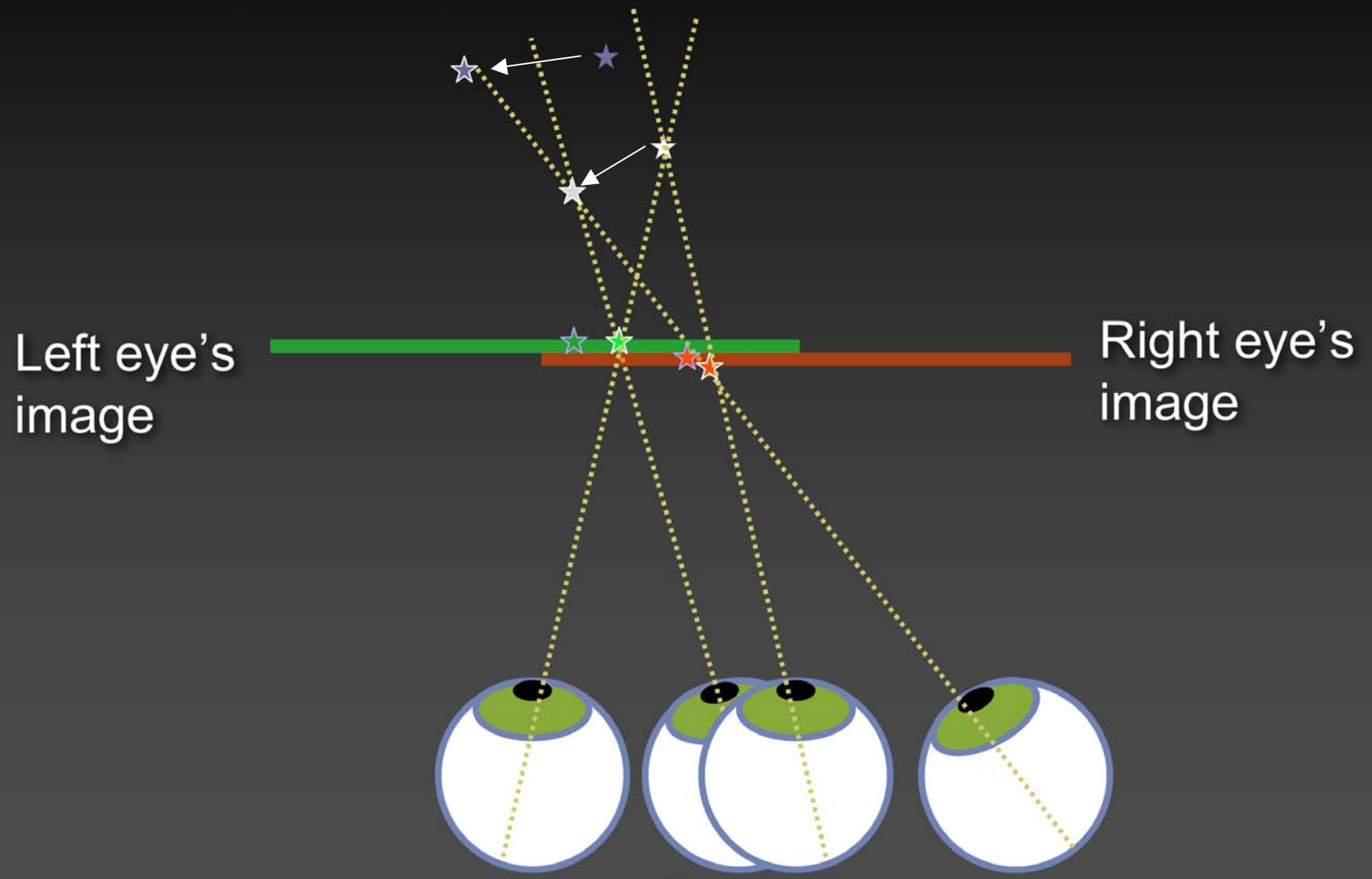
Project Proposal

Disparity-Based Distortions



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