CSE 190: Virtual Reality Technologies

LECTURE #18: LIGHT FIELD TECHNOLOGY

Upcoming Deadlines

Sunday, May 30: Project 4 original due date

Monday, May 31: Memorial Day (no discussion)

Sunday, June 6: Project 4 due

June 7+8: Final exam Monday 11:30am – Tuesday 11:30am

App Presentations

Jennifer Purevsuren

- Pistol Whip

Jeffrey Ha

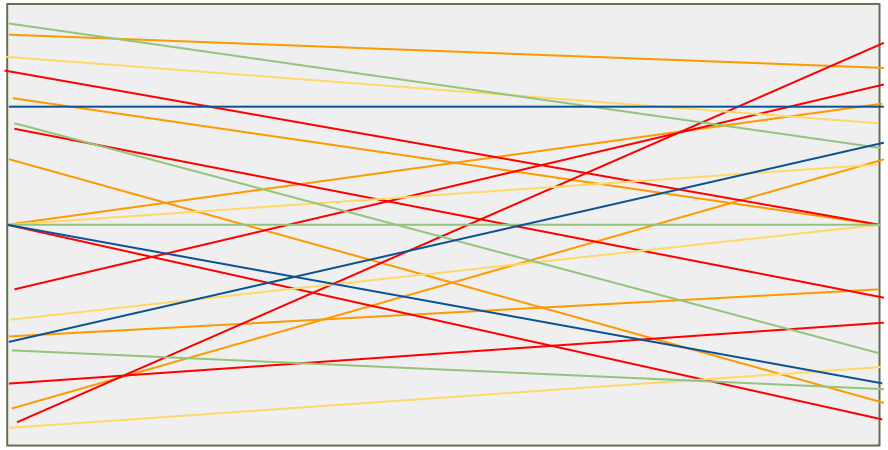
- The Climb

Annika Hatcher

- Quill Theater

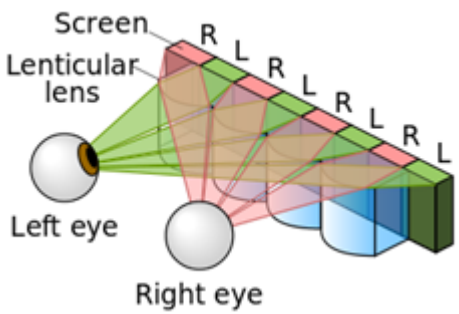
What is a Light Field?

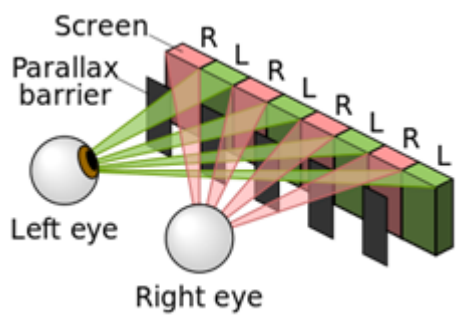
A function describing the radiance of light at every point (x, y, z) in space, in every direction (θ, ϕ)



