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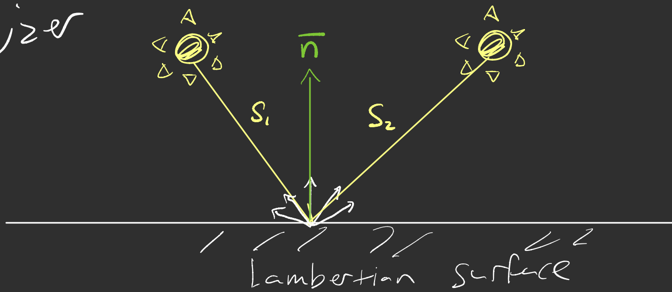


ⓐ

$$\left.\begin{array}{l} L_1 = k_1 P(n \bullet S_1) \\ L_2 = k_2 P(n \bullet S_2) \end{array}\right\} \text{ where } \begin{array}{l} k = \text{intensity} \\ S = \text{Source direction (unit vector)} \end{array}$$

$$L_3 = L_1 + L_2$$

$$\Rightarrow L_3 = (k_1 P(n \bullet S_1)) + (k_2 P(n \bullet S_2))$$

$\Rightarrow$ since $k_1 = k_2 = k$, $L_3 = kP(n \bullet S_1) + kP(n \bullet S_2)$

$$\Rightarrow L_3 = kP(n \bullet (S_1 + S_3))$$

To represent a single effective light source $S_3$,

$$L_3 = k_3 P(n \bullet S_3)$$

Therefore $k_3 P(n \bullet S_3) = kP(n \bullet (S_1 + S_2))$

Thus $\boxed{S_3 = \dfrac{(S_1 + S_2)}{|S_1 + S_2|}}$

unit vector

$$\Rightarrow L_3 = k_3 P\left(n \cdot \left(\frac{(S_1 + S_2)}{|S_1 + S_2|}\right)\right) \Rightarrow L_3 = \frac{k_3}{|S_1 + S_2|} P(n \cdot (S_1 + S_2))$$

Since $L_3 = kP(n \cdot (S_1 + S_2)) = \dfrac{k_3}{|S_1 + S_2|} P(n \cdot (S_1 + S_2))$

$$\Rightarrow k = \frac{k_3}{|S_1 + S_2|} \Longrightarrow \boxed{k_3 = k|S_1 + S_2|}$$

(b) $k_1 \neq k_2$

$$L_3 = k_1 \rho(n \cdot S_1) + k_2 \rho(n \cdot S_2)$$

$$\Rightarrow L_3 = \rho(k_1 n \cdot S_1 + k_2 n \cdot S_2)$$

$$\Rightarrow L_3 = \rho(n \cdot (k_1 S_1 + k_2 S_2))$$

To represent $S_3$,

$$S_3 = \frac{(k_1 S_1 + k_2 S_2)}{|k_1 S_1 + k_2 S_2|}$$

$$k_3 = |k_1 S_1 + k_2 S_2|$$