

CSC 2524, Fall 2017

VR Stereo+Optics

Karan Singh

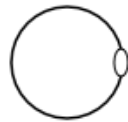
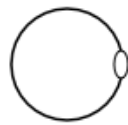


Inspired and adapted from Oliver Kreylos

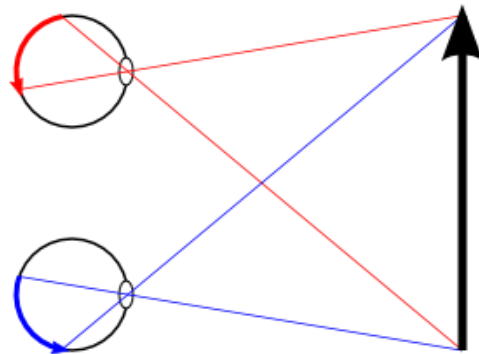
Outline

- Real-world visual perception.
- how VR emulates it.
- Problems and consequences of the emulation in VR.

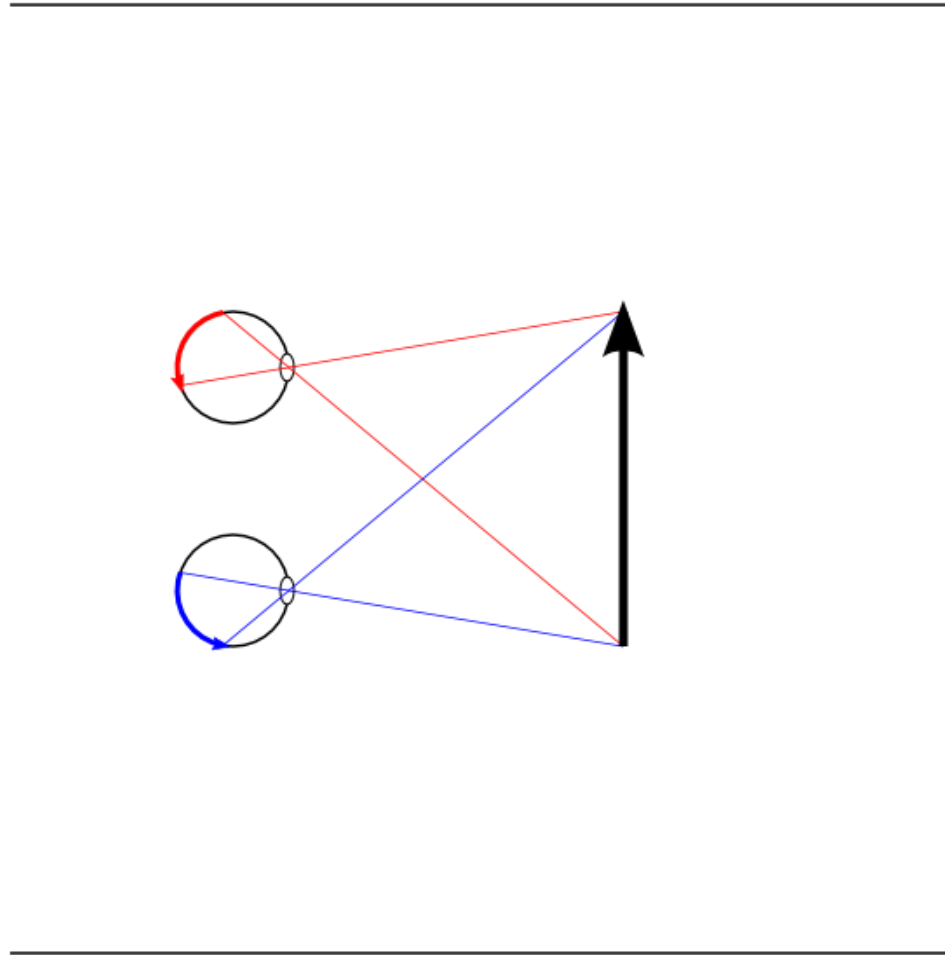