Review: Autostereo Displays

Lenticular screen





Parallax barrier

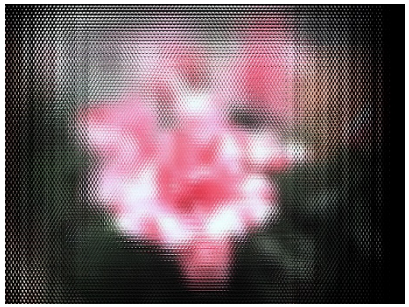
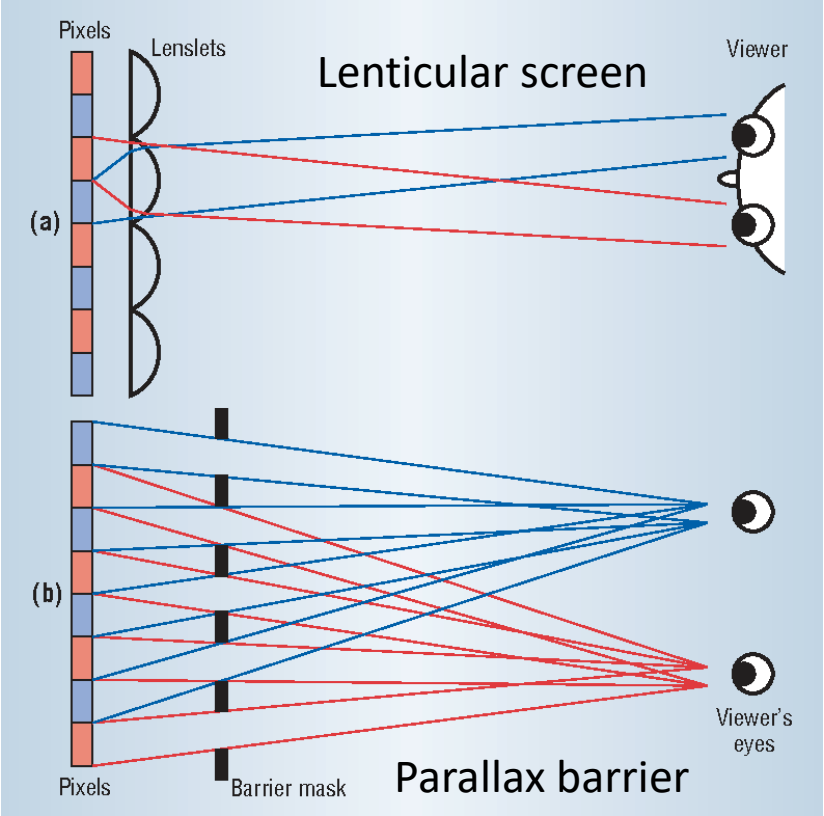
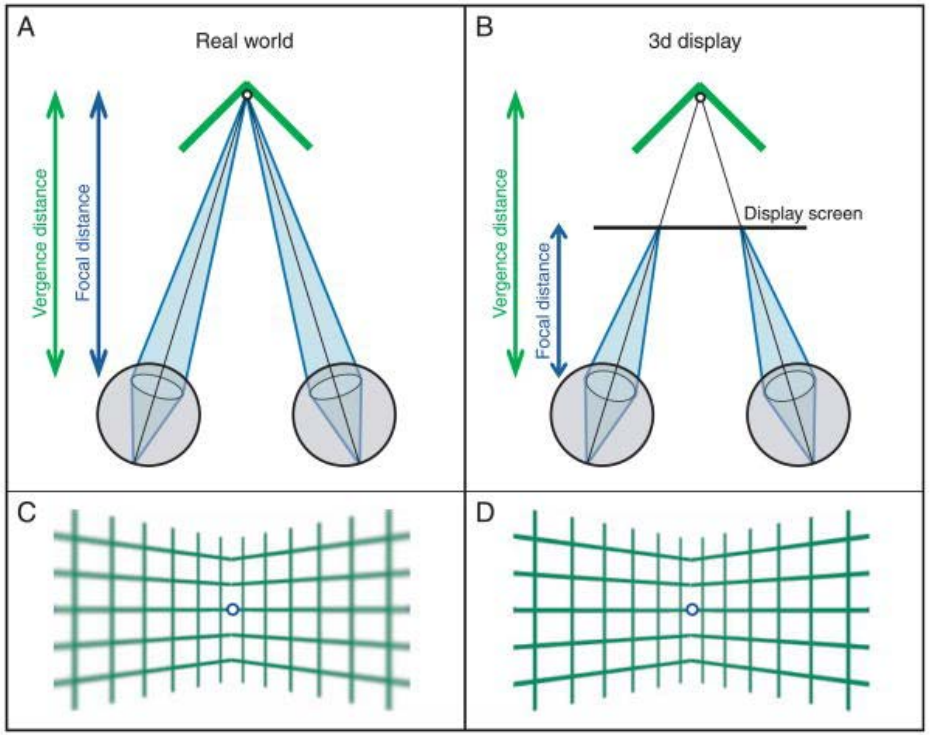


Image without autostereo filter



Review: Vergence-Accommodation Conflict



Hoffman, D. M., Girshick, A. R., Akeley, K., & Banks, M. S. (2008). Vergence–accommodation conflicts hinder visual performance and cause visual fatigue. *Journal of Vision*, *8*(3), 33.1–3330. http://doi.org/10.1167/8.3.33

