

CSE 190: Virtual Reality Technologies

LECTURE #15: HMD RENDERING OPTIMIZATIONS

Announcements

Project 3 due Sunday, May 31st at 11:59pm

No discussion on Monday (Memorial Day)

Today's VR app presentations:

- Yilin Cai: Laser Mazer
- Silvia Lee: VR Grocery
- Xiaoyang Zeng: Rush VR

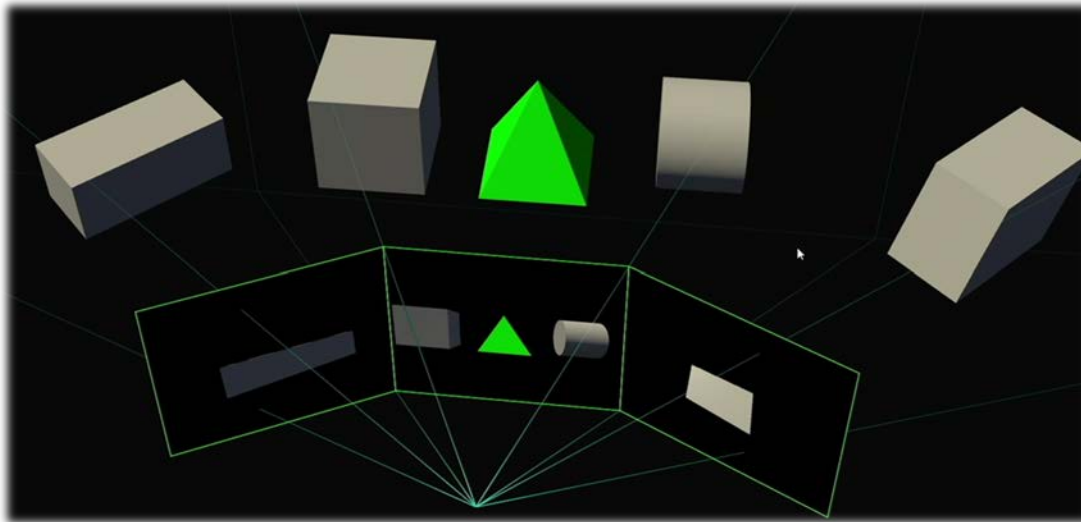
SMP

NVIDIA SMP (Simultaneous Multi-Projection)

Up to 16 independent viewports can be projected simultaneously in one rendering pass

- Includes stereo (=2 viewports)

Video (1'50+): <https://www.youtube.com/watch?v=p6NbyEmPaIA>

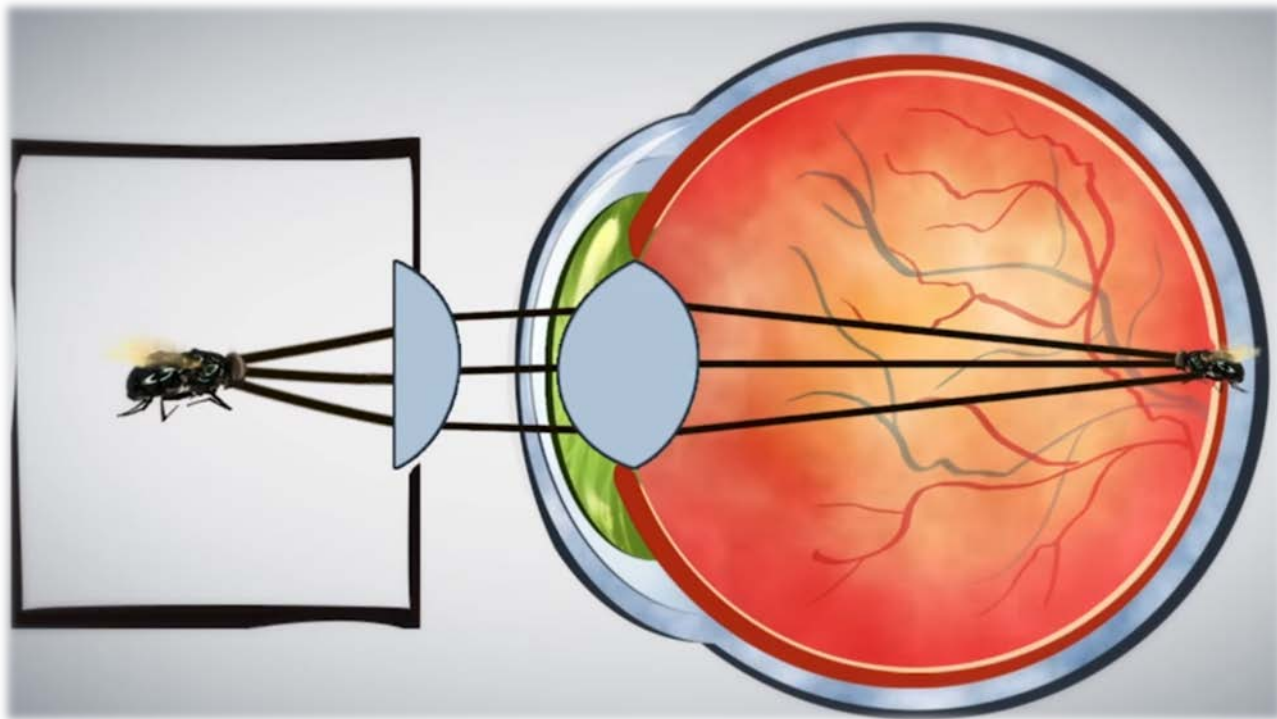


Display Limitations

Lenses for VR HMDs

How lenses for VR HMDs work:

- <https://www.youtube.com/watch?v=NCBEYaC876A>



Focal Distance

Apparent distance from eye to where the pixels are in focus.