Vision



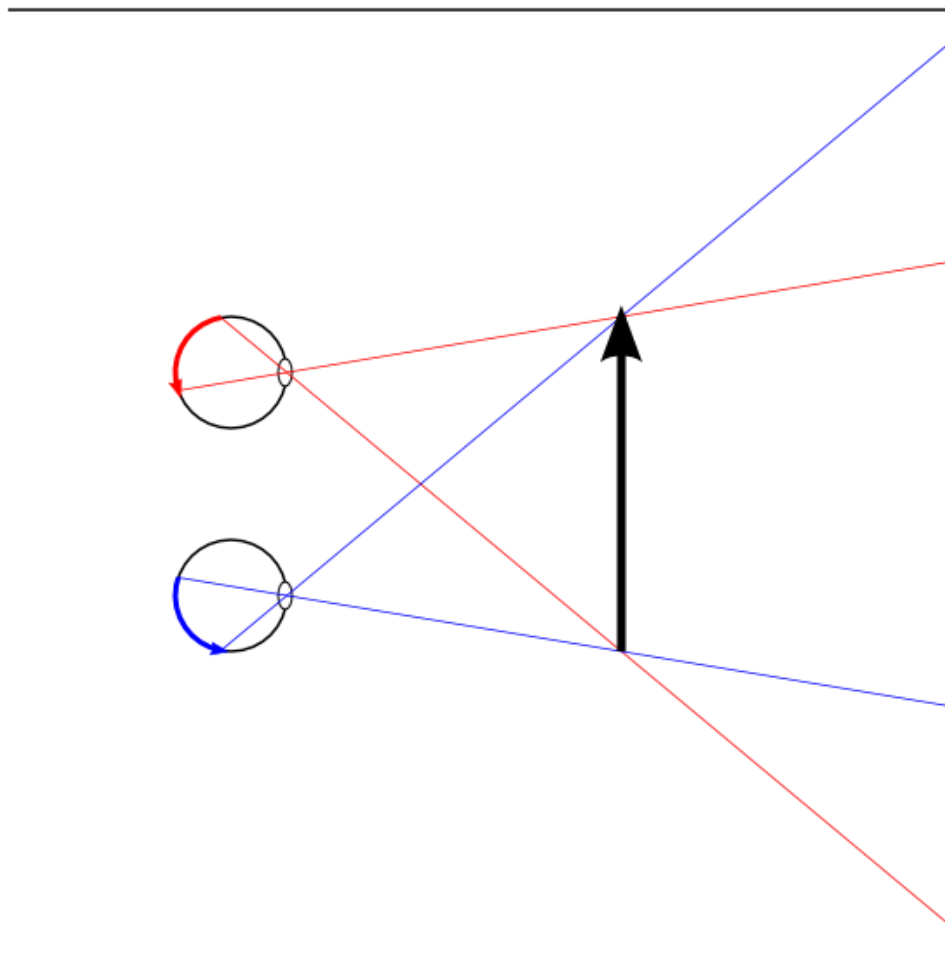
Vision



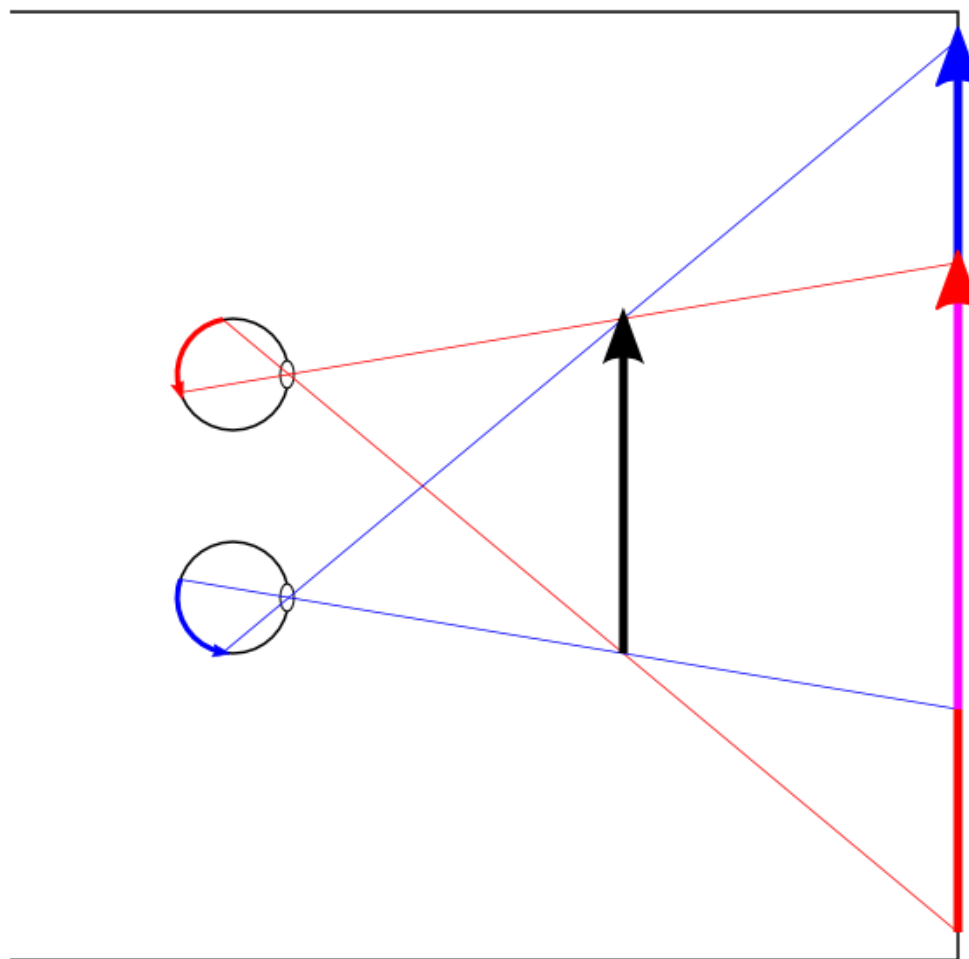
Vision in Room VR



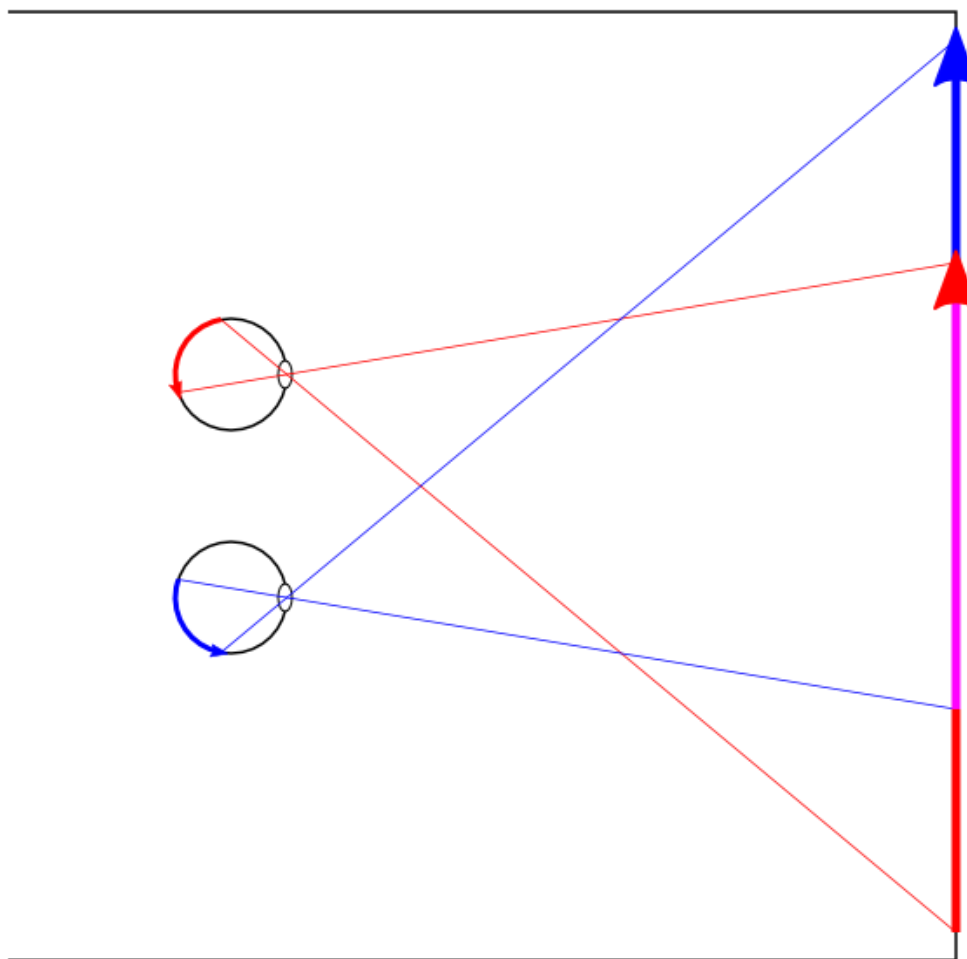
Vision in Room VR



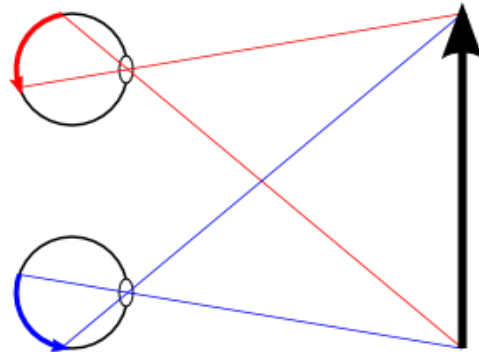
Vision in Room VR



Vision in Room VR

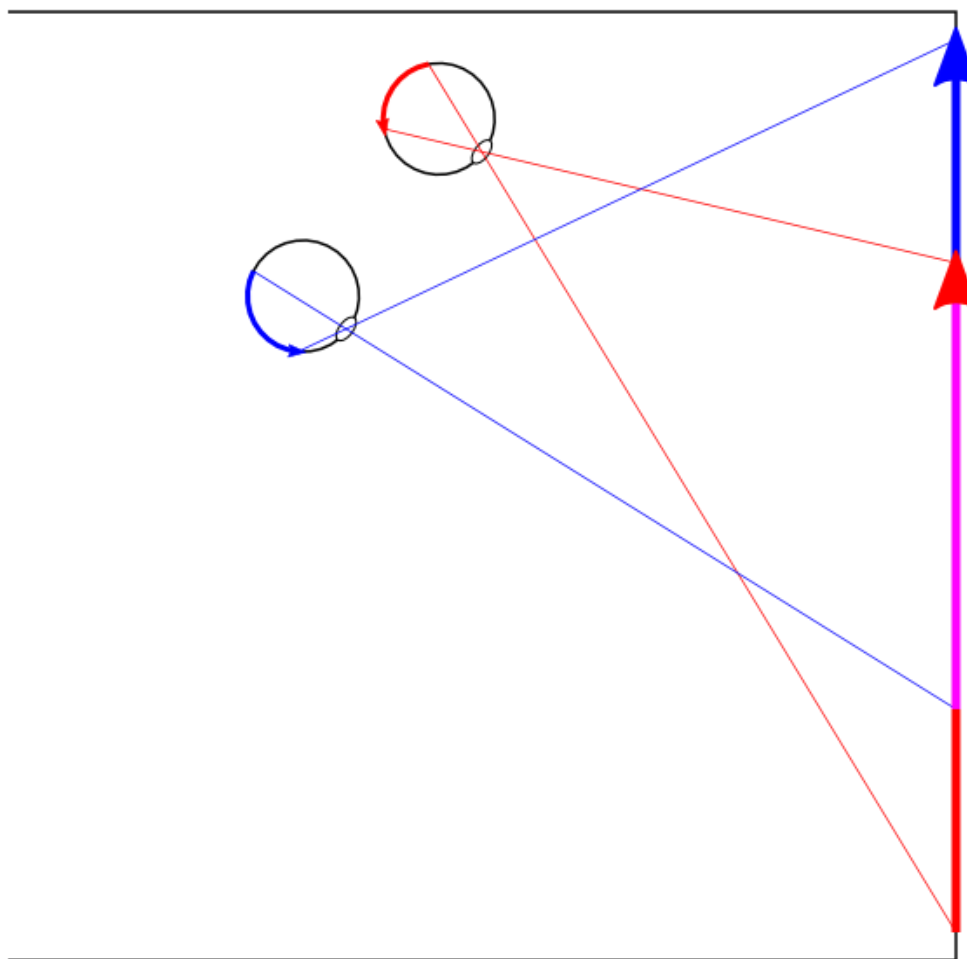


Vision in Room VR

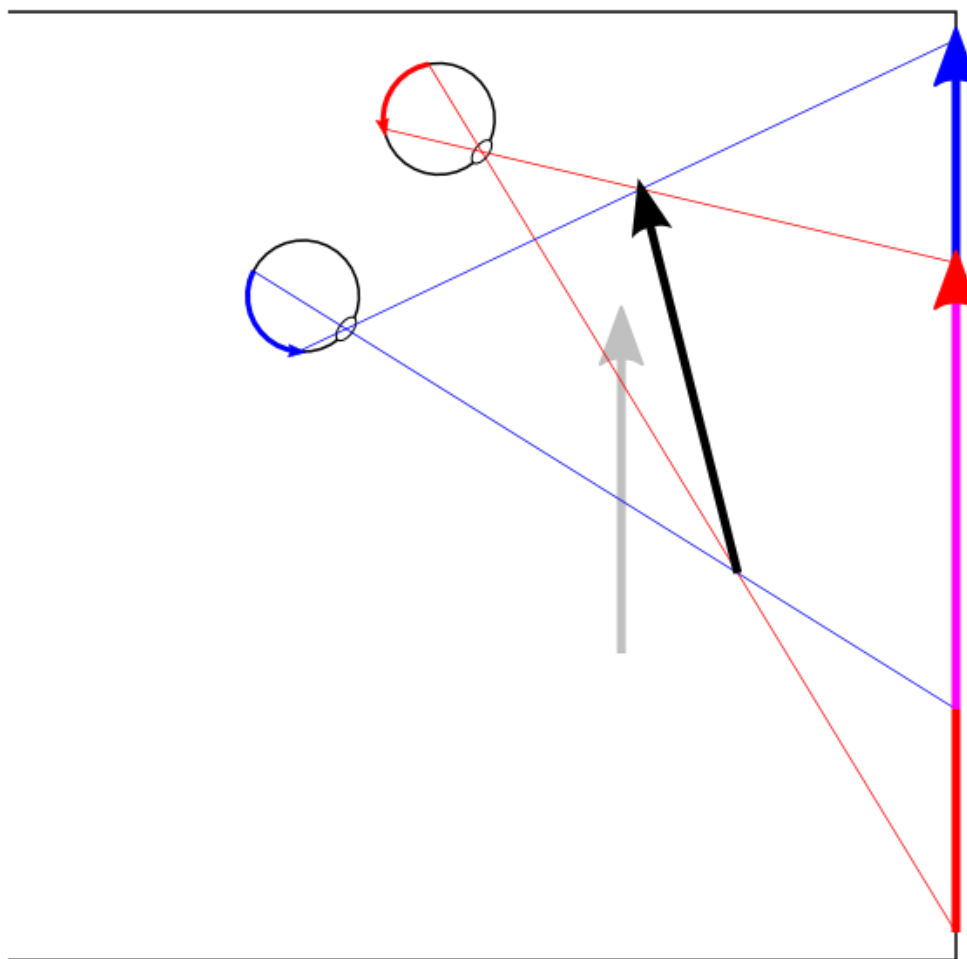


