

AR Headsets

Tue, July 7 (Week 3)

Computer Display Color System

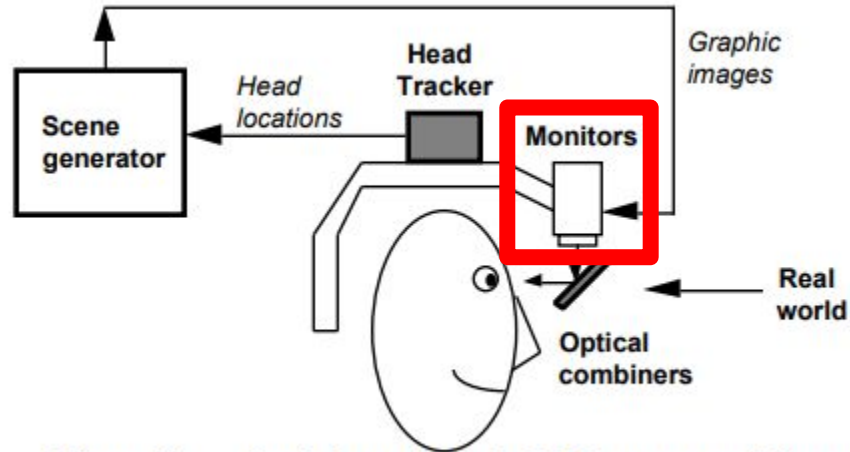
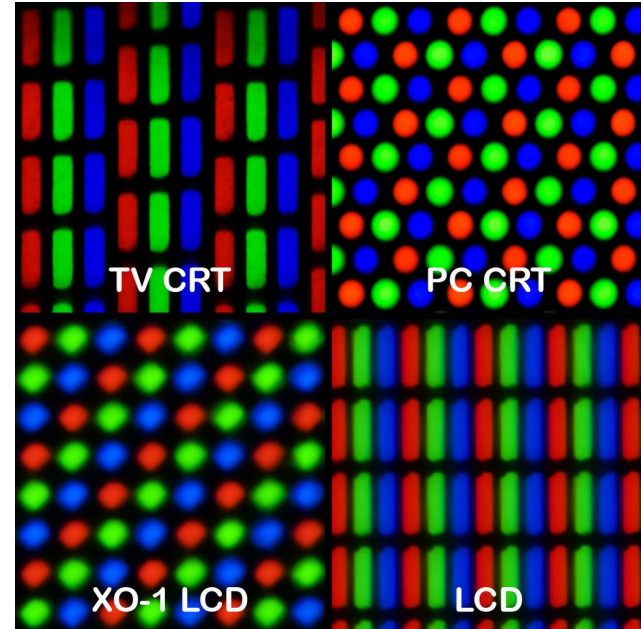
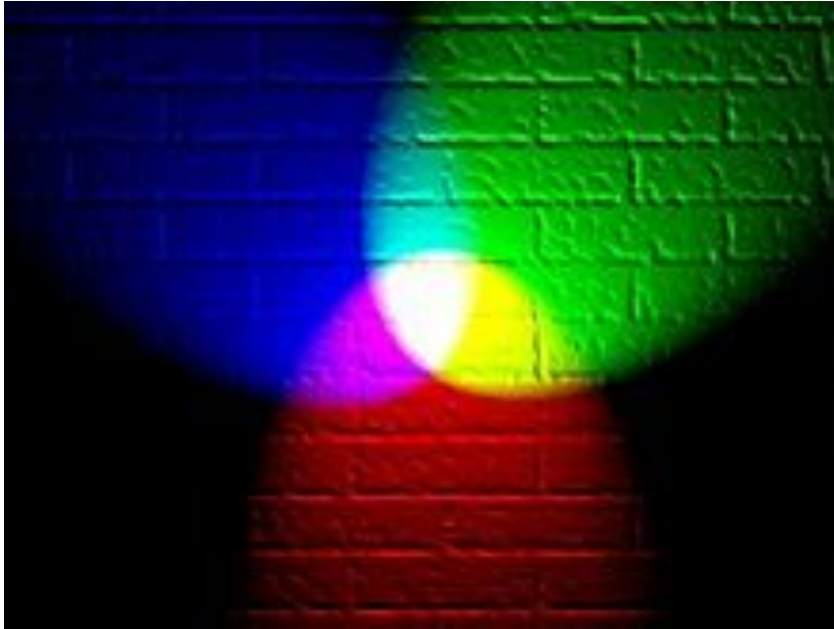