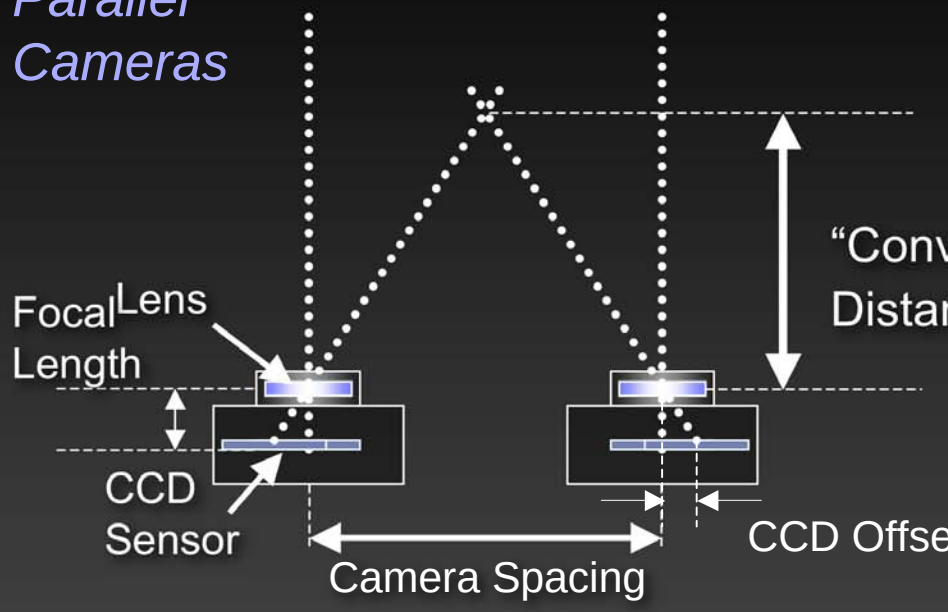
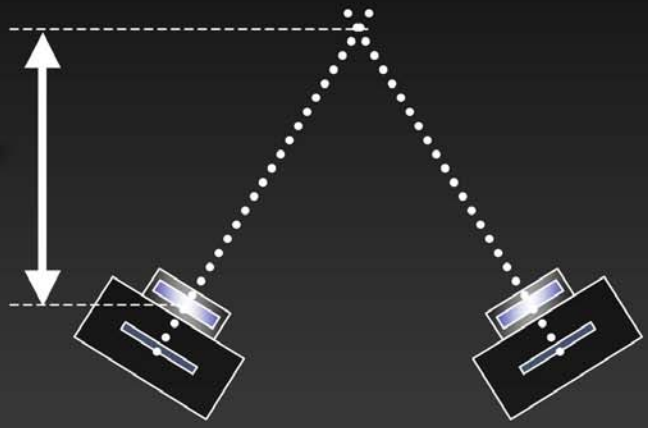
Capture and Viewing Effects