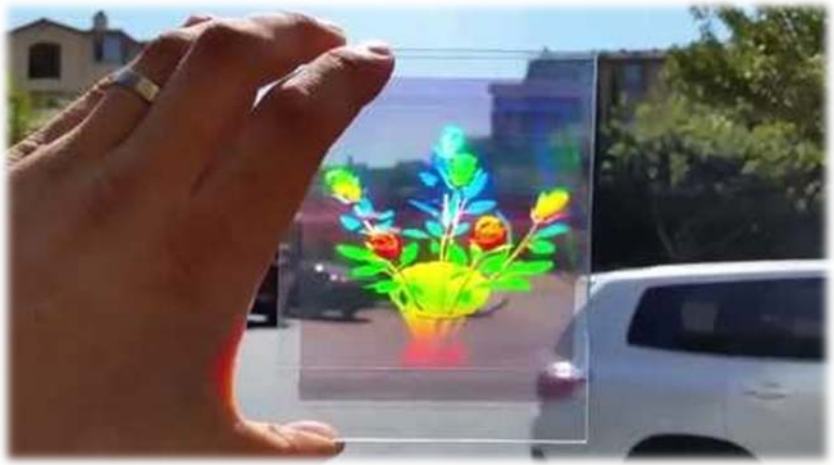
Holy Grail: Holograms

Holography: enables a wavefront to be recorded and later re-constructed.

A hologram is made by superimposing a second wavefront (reference beam) on the wavefront of interest, generating an **interference pattern** which is recorded on a physical medium. When only the second wavefront illuminates the interference pattern, it is **diffracted** to recreate the original wavefront.

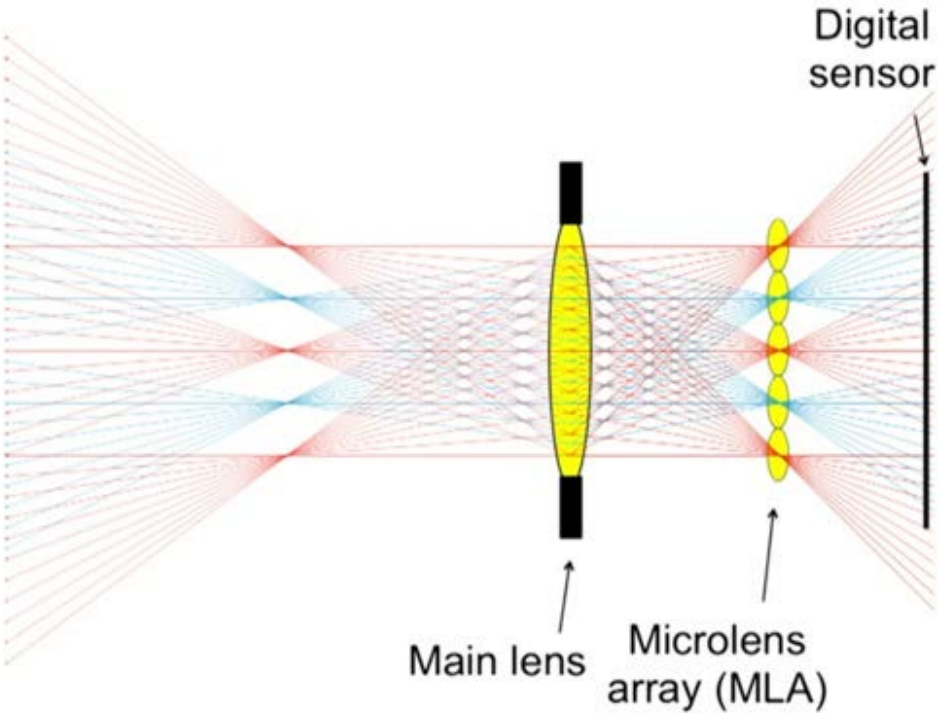
Holograms can be computer-generated by modeling the two wavefronts and adding them together digitally. The resulting digital image is then printed onto film and illuminated by a suitable light source to reconstruct the wavefront.

Holograms can support **full color, head motion and varying focal distance**.