Figure 11: Optical see-through HMD conceptual diagram

Computer Display Color System



Collimated Light & Eye Box

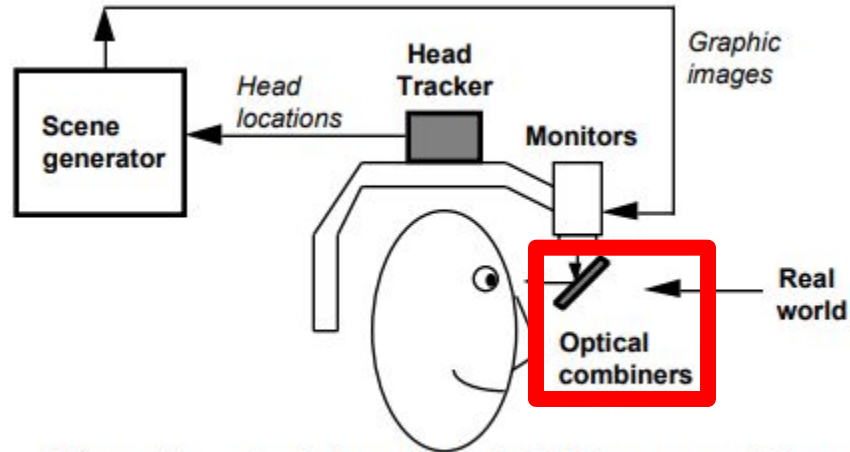


Figure 11: Optical see-through HMD conceptual diagram

Collimated Light & Eye Box

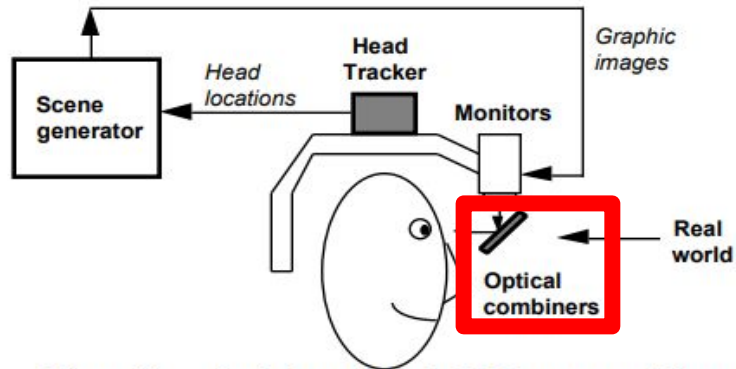
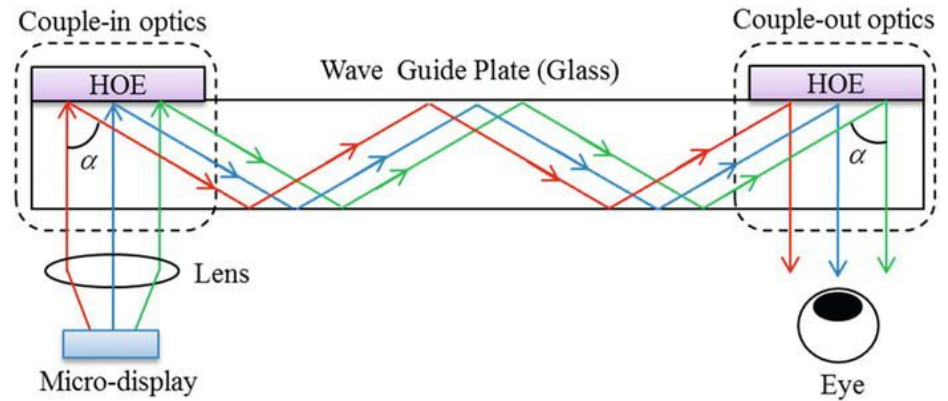
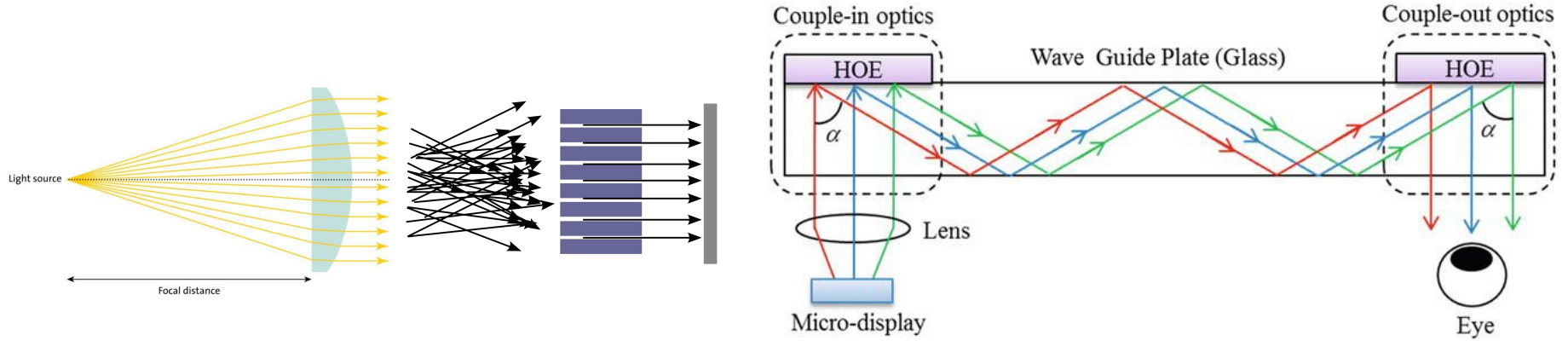