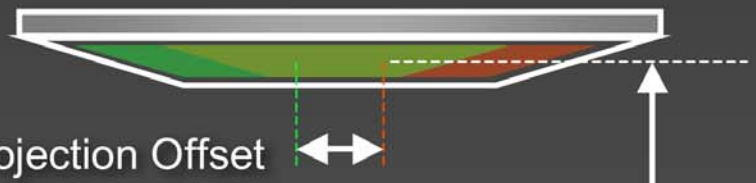
Parallel Cameras

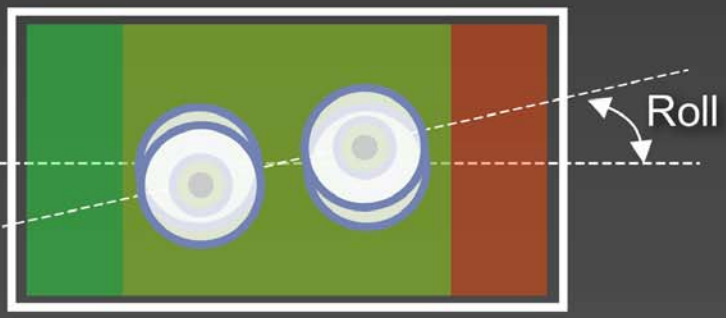


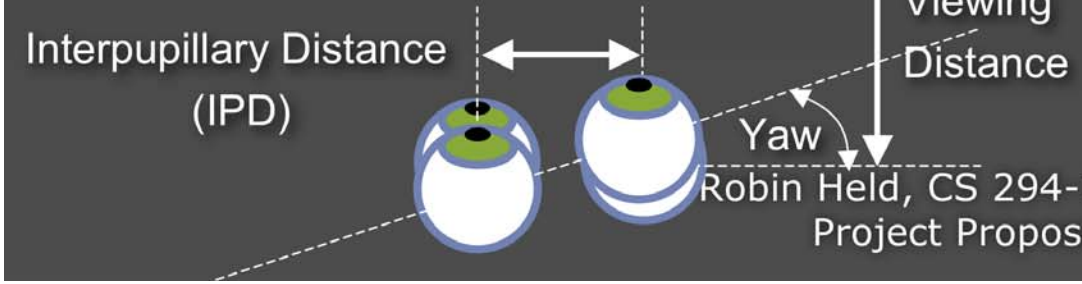
Converging Cameras



Viewing Conditions:

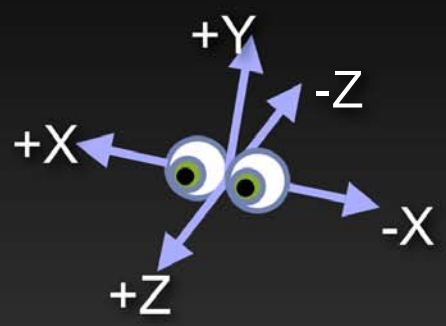


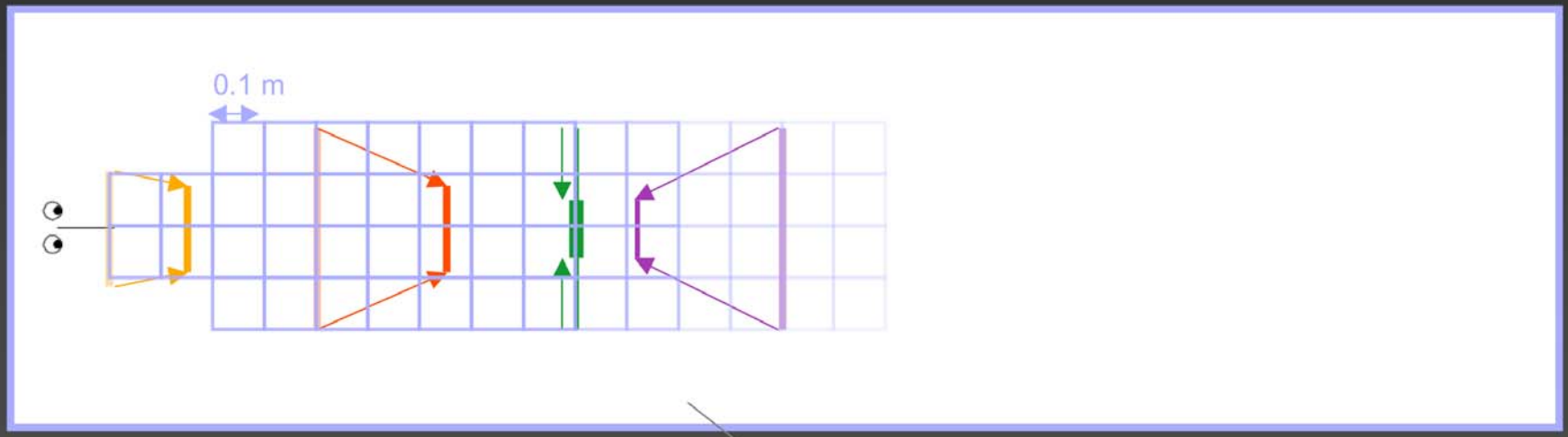




Existing Literature

- Analysis in XZ plane
- Case 1:
  - Parallel cameras
  - Camera spacing ≠ IPD
  - No projector offset





A Woods, T Docherty, R Koch.
Image Distortions in Stereoscopic Video Systems.
Stereoscopic Displays and Applications IV, Proceedings of the SPIE Volume 1915, San Jose, CA, Feb. 1993.