User Movement

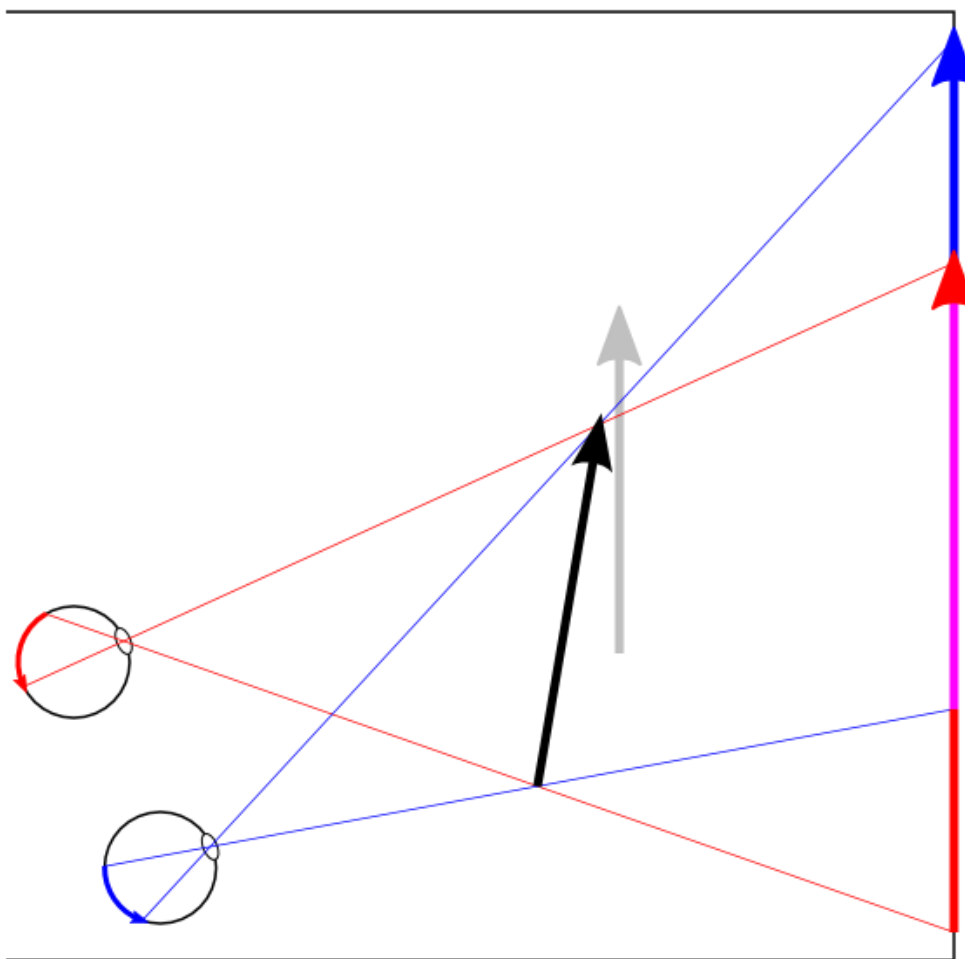
Vision in Room VR



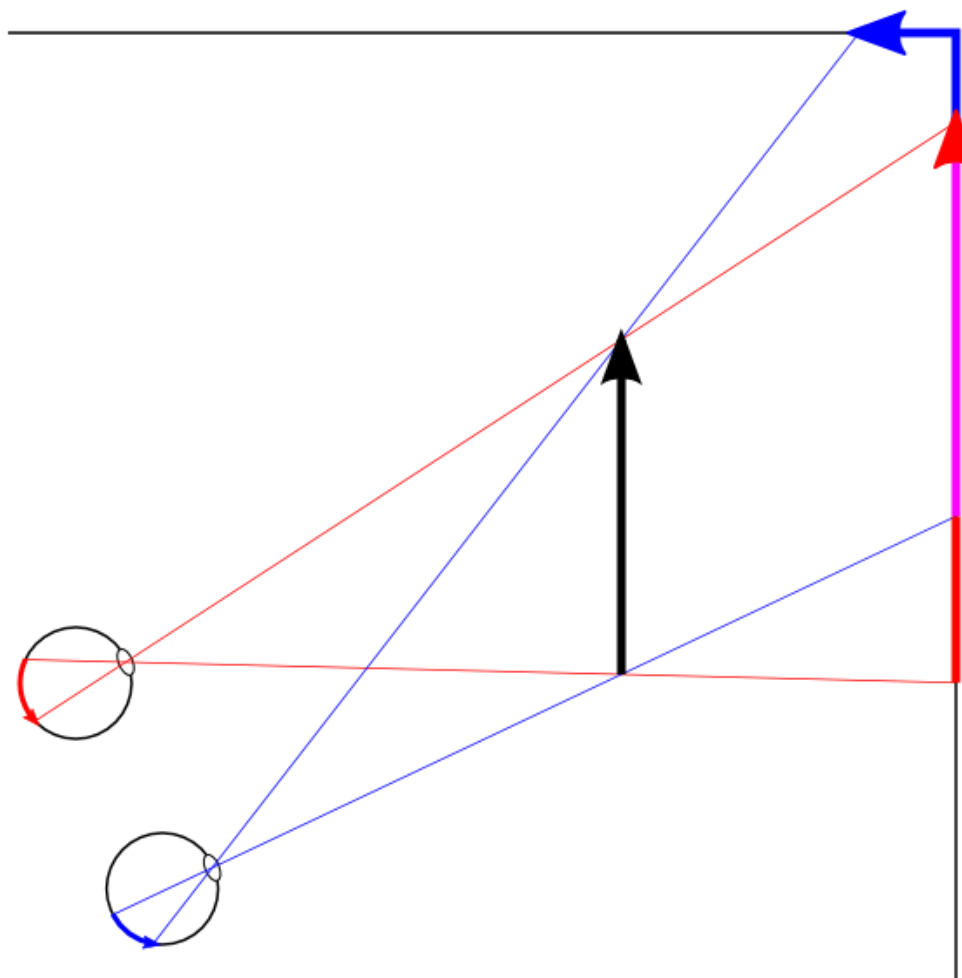
Vision in Room VR



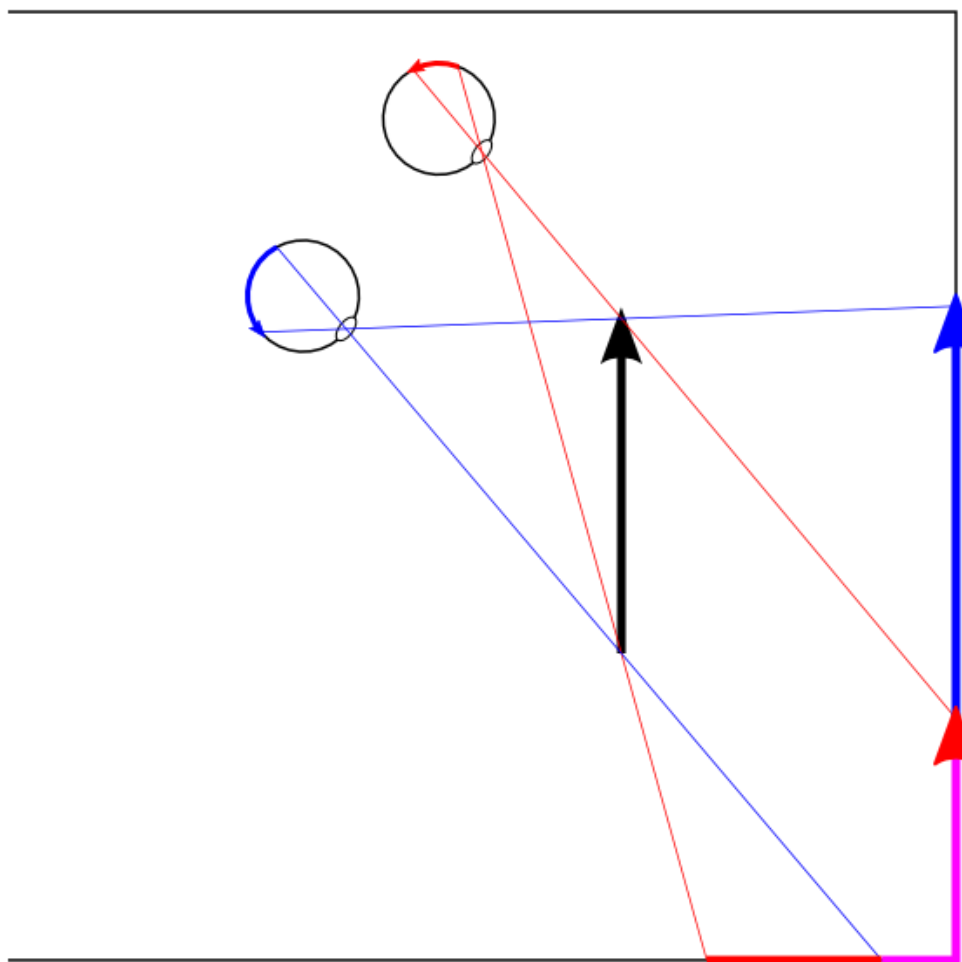
Vision in VR



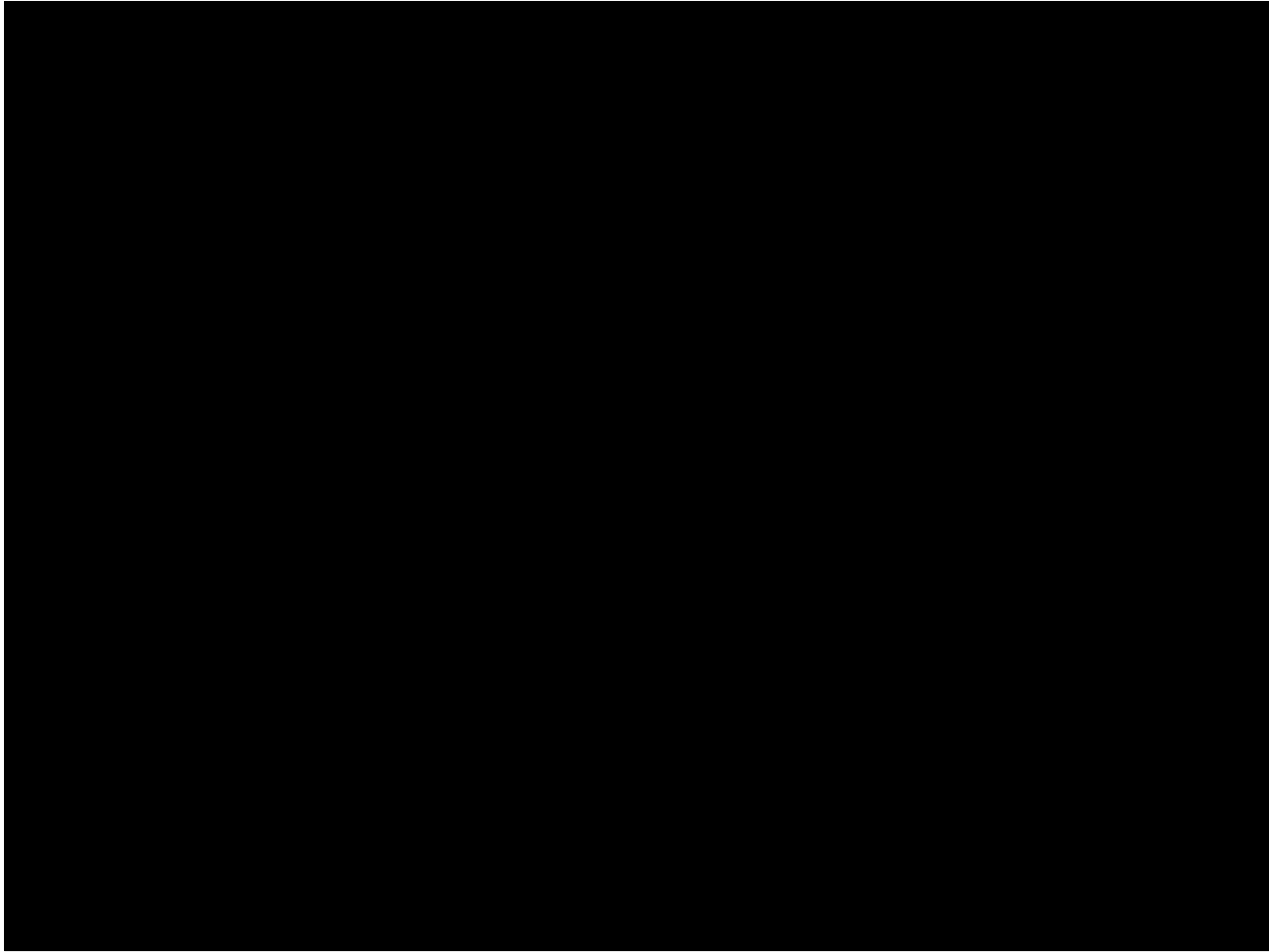
Vision in Room VR



Vision in Room VR

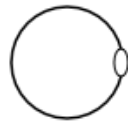
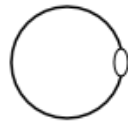


