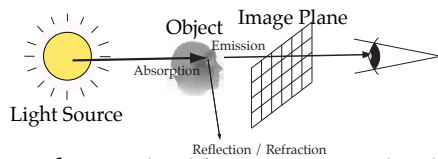


Modelling Transmission



- Light is *emitted* from a source, *absorbed* / *reflected* / *refracted* by an object, additional light added by *emission and reflection*, then reaches the eye



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Density Clouds

- Photons are *blocked* by *absorption*
- Probability depends on *density*
 - i.e. how many particles are in the way
- Measured as *optical density*
 - # of particles / mm



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Example

- Suppose an inch of lead blocks 90% of X-ray photons
- How much does 2 inches block?
 - $99\% = 100\% - (100\% - 90\%)^2$
- I.e. absorption is *exponential*



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Volume Rendering Integral

Let λ be a given wavelength of light

Let $x + \vec{r}t$ be a ray of length L from the eye through a pixel x

Then the amount of light of wavelength λ at the pixel is:

$$I_{\lambda}(x, r) = \int_0^L C_{\lambda}(s) \mu(s) e^{-\int_0^s \mu(t) dt} ds$$

$C_{\lambda}(s)$ is the colour contribution at s

$\mu(s)$ is the mass density at s



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Opacities & Colour

- We relate *isovalue* to colour & opacity
- Simple model:

$$C_{\lambda}(s) = (r(f(s), g(f(s)), b(f(s))), a(f(s)))$$
- Optical *properties* are a *function* of *isovalue*
 - We call this a *transfer function*



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Transfer Functions

- The *transfer function* defines $C_{\lambda}(s)$
- Depends on:
 - isovalue at s
 - gradient at s
 - *classification* / *segmentation* of s



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VR Methods

- Ray-tracing (slow)
 - numerical integration along rays
- Compositing techniques:
 - projected
 - shear-warp