Figure 11: Optical see-through HMD conceptual diagram



Collimated Light & Eye Box



Collimated Light & Eye Box

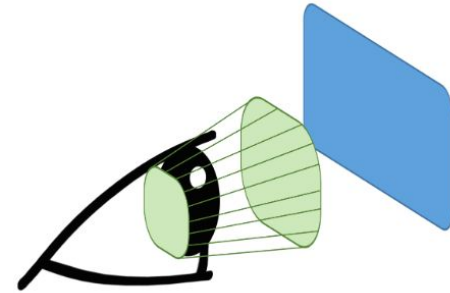
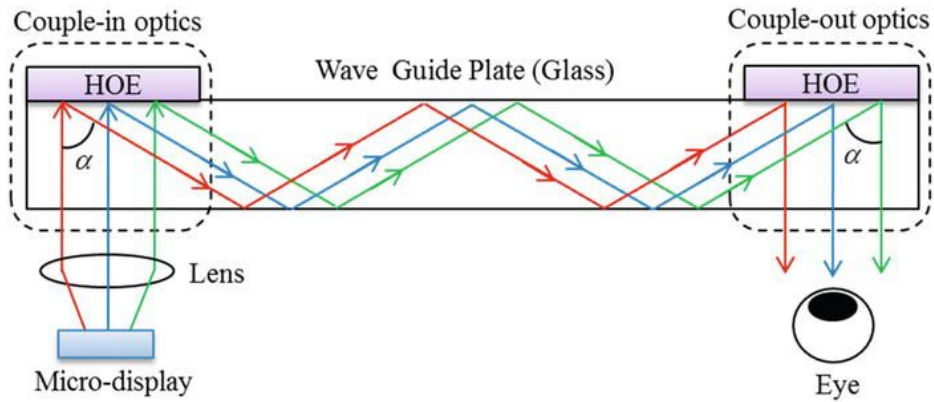


Figure: Eye (black) inside the eye box (green) in front of a display (blue)

Interpupillary Distance & Binocular Disparity

From collimated lights, pixels are angles, not positions.

Same angles with larger interpupillary distance (IPD) mean longer distances.

