PBR Notes

Arden Rasmussen

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2.1 Radiometry Recap

What to measure in a simulation?

Radiant flux (or power) Total amount of energy passing through a surface (measured per second).

$$\Phi\,[W]$$

It is not good to measurethe radiant flux , because it is the energy per surface, so a large radiant flux could either be

1. A lot of energy over a small surface.
2. A little energy over a large surface.

This metric is ambiguious, and thus it is not good enough.

Lets comput the flux by unit area (irradiance).

$$E\,[W/m^2]$$

This is still ambiguous, we haven't fixed the angle wihc the ligh arives to the surface. So

1. A lot of energy in a huge angle.
2. A little energy in a small angle.

will measure the same irradiance.

Compute the flux by unit area and unit angle(radiance).

$$L\,[W/\left(m^2 \cdot sr\right)]$$

Note: angle in more diemsions is called solid angle, for which the unit is steradians.

This is the measurement that we will be using to measure.

2.2 The most fundamental question

How much light exiss a surface point in a given direction?

The answer is given by Maxwell equations!

In practice, we don't do this, it would be too complicated.

The real solution is the rendering equation!

2.3 The scalar product

$$\vec{a} \cdot \vec{b} \equiv ||\vec{a}|| \cdot ||\vec{b}|| \cos\theta$$

We will usualy use vectors of unit length, so

$$\vec{a} \cdot \vec{b} \equiv \cos\theta$$

2.4 Terminology

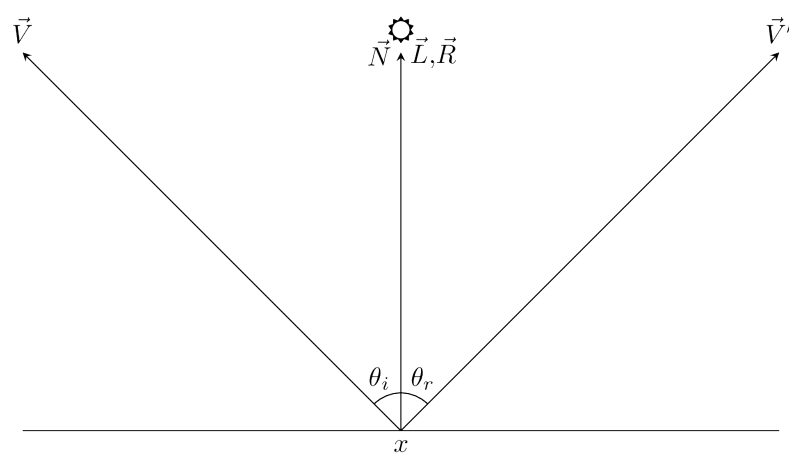

Figure 2.1: Figure

- $\vec{V}$ direction towards the viewer (eye,camera)
- $\vec{N}$ surface normal

- $\vec{L}$ vector point towards the light source
- $\vec{R}$ reflected ray direction $\vec{R} = \vec{L} - 2\vec{N}\left(\vec{L} \cdot \vec{N}\right)$.
- θ_i, θ_r incident and reflected angles

Vectors are always pointing out form the point x.

2.5 Light Attenuation

When the sun is directly above as in the prvious figure.

$$\left(\vec{L} \cdot \vec{N}\right) \Phi = \cos 0 \Phi = \Phi$$

If the sun is off to one side as in this figure if $\alpha \approx 45°$.

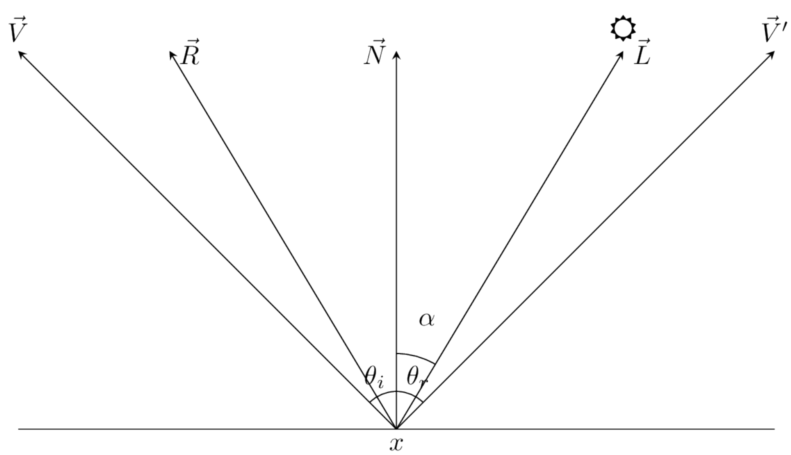

Figure 2.2: Figure

$$\left(\vec{L} \cdot \vec{N}\right) \Phi = \cos \alpha \Phi \approx 0.7\Phi$$

If the sun is near 90°, as in this figure, where $\alpha \approx 90°$.

$$\left(\vec{L} \cdot \vec{N}\right) \Phi = \cos \alpha \Phi \approx 0$$

Thus we can model the light attenuation using this dot product.

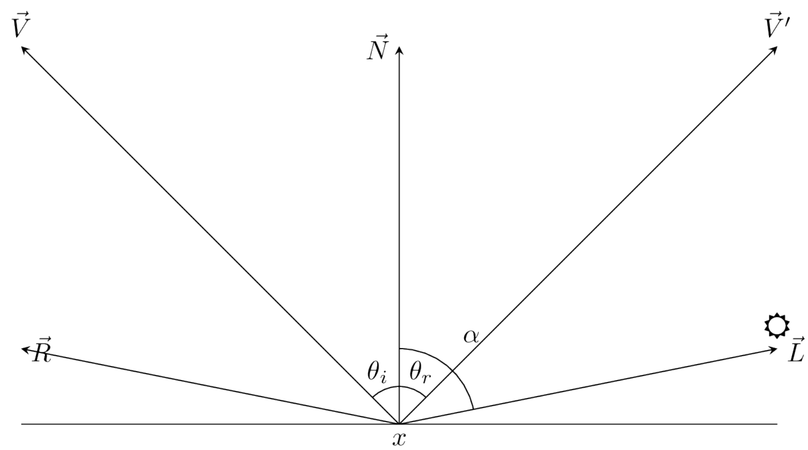

Figure 2.3: Figure