Vision in Room VR

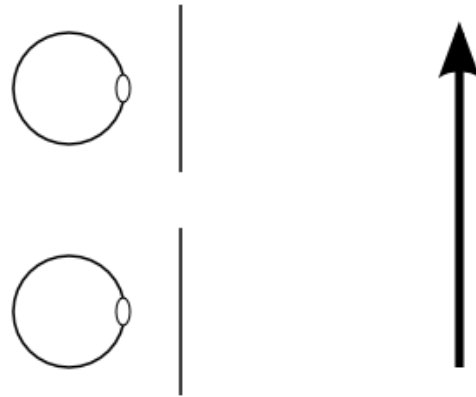


Head-Mounted Displays

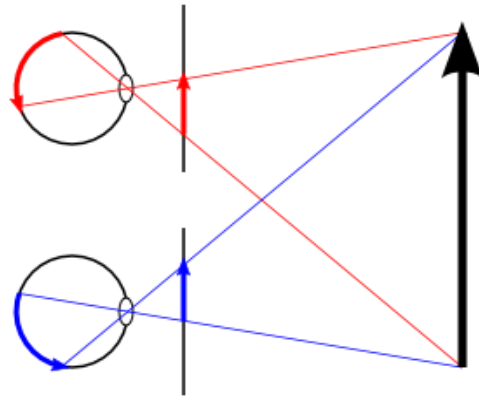
Head-mounted Displays



Head-mounted Displays



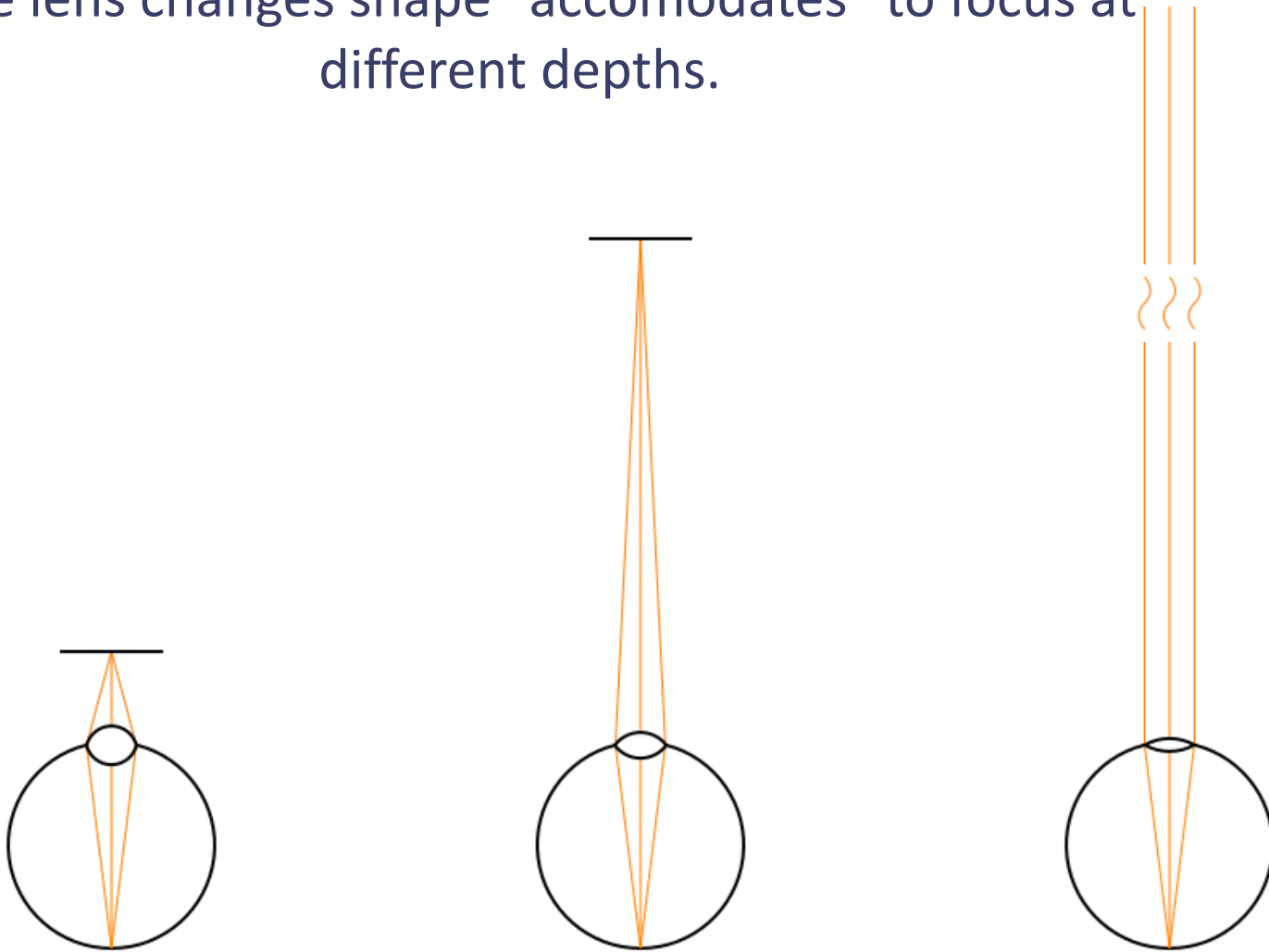
Head-mounted Displays



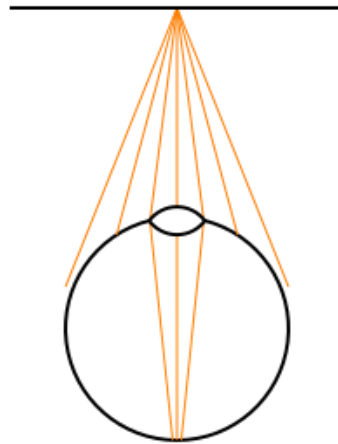
Optics

Accommodation

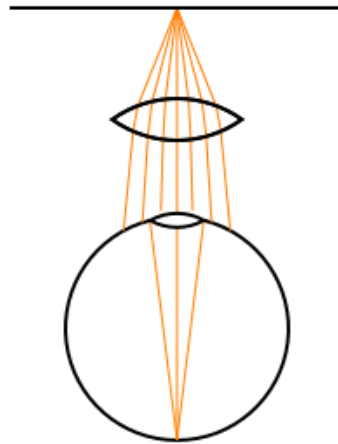
...eye lens changes shape “accommodates” to focus at different depths.