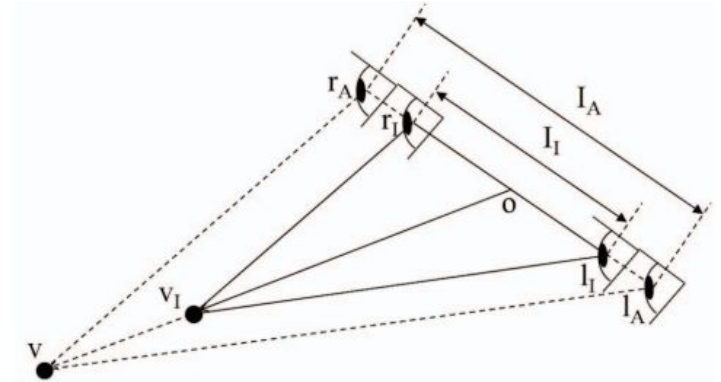
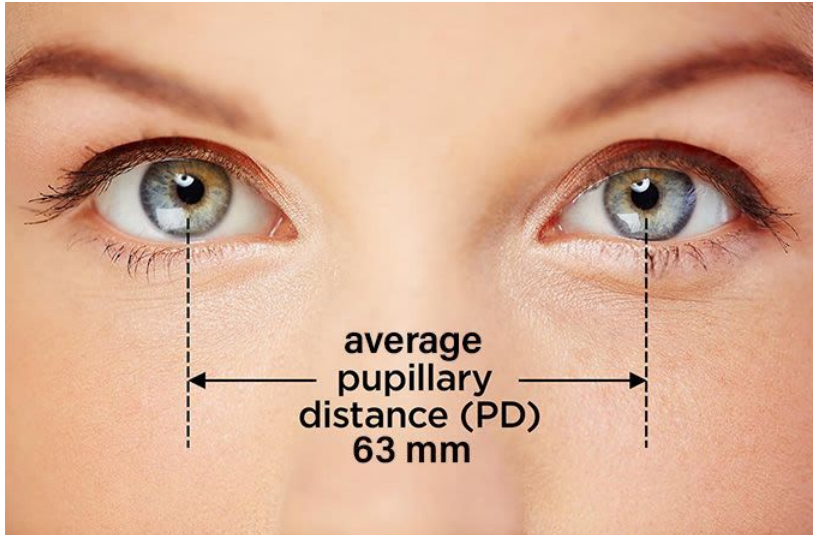
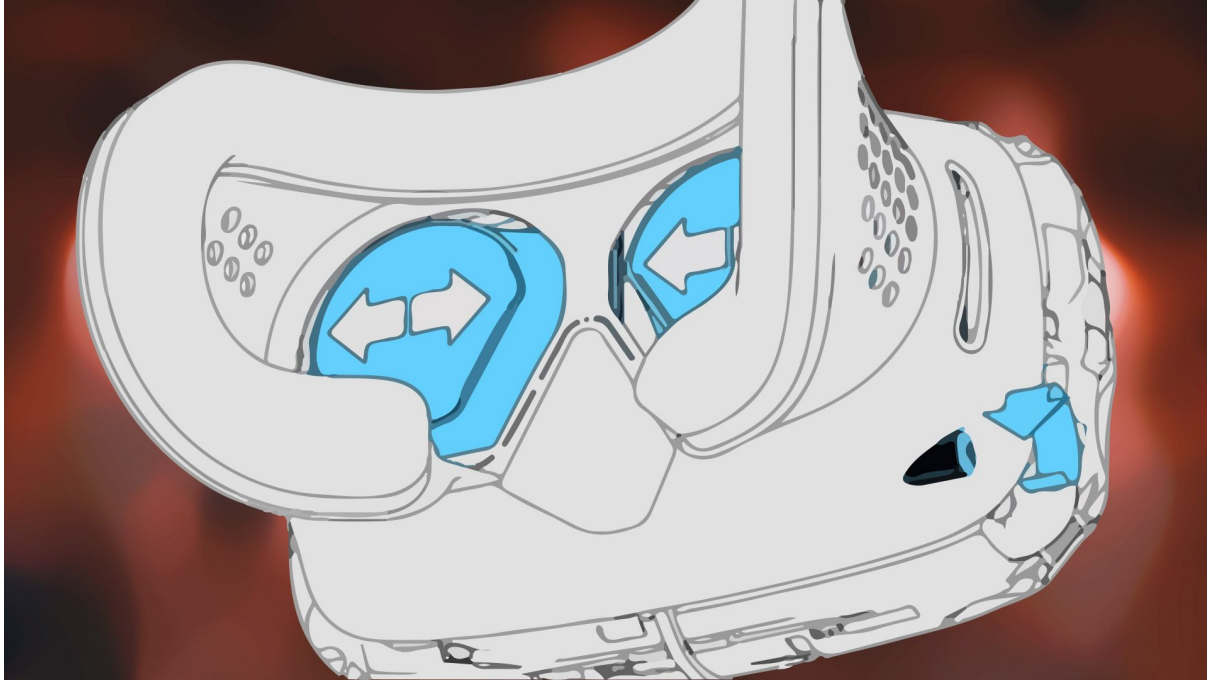


