



Chapter 4

Light and Optics

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Two purposes: Understand how headsets behave in the real world, and understand how physics of a virtual world should mimic the real world.

4.1 Physics of Light

Three interpretations: particles, rays, waves

Point sources of light: wavefronts and rays. Always diverge, unless mirrors or lenses.

Parallel rays (collimated rays, zero vergence, rays to/from infinity)

Interactions with materials: 1. transmission, 2. absorption, 3. reflection, 4. diffraction.

Reflection types: specular, diffuse

Snell's law

4.2 Lenses

A bit of history? Could be mirrors or transparent. Fresnel.

Simple convex lens: A stack of pancake prisms.

Show what happens to parallel rays

Wavefront interpretation as well.

Off center parallel rays and focal plane.

Simple concave lens for parallel rays

Lensmaker's equation (thin approximation)

Diopters with examples and algebra.

Imaging properties of lens

$$\frac{1}{s_1} + \frac{1}{s_2} = \frac{1}{f} \quad (4.1)$$

If $s_1 = \infty$, then $s_2 = f$.

With $s_2 < 0$, a magnifying glass is obtained, like in Rift. This is a virtual image.

4.3 Optical Aberrations

Spherical aberration

Optical distortion: barrel, pinchusion. Solutions.

Chromatic aberration: spectral power, spectral reflectance, dispersion in prism.

Solutions.

Astigmatism.

Coma, Airy pattern.

4.4 The Human Eye

A quick lesson on the human eye as a lens. Consider it a preview until Chapter 5. Here is just geometric or lens-equivalent concepts.

Rays from infinity, sharp image

Diverging rays, relaxed eye muscle, blur on retina

Accommodation: Eye muscles refocus, diopter increases, sharp image

Reading glasses: Makes objects seem infinitely far away, or at least further than they really are. Performs some diopter/convergence.

A video display in front of a lens which is in front of the eye. Mention problems such as "input pixels" and eye movement. Pointers to later sections.

4.5 Cameras

A bit on history of cameras.

Rolling vs. global shutter.

Sensing elements.

Perspective projection reminder from Section 3.4.

Calibration parameters.

Bibliography