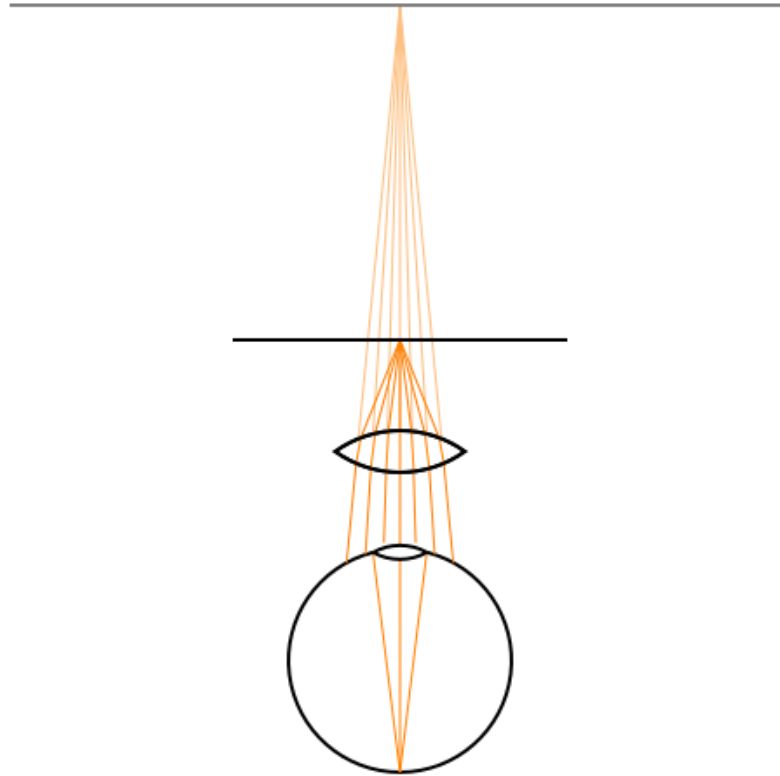
HMD Optics



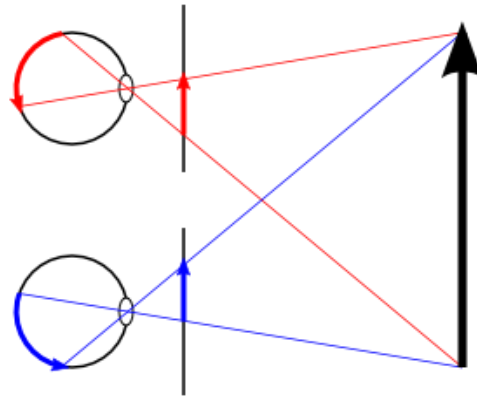
HMD Optics



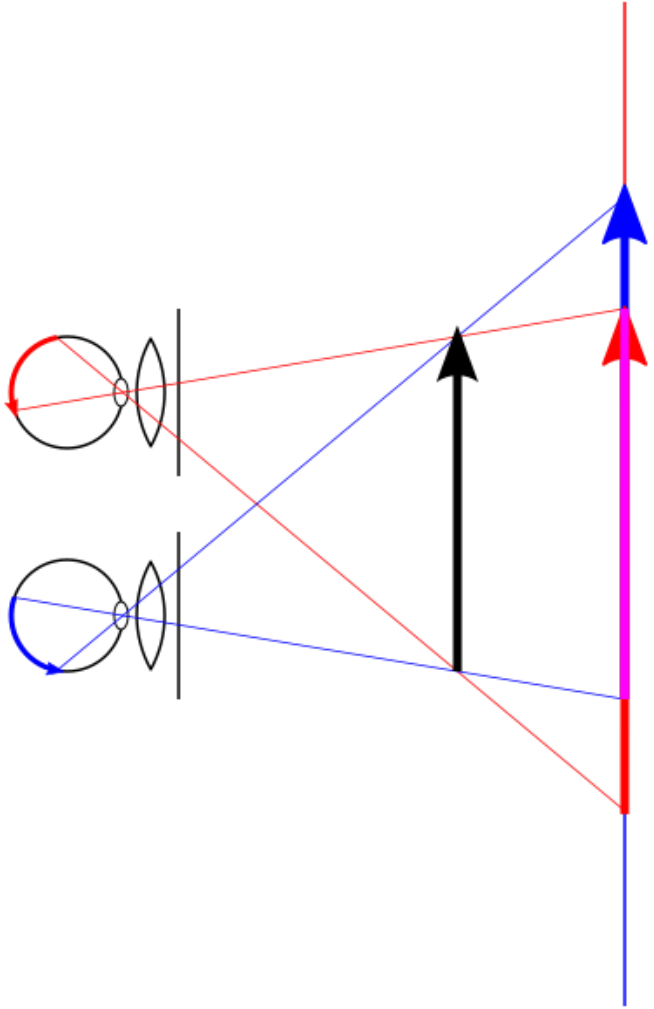
HMD Optics



Head-mounted Displays

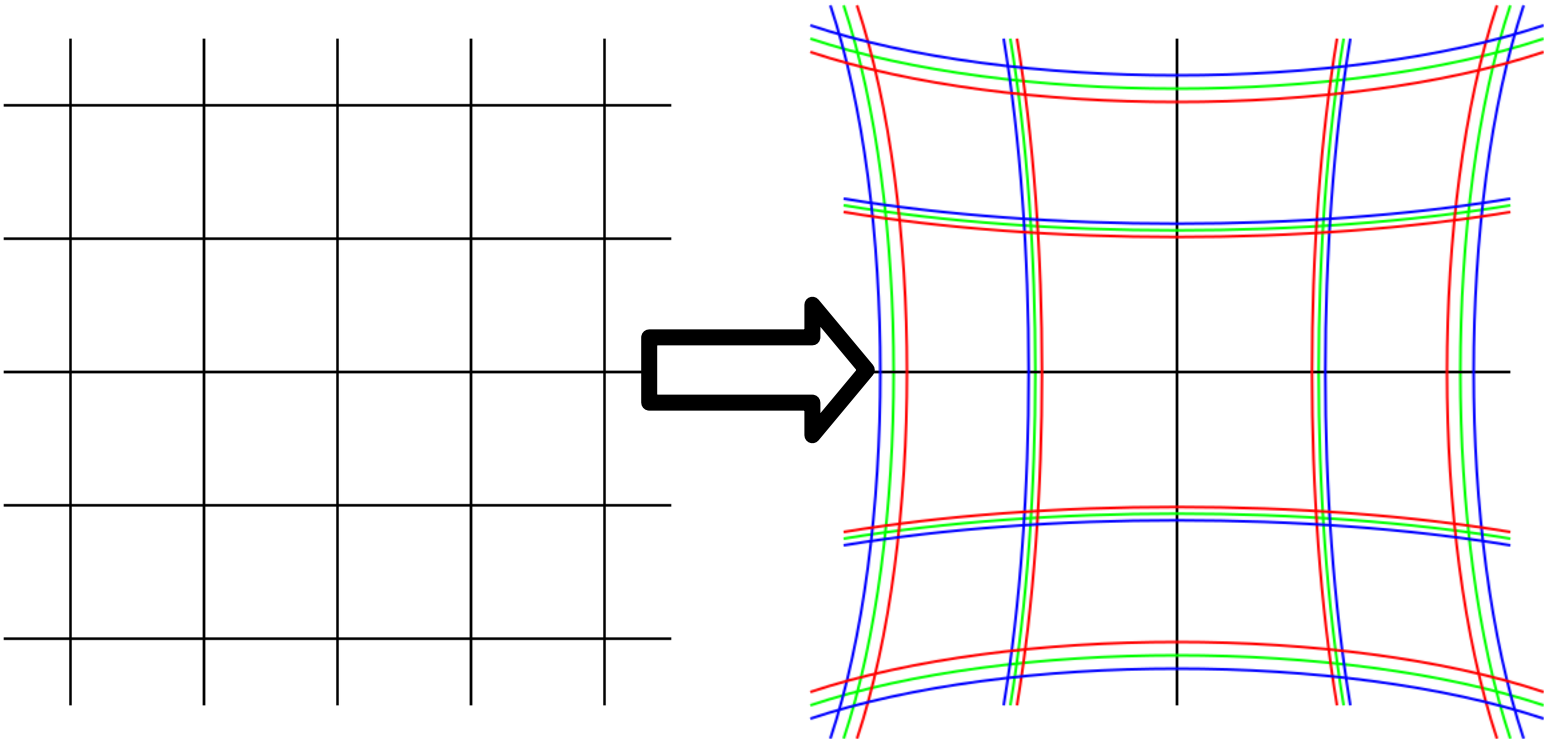


Head-mounted Displays

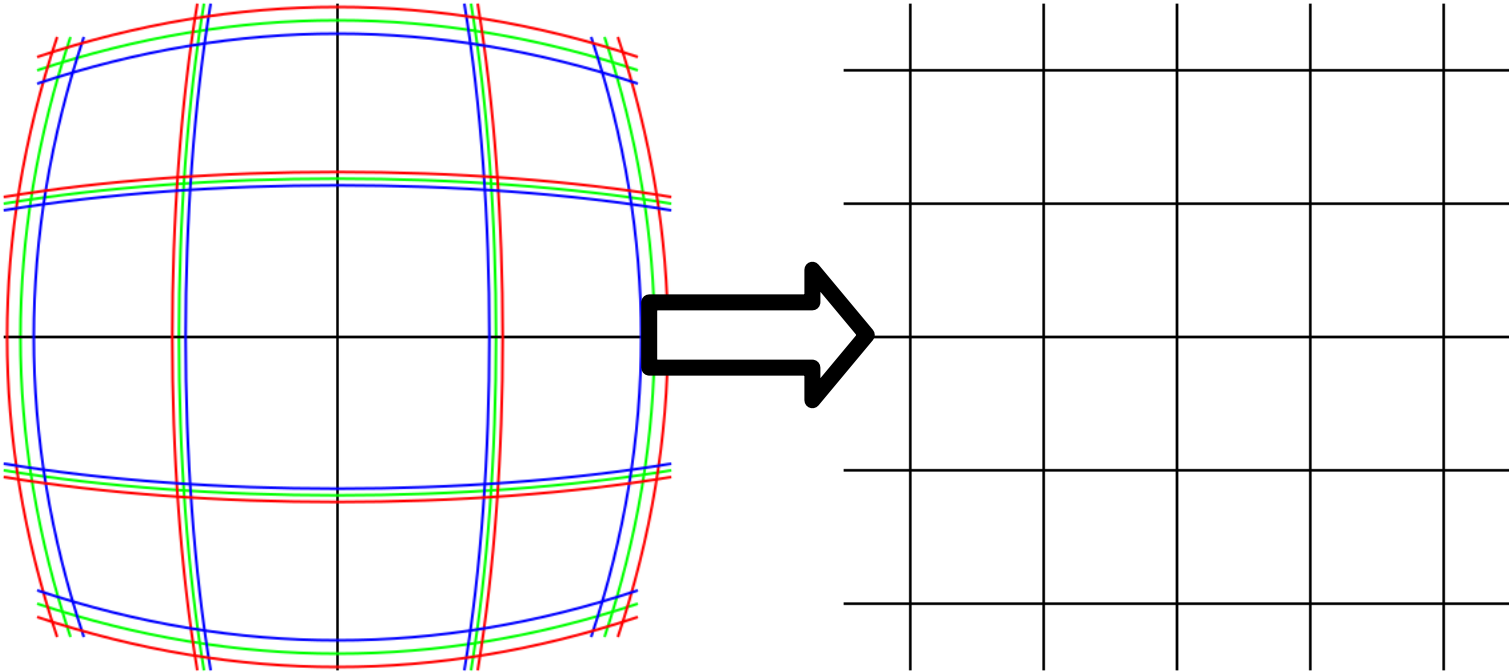


Lens Distortion

Lens Distortion

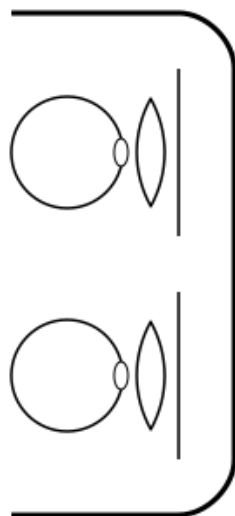


Lens Correction

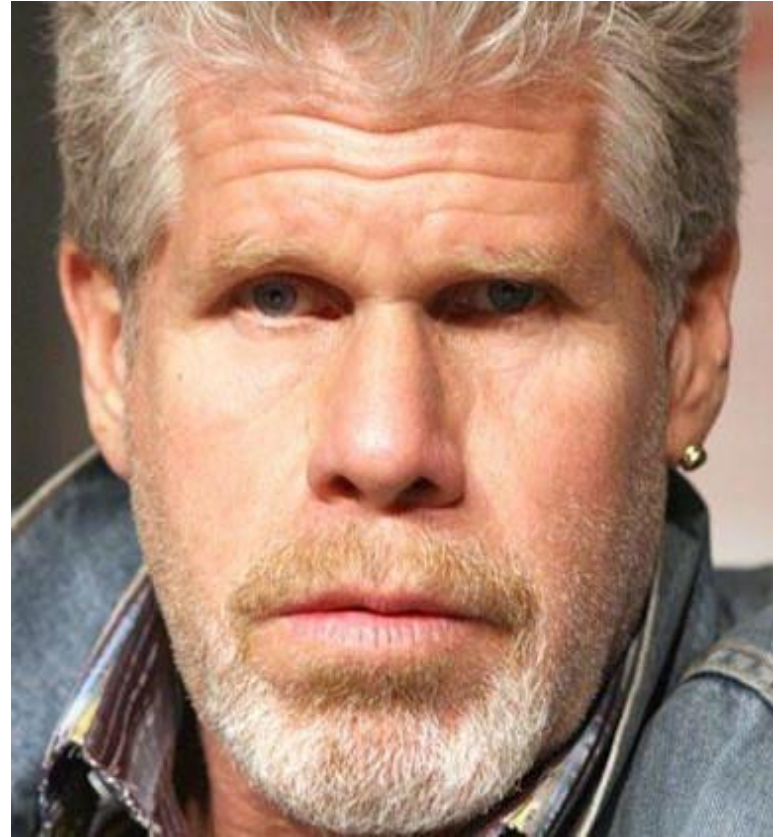


Configuration