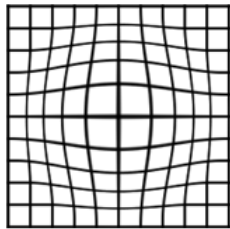
HMD	Focal Distance
Oculus DK1	Infinity
Oculus DK2	1.4 meters
Oculus CV1	2 meters
HTC Vive	~1 meter

Lens Distortion

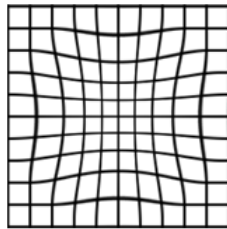
All VR HMDs have lenses which distort the image.

VR engine has to render a pre-distorted image so that the user will see a correct, undistorted image. A simple pixel shader can do this.

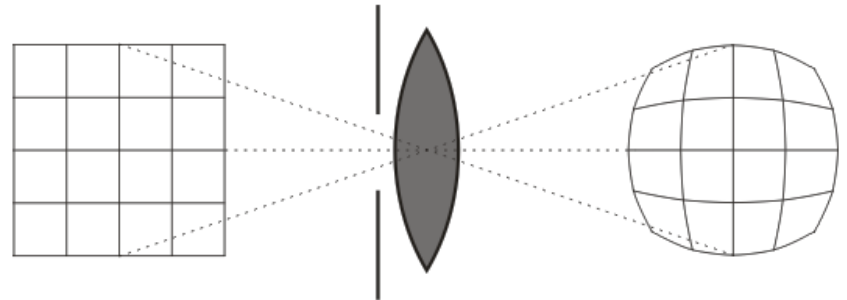
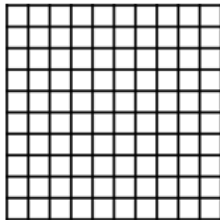
**Barrel Distortion
(In-Engine)**



**Pin-cushion Distortion
(From Rift Lenses)**

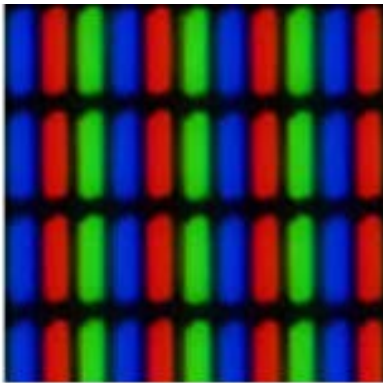


**No Distortion
(Final Observed Image)**

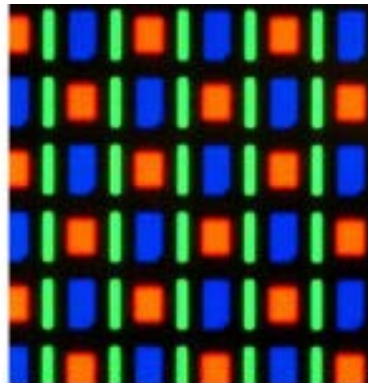


Screen Door Effect

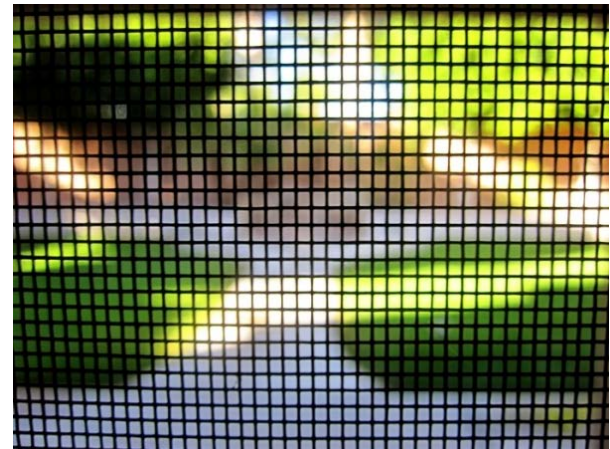
Because pixels on LCD and OLED displays have dead space in-between them image looks like looking through a screen door when looking at it through magnifying lenses.



LCD
DK1



OLED
DK2



Screen Door

Chromatic Aberration

Arises from the inability of a lens to focus all colors in the same place.

Focal length depends on refraction.

blue and red light have different indexes of refraction → their focal length is also slightly different.

Chromatic aberration is clearly visible on photographs or video as the color channels are not perfectly aligned.

Remedy: apply “Brown's model” distortion correction formula to each color channel independently.

