Philipp von Bachmann,
Mat.-Nr.: 4116220
David Ott,
Mat.-Nr.: 4185646

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Assignment Nr. 4

4.1 Radiometry

a)

$\omega = (\theta, \phi)$

$$
\begin{aligned}
E &= \int_0^{2\pi} \int_0^{\frac{\pi}{2}} L(x,\omega) \cos\theta \sin\theta d\theta d\phi \\
&= \int_0^{2\pi} \int_0^{\frac{\pi}{2}} \frac{d^2\Phi}{dA\cos(\theta) d\omega} \cos\theta \sin\theta d\theta d\phi \\
&= \int_0^{2\pi} \int_0^{\frac{\pi}{2}} \frac{d^2\Phi}{\sin(\theta) d\theta d\phi \cdot r^2 \cos(\theta) d\omega} \cos\theta \sin\theta d\theta d\phi \\
&= \int_0^{2\pi} \int_0^{\frac{\pi}{2}} \frac{d^2\Phi}{r^2 d\omega} \\
&= \int_0^{2\pi} \int_0^{\frac{\pi}{2}} \frac{d^2\Phi}{r^2 d\theta d\phi} \\
&= \\
&= \frac{\Phi_S \cos(\theta)}{4\pi(r^2+d^2)}
\end{aligned}
$$

4.2 Analytical solution of the rendering equation in 2D

b)

$$
\begin{aligned}
L(x,\omega_o) &= L_e(x,\omega_o) + \int_{y\in S} f_r(\omega_i, x, \omega_o) \cdot L(y, -\omega_i(x,y)) \cdot \frac{\cos\phi_i \cos\phi_y}{|x-y|} \cdot dy_x \\
&= L_e(x,\omega_o) + \int_{-1}^{1} f_r(\omega_i, x, \omega_o) \cdot L(y, -\omega_i(x,y)) \cdot \frac{\cos\phi_i \cos\phi_y}{|x-y|} \cdot dy_x
\end{aligned}
$$

If we are not in a light source this is:

$$
\begin{aligned}
&= \int_{-1}^{1} f_r(\omega_i, x, \omega_o) \cdot L(y, -\omega_i(x,y)) \cdot \frac{\cos\phi_i \cos\phi_y}{|x-y|} \cdot dy_x \\
&= \int_{-1}^{1} f_r(\omega_i, x, \omega_o) \cdot L(y, -\omega_i(x,y)) \cdot \frac{\cos\phi_i \cos\phi_y}{\sqrt{(x_x-y_x)^2+(x_y-y_y)^2}} \cdot dy_x \\
&= \int_{-1}^{1} f_r(\omega_i, x, \omega_o) \cdot 1 \cdot \frac{\cos\phi_i \cos\phi_y}{\sqrt{(x_x-y_x)^2+(x_y-y_y)^2}} \cdot dy_x \\
&=
\end{aligned}
$$

4.3 Simple Path Tracer