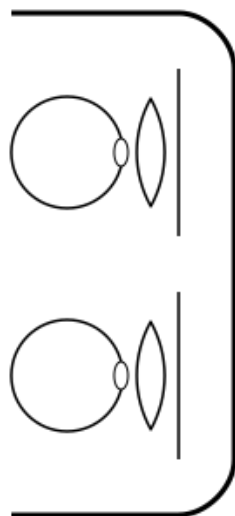
Configuration



Physiognomy

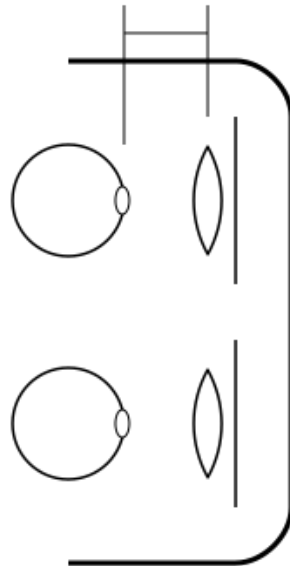


Configuration

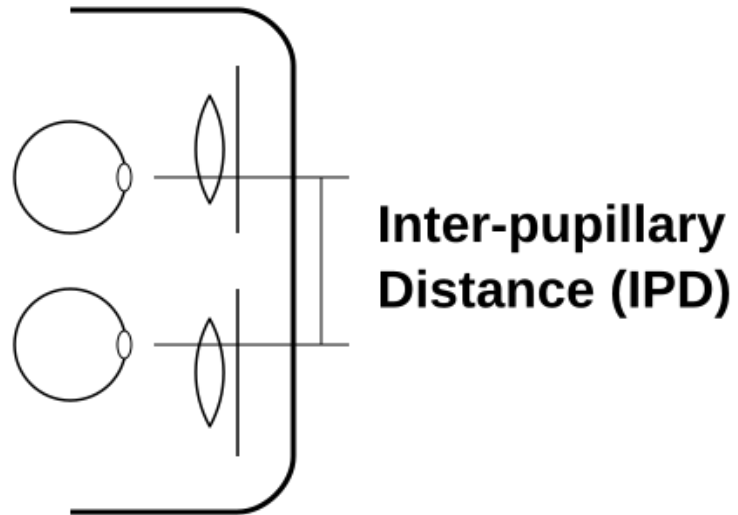


Configuration

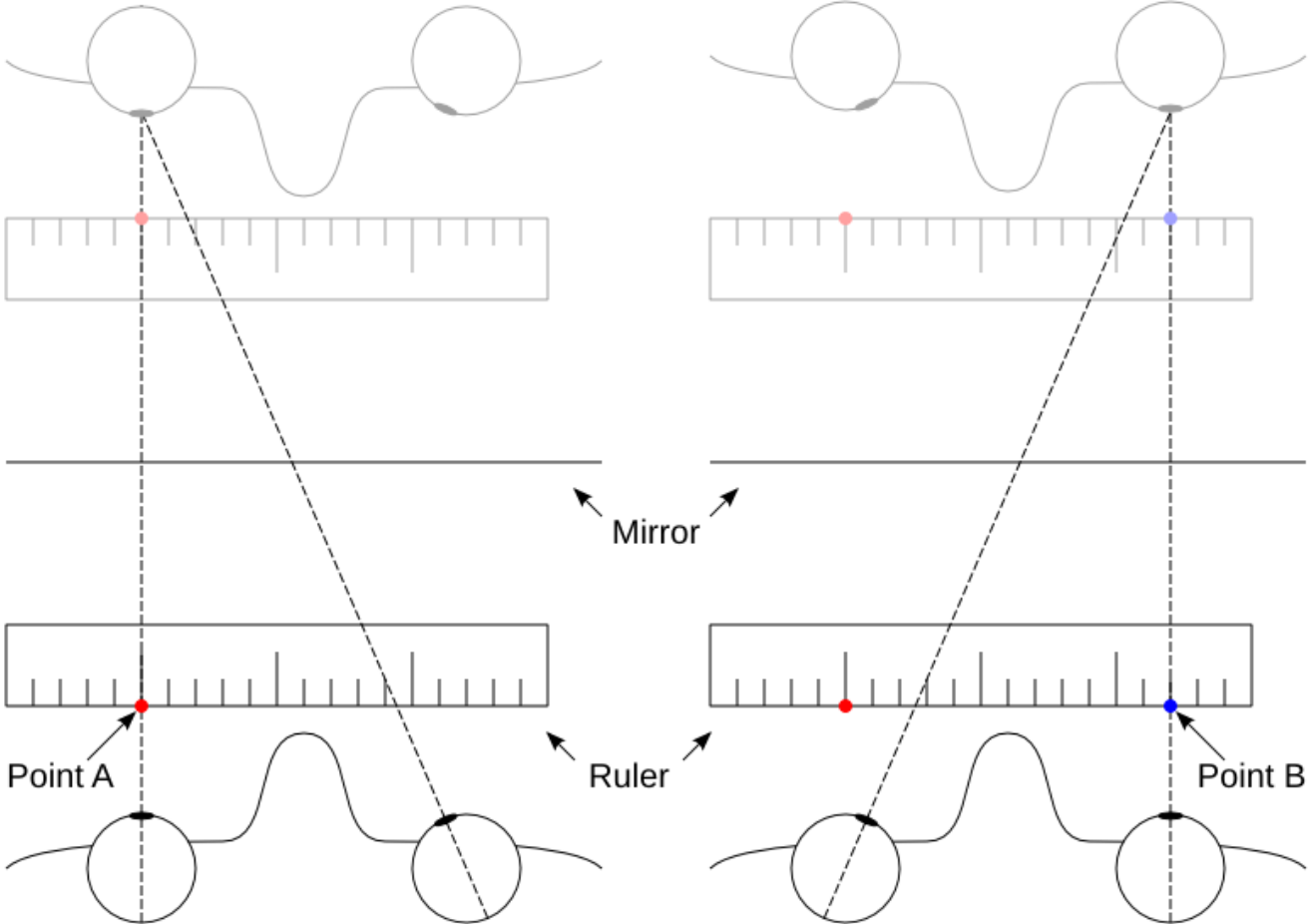
Eye Relief



Configuration



How to measure your IPD

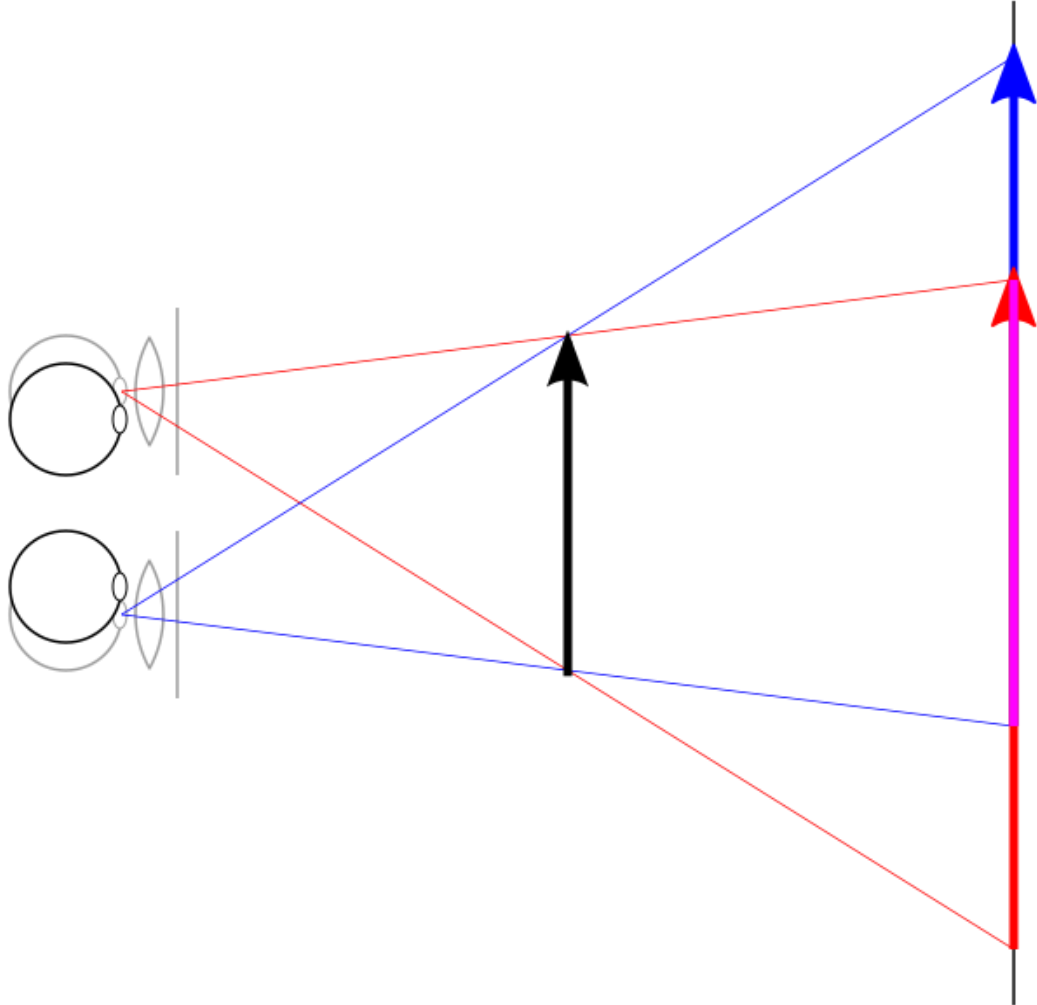


Mis-configuration

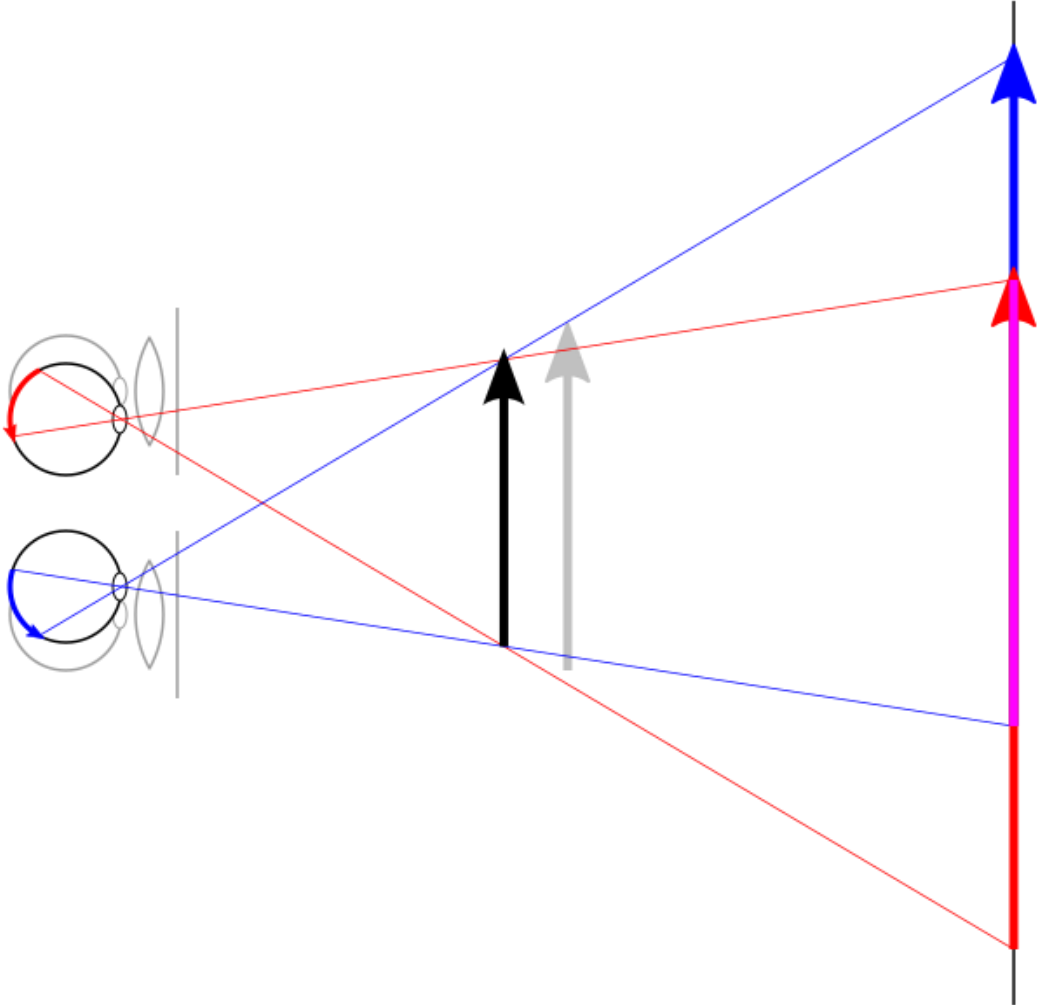
Mis-configuration



Mis-configuration