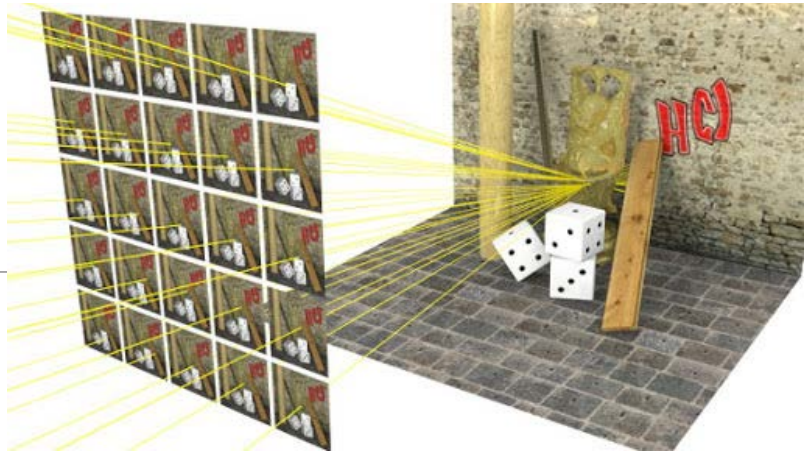


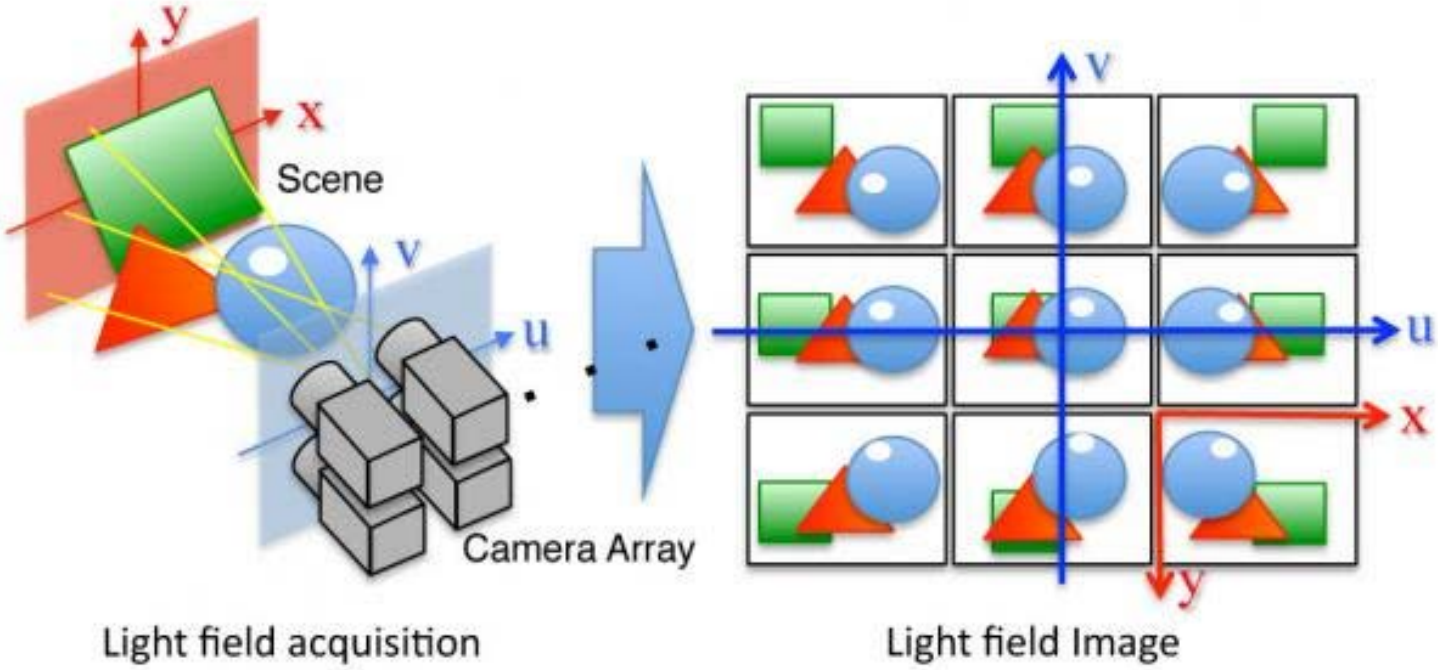
Light Field Cameras

Micro-lens array captures light from different directions



Capturing Light Fields

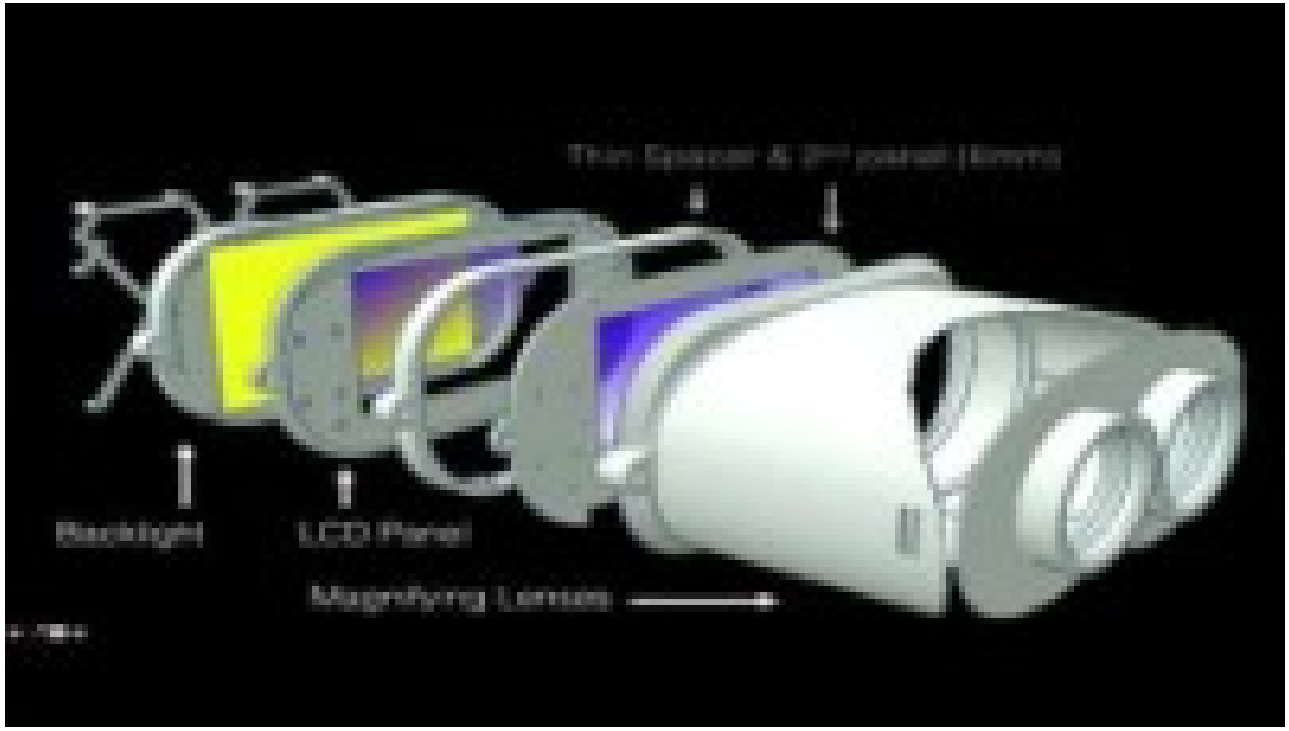




Stanford Light Field HMD Prototype

Light field display prototype by Dr. Wetzstein/Stanford

- Video: 8’40 – 13’45



https://youtu.be/c8Ge08MwSLQ?t=519

Nvidoa Light Field HMD Prototype

Nvidia presentation at Siggraph 2013: “Near-Eye Light Field Displays”

