

# Equation summary

## Direct illumination

$$I_{\text{direct}} = k_e + k_a I_{La