Mis-configuration (depth inaccuracy)

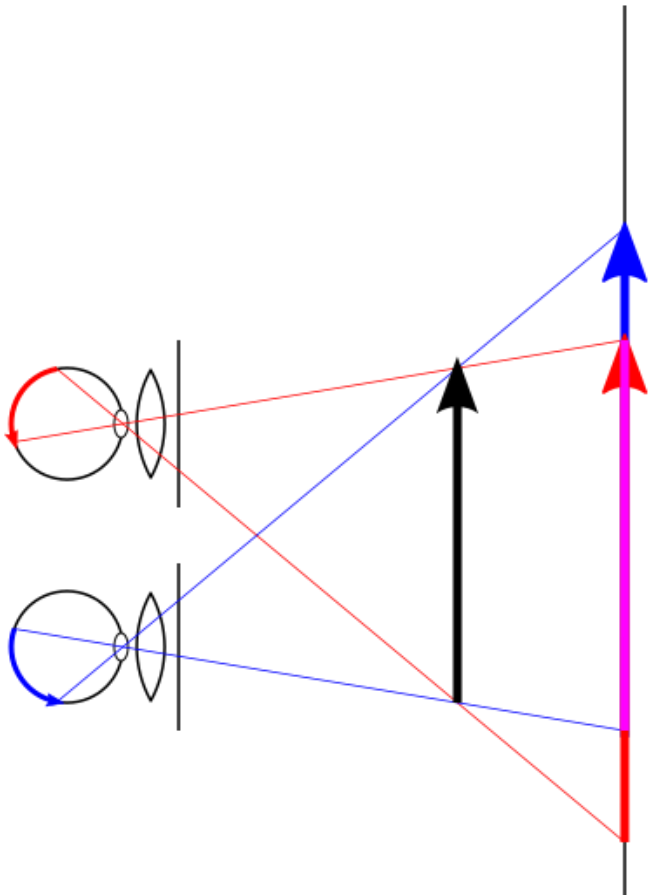


What VR Needs

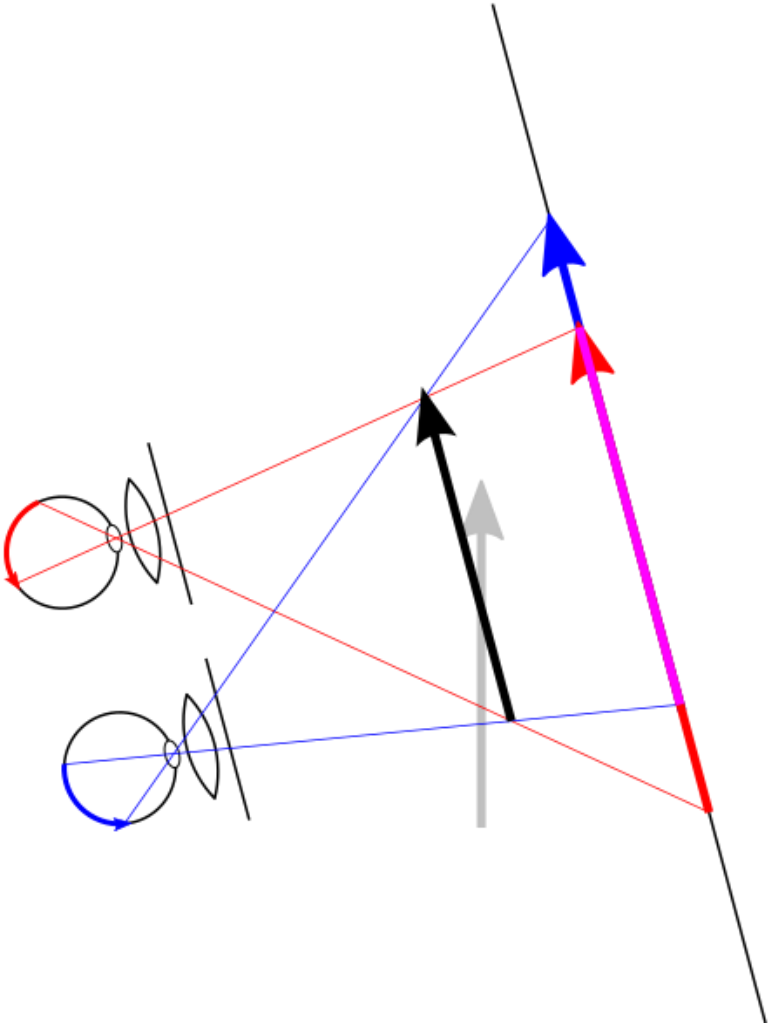
- Good screens and lenses
- Good internal calibration
- High-precision head tracking
- Good user calibration
- Ideally eye tracking
- Low end-to-end latency

End-to-end Latency

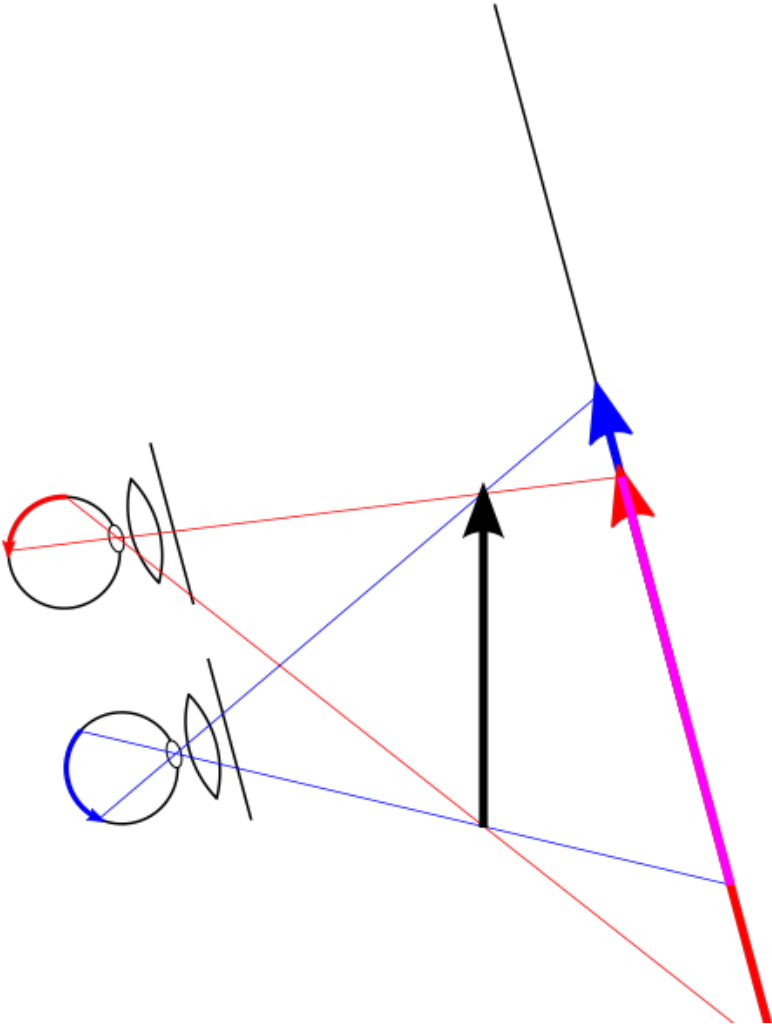
End-to-end Latency



End-to-end Latency



End-to-end Latency



What Else Can Go Wrong?