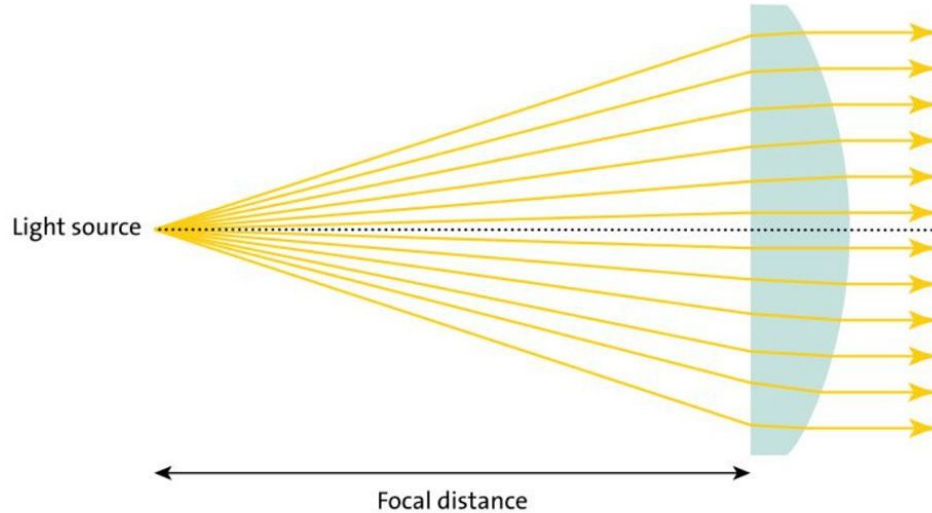
Figure 2: The triangular similarity for an initialized interpupillary distance (IPD) $I_I (= |\overline{I_I r_I}|)$ and an actual IPD $I_A (= |\overline{I_A r_A}|)$.

