

# Advanced Topics in Computer Graphics I - Sheet R03

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## Assignment 2

### Reflection Equation

Radiance of Sun:  $L_s = 20.045 \frac{MW}{m^2 \cdot sr}$

### Irradiance of table:

Solid Angle Sun:

$$\begin{aligned}\Omega &= \pi \cdot \frac{r_s^2}{d_s^2} \\ &= 6.81 \cdot 10^{-5} sr\end{aligned}$$

Where  $r_s$  is the radius of the sun and  $d_s$  is the distance to the sun.

$$\begin{aligned}E_T &= \int_{\Omega} L_{\theta} \cdot \cos(\theta) \cdot d\omega \\ &= L_s \cdot \cos(45^\circ) \cdot \int_{\Omega} d\omega \\ &= 20.045 \cdot 10^6 \frac{W}{m^2 \cdot sr} \cdot \cos(45^\circ) \cdot 6.81 \cdot 10^{-5} sr \\ &= 965.246 \frac{W}{m^2}\end{aligned}$$

**Radiance of table:**

$$\begin{aligned}
 L_T &= L_e + f_{BRDF} \cdot E_T \\
 &= 0 + \frac{0.5}{\pi} \cdot E_T \\
 &= \frac{0.5}{\pi} \cdot 965.246 \frac{W}{m^2} \\
 &= 153.624 \frac{W}{m^2 \cdot sr}
 \end{aligned}$$

**Irradiance of Lens:**

Solid Angle Table:

$$\begin{aligned}
 \Omega &= 4 \cdot \arctan \left( \frac{l^2}{2d \cdot \sqrt{4d^2 + 2l^2}} \right) \\
 &= 4 \cdot \arctan \left( \frac{(0.8m)^2}{2 \cdot 1.2m \cdot \sqrt{4 \cdot (1.2m)^2 + 2 \cdot (0.8m)^2}} \right) \\
 &= 0.401sr
 \end{aligned}$$

$$\begin{aligned}
 E_L &= \int_{\Omega} L_{\theta} \cdot \cos(\theta) \cdot d\omega \\
 &= L_T \cdot \cos(45^\circ) \cdot \int_{\Omega} d\omega \\
 &= 153.624 \frac{W}{m^2 \cdot sr} \cdot \cos(0^\circ) \cdot 0.401sr \\
 &= 61.552 \frac{W}{m^2}
 \end{aligned}$$

**Radiant Power of Lens:**

$$\begin{aligned}
 A &= \pi \cdot r^2 \\
 &= \pi \cdot (0.025m)^2 \\
 &= 0.0019635m^2
 \end{aligned}$$

$$\begin{aligned}
 P_L &= E_L \cdot A \\
 &= 61.552 \frac{W}{m^2} \cdot 0.0019635 m^2 \\
 &= 0.121 W
 \end{aligned}$$