Physical Rendering

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1 Measurements

1.1 Radiant Flux

The radiant flux (or power) Φ is the total amount of energy passing through a surface per second and is measured in $[W]$ (watts) as $\frac{J}{s}$.

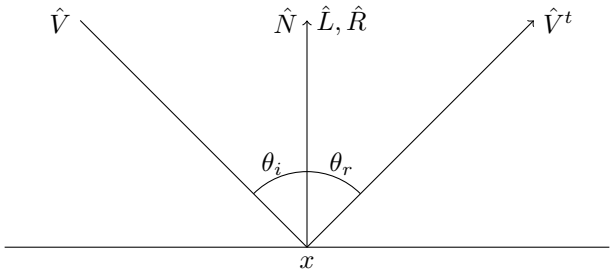
1.2 Irradiance

The irradiance E is the measurements of the radiant flux per *unit area* and is measured in $[W][M]^{-2}$ as $\frac{\Phi}{m^2}$.

1.3 Radiance

The radiance L is the irradiance per unit solid angle (steradian) and is measured in $[W][M]^{-2}[M]^{-2}[sr]^{-1}$ as $\frac{E}{sr}$.

2 Terminology



- $\hat{V}$ direction towards the camera
- $\hat{N}$ surface normal
- $\hat{L}$ vector pointing toward the light source
- $\hat{R}$ reflected ray direction
- θ_i, θ_r incident and reflected angles

$\hat{R} = \hat{L} - 2\hat{N}(\hat{L} \cdot \hat{N})$

3 Rendering equation

The rendering equation tells us how much light is exiting a *surface point* in a given direction

ASSETS TO USE

The rendering equation

$$L_o(x,\vec{\omega}) = L_e(x,\vec{\omega}) = \int_\Omega L_i(x,\vec{\omega}) f_r(\vec{\omega},x,\vec{\omega}^{'}) \cos\theta d\vec{\omega}^{'}$$

The Fresnel Equation

$$R_s(\theta) = \left| \frac{n_1 \cos\theta - n_2 \sqrt{1 - \left(\frac{n_1}{n_2}\sin\theta\right)^2}}{n_1 \cos\theta + n_2 \sqrt{1 - \left(\frac{n_1}{n_2}\sin\theta\right)^2}} \right|$$

Snell's law

$$\frac{\sin\theta_1}{\sin\theta_2} = \frac{V_1}{V_2} = \frac{n_2}{n_1}$$

References

[1] K'aroly Zsolnai-Feh'er. *TU Wien Rendering Course*. https://users.cg.tuwien.ac.at/zsolnai/gfx/rendering-course/. 2018.