IPD & VR Headsets



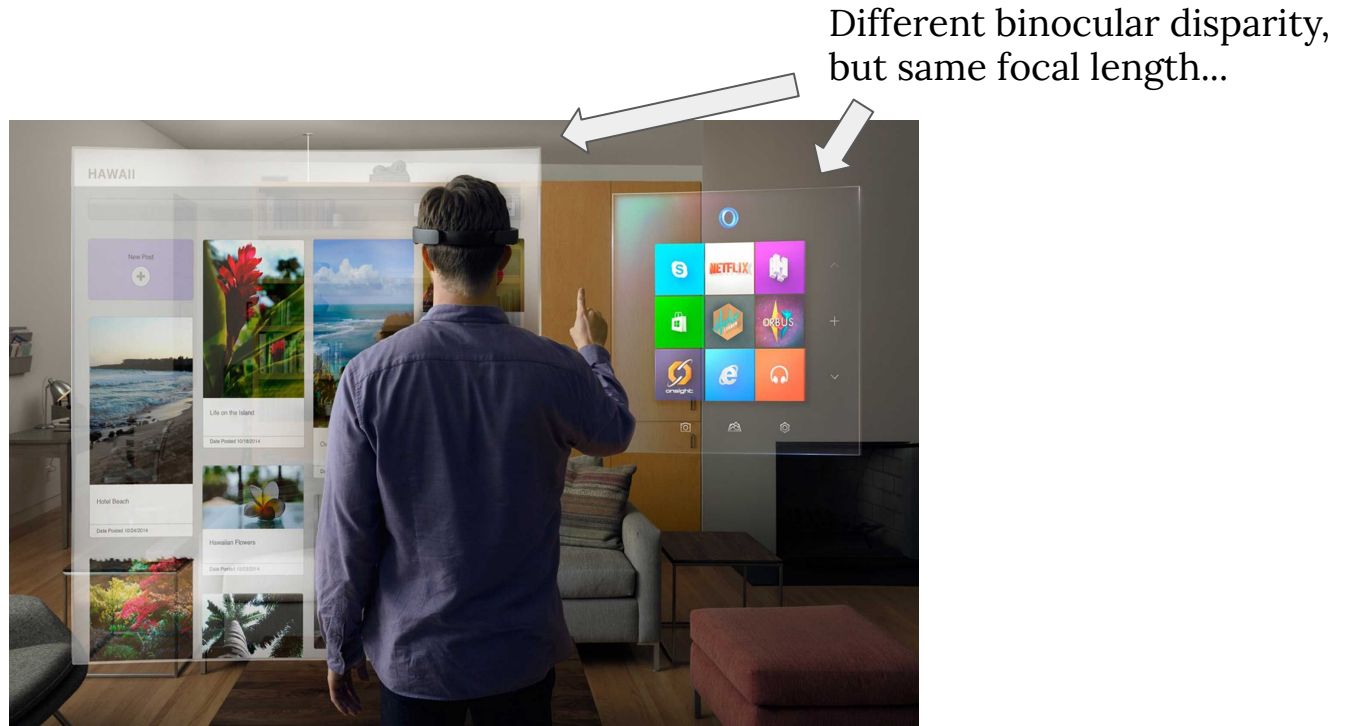
The Problem with Focal Length

In most cases, an optical device with lenses can have only one focal length.



The Problem with Focal Length

In most cases, an optical device with lenses can have only one focal length.



Field of View

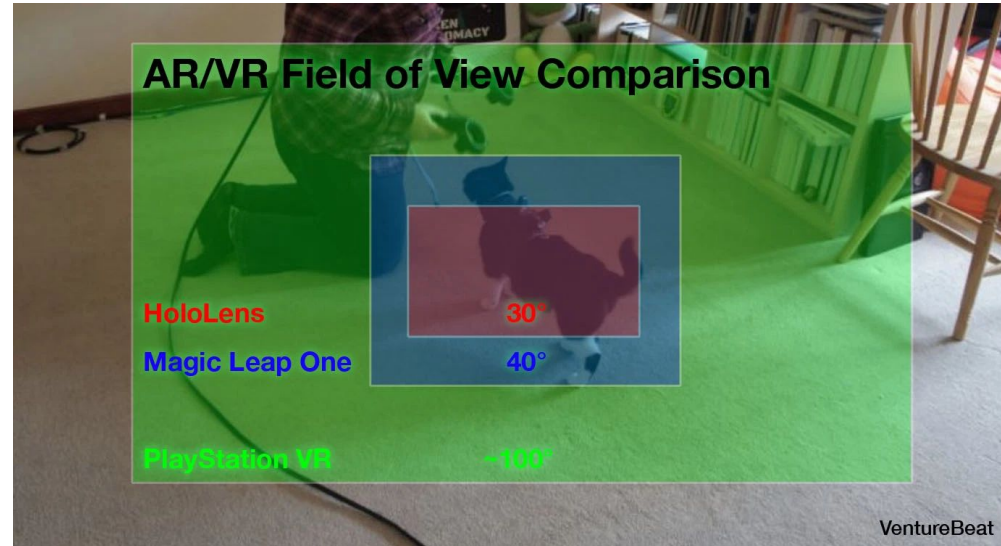
Human Field of Vision (around $150^\circ \times 120^\circ$)

Typical VR Headset today (around $90^\circ \times 90^\circ$)

MagicLeap One ($40^\circ \times 40^\circ$)

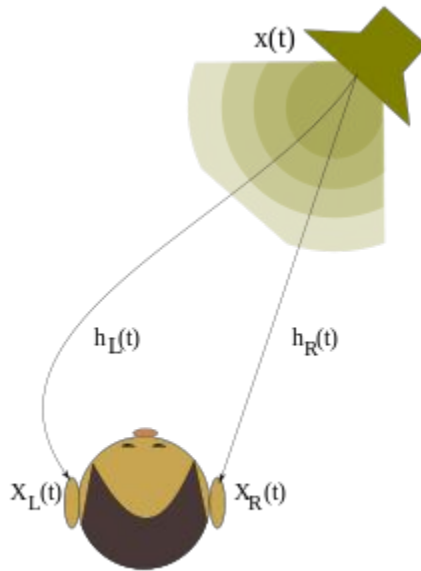
HoloLens
($30^\circ \times 17.5^\circ$)

DAQRI Smart Glasses ($34^\circ \times 18^\circ$)