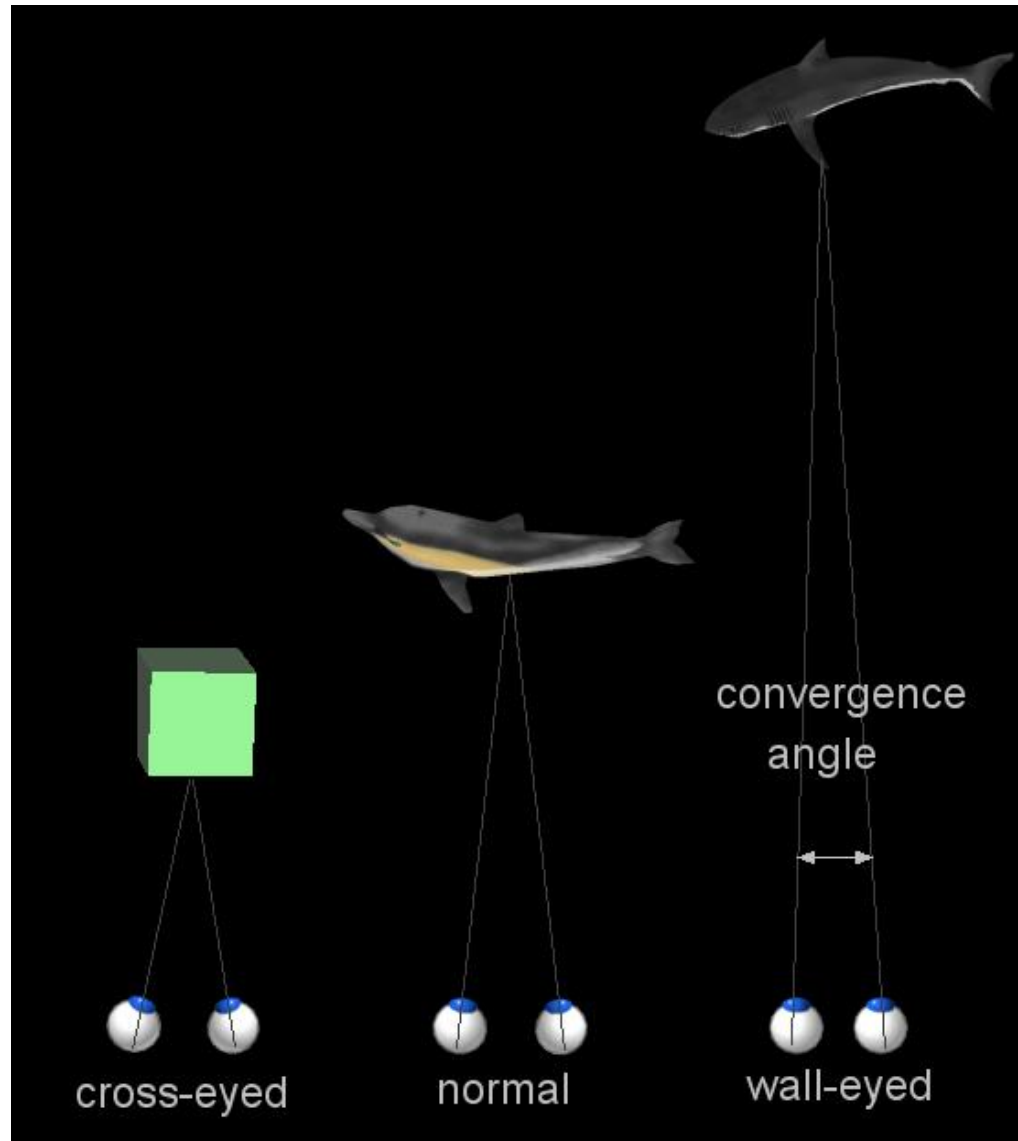
- Artificial locomotion
 - Mismatch between “seen” and “felt” motion
 - Vection-vestibular conflict

Accommodation and Vergence Conflict

Why do virtual objects close to my face appear blurry when wearing a VR headset? My vision is fine!

And why does the real world look strange immediately after a long VR session?

Vergence



Accommodation-Vergence Coupling

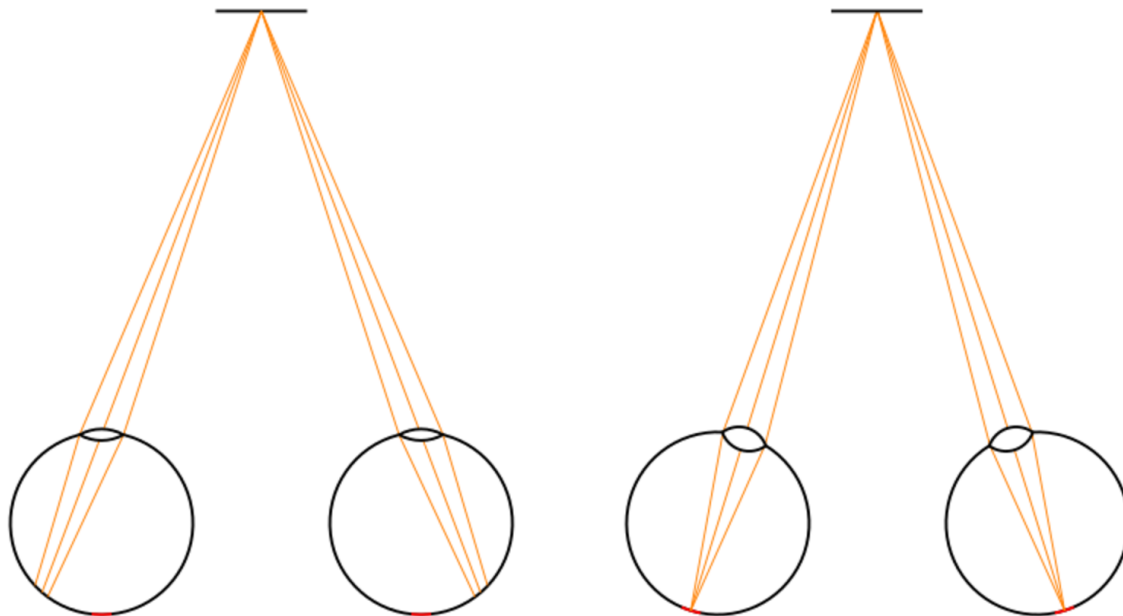
How do our eyes “accommodate” or determine lens focus?

Blurriness reflex.

Foveal vision is clearer than peripheral.

We have two eyes.

=> “vergence”



A-V Conflict Effects

- Blurry objects
- Eye strain
- Accommodation-vergence **decoupling**
- Vision feels “off” for a while after using VR
- Might interfere with vision development in very young children
- Potential solutions:
 - Lenses that allow different screen distances.
 - True Holographic displays.

Projects

Tempest projects

- **Storm: fake storm, audience driven.**

idea: estimate audience interest/gaze on stage, by some optical technology. for eg. processing colored ballcaps worn by audience from a camera on the ceiling. or library like densepose. use the estimated attention of lack of to produce glitches in a projected audio-visual storm to convey it is a manufactured storm. <http://densepose.org/>

- **Prospero's brush: tiltBrush for natural phenomena.**

idea: a tilt brush like interface where you paint out a dynamic landscape with trees and waterfalls. For inspiration see

<https://www.youtube.com/watch?v=uthd5rLJZtg>

http://www.dgp.toronto.edu/~karan/videos/drive_clip.wmv

<https://www.youtube.com/watch?v=TckqNdrdbgk>

<https://www.youtube.com/watch?v=GSbkn6mCfXE>

https://www.youtube.com/watch?time_continue=7&v=qj2XxB2dsco

- **Ariel' magic: Projective painting in real-time.**

idea: have a user view their environment via a 360 camera that they are able to overlay drawings on a tablet. The drawings are projected back onto the environment in real-time.

<https://www.youtube.com/watch?v=KYKyqCsmMAU>

- **Drawing on surfaces in AR/VR**

idea: drawing on an object in 2D is best handled by projecting the sketched 2D points onto the visible objects through the screen. The best way to project an in-air 3D stroke on to 3D objects is not known. A good technique needs to be both intuitive and provide instant feedback so that a user is able correctly produce the on-surface strokes they desire. We already have a working prototype for this. The prototype will need to be improved and tested for usability using the vive in VR.

https://www.youtube.com/watch?v=PSD_nISLoIY

https://www.youtube.com/watch?v=vBos8A_cwSM

Projects

- **Facial Animation in VR**

idea: use voice and hand gestures to control an animated face in VR.

<http://jaliresearch.com/>

- **Proprioceptive interfaces in AR/VR.**

idea: perform a study to understand human proprioceptive zones and design an interface of menus and commands to exploit the zones.

- **Pointing in AR/VR (mirror pointing).**

idea: perform a study to understand human pointing at targets and build a data-driven model to predict pointed targets.

- **Interactive 3D acquisition and scanning of large spaces with AR**

idea: create a gestural interface to create a 3D model of spaces using AR/VR

https://www.youtube.com/watch?v=Xnp3_eMYXj0

- **Direct manipulation, browsing of linked 360 images and video.**

idea: given a number of 360 images of spaces with common features, create a system that allows a user to browse the collection using familiar mobile hand gestures. As an example here are some 360 images, that are not spatially collocated but shown as hotspots that you can use gaze to switch between

<http://demos.janusvr.com/karan/webvr/hotspots/>

Projects

- **Developing a cinematic vocabulary for 360 video in VR.** (shots/cuts/staging).
idea: adapt ideas from 2D cinematography to drive user gaze in 360 video.
- **Augmented Reality for Dance Choreography (with National Ballet).**
idea: take clips or key points of dance choreography that can be overlaid live and controlled by a dancer while dancing.
- **Guided Tours in VR.**
idea: design a system to allow the creation of bots, that are able to guide users through a VR environment. The bot needs to be able to pause the tour based on user interest and focus, the user can choose to leave, join and catch-up with the tour, as well as choose between tours.
- **Immersive platform for language and cultural exchange.**
idea: the French dept. is interested in creating a restaurant scenario that can be used as a setting for language education.