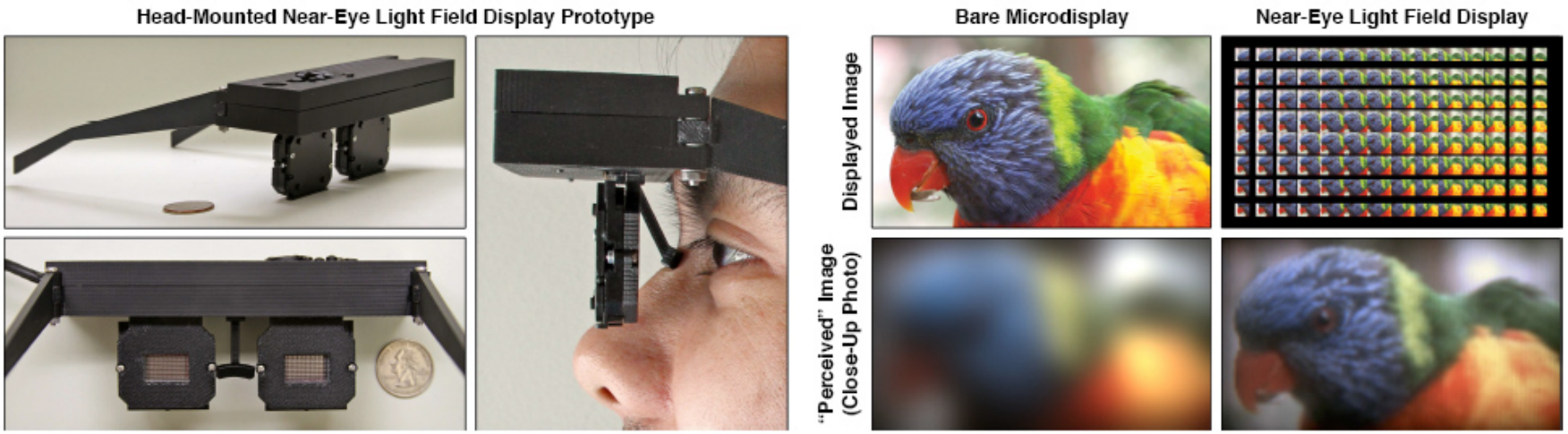


Figure 1: *Enabling thin, lightweight near-eye displays using light field displays. (Left) Our binocular near-eye display prototype comprises a pair of OLED panels covered with microlens arrays. This design enables a thin head-mounted display, since the black box containing driver electronics could be waist-mounted with longer OLED ribbon cables. (Right) Due to the limited range of human accommodation, a severely defocused image is perceived when a bare microdisplay is held close to the eye (here simulated as a close-up photograph of an OLED). Conventional near-eye displays require bulky magnifying optics to facilitate accommodation. We propose near-eye light field displays as thin, lightweight alternatives, achieving comfortable viewing by synthesizing a light field corresponding to a virtual scene located within the accommodation range (here implemented by viewing a microdisplay, depicting interlaced perspectives, through a microlens array).*

https://research.nvidia.com/publication/near-eye-light-field-displays-0

Nvidia Prototype Video

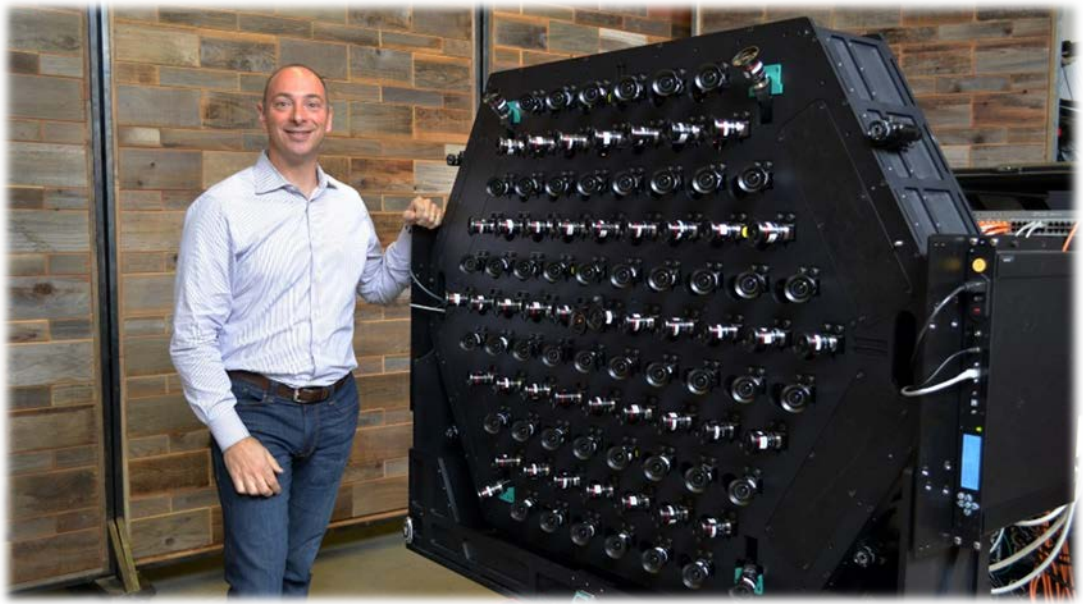
https://www.youtube.com/watch?time_continue=4&v=f_CkJCZ3Uxw

Hallelujah: First Light Field Movie

Hallelujah

Hallelujah: the world's first Lytro VR experience

- Presented at ACM SIGGRAPH 2017
- Used Lytro Immerge technology:



Hallelujah Trailer

https://www.youtube.com/watch?v=6fdH6piDl2Y

Behind the Scenes

https://vimeo.com/431644334

Light Field Challenges

The bigger the desired range of motion for the user, the larger the camera system

Camera arrays are expensive

Cameras capture large amounts of video data

Large amounts of video needed for viewing in VR

True light field displays not yet available commercially