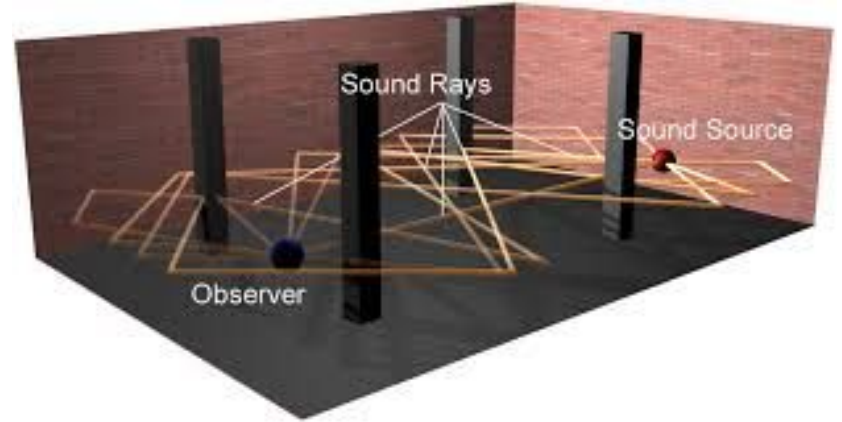
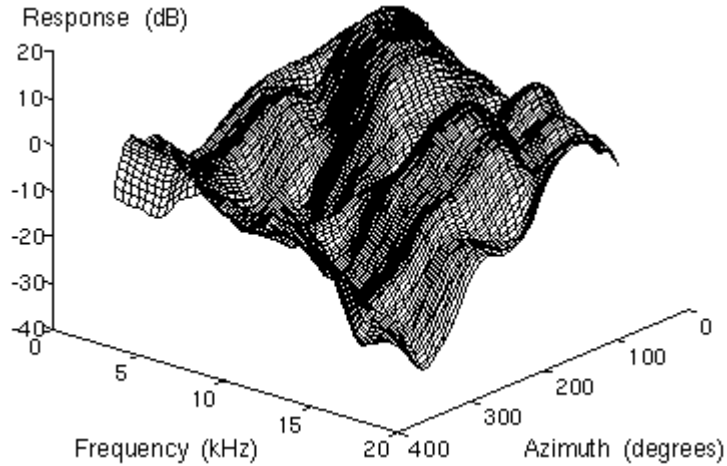
Spatial Sound

Head-related transfer function (HRTF)



Spatial Sound

HRTF is a complicated function that depends on frequencies of sound, the positions of the source and listener, and the structure and material of the surrounding space...



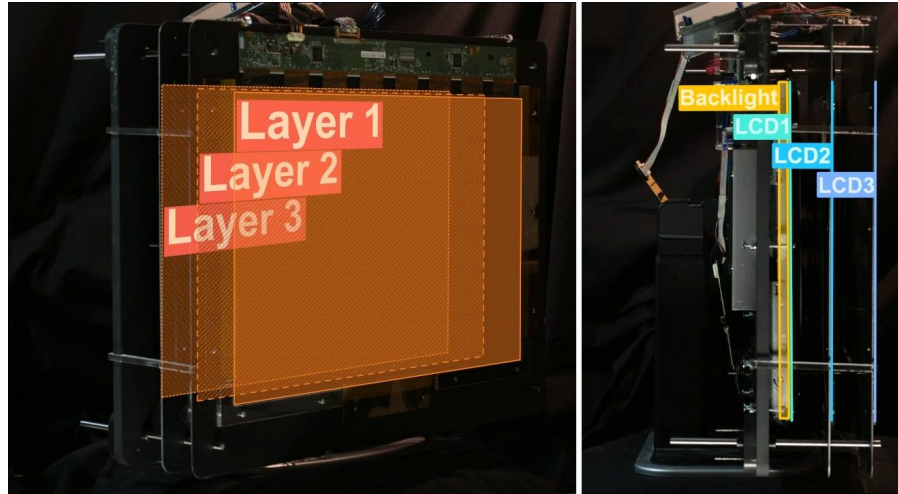
Regarding the Focal Length Problem

Project North Star	HoloLens 1	Magic Leap 1
1 Focal Length (≈ 0.5 m)	1 Focal Length (≈ 2 m)	2 Focal Lengths (≈ 1 or 3 m)
\$300 (2018)	\$3000 (2015)	\$2300 (2018)



Light Field Display

A possible improvement for displays, in terms of focal lengths, but in the future yet.





https://youtu.be/itSjM_OzVtA