Existing Literature

- Case 2: Offset the eyes by 300 mm

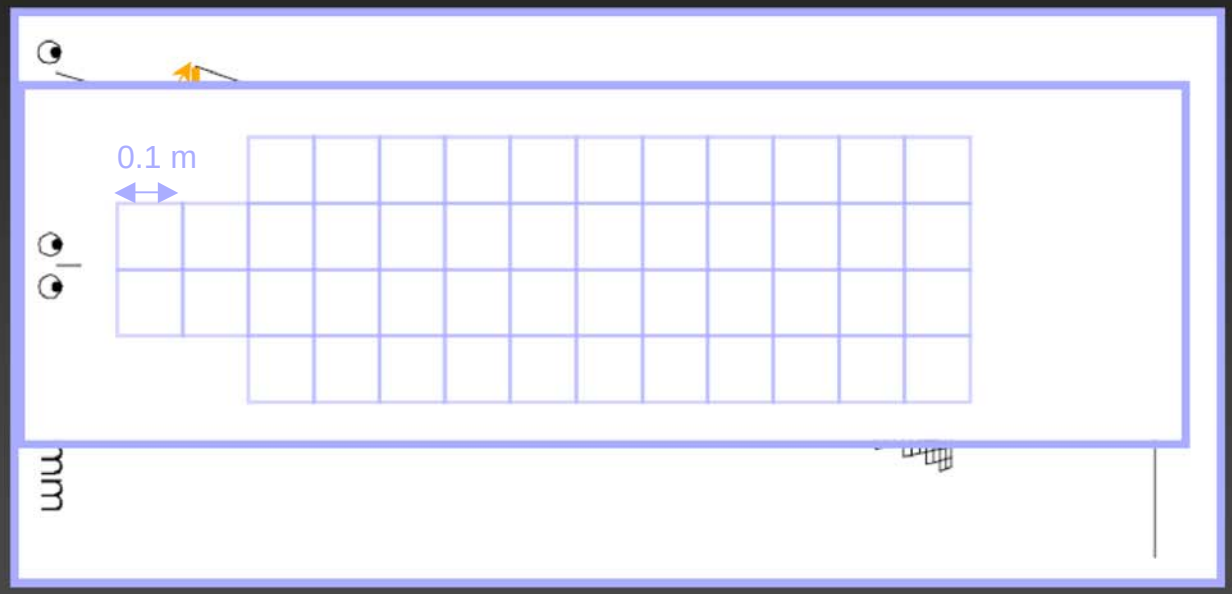


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Image Distortions in Stereoscopic Video Systems.
Stereoscopic Displays and Applications IV, Proceedings of the SPIE Volume 1915, San Jose, CA, Feb. 1993.

Similar Work

- Distortion of size and shape
  - Masaoka, K., et al., “Spatial distortion prediction system for stereoscopic images.” Journal of Electronic Imaging, 2006. 15(1): p. 13002-13002.
  - Wartell, Z., L. F. Hodges, et al. (2002). “A geometric comparison of algorithms for fusion control in stereoscopic HTDs.” IEEE Transactions on Visualization and Computer Graphics 8(2): 129-143.
  - Yamanoue, H., et al., “Geometrical analysis of puppet theater and cardboard effects in stereoscopic images.” J. Inst. Image Inf. TV Engineers, 2002. 56(4): p. 575–582.
  - Yamanoue, H., M. Okui, and I. Yuyama, “A study on the relationship between shooting conditions and cardboard effect of stereoscopic images.” Circuits and Systems for Video Technology, IEEE Transactions on, 2000. 10(3): p. 411-416.

Proposed Project

- Create interface that allows the user to change various acquisition and viewing parameters and observe the effect on the perceived stimulus
- Design the interface for use as a demo of the concept of stereoscopic distortions
- Use 3D stimuli, so distortions of entire volumes can be explored
  - Significant improvement over previous implementations
- Update in real time
- OpenGL, Cocoa-based interface
- Demo

Expected Hurdles

- Intuitive design
- Effective management of space
- Large number of variables
  - Capture: Camera orientation, spacing
  - Presentation: Screen Size
  - Viewing: Viewer location/orientation, interpupillary distance
- OpenGL programming
  - Level of detail
- Distortion of individual points over stimulus surface

Milestones

1. Preliminary code already in place
2. Add other 3D stimuli
3. More clearly indicate capture and viewing objects within the OpenGL view
4. Reassess layout of controls
5. Create interactive tutorial
    - Add educational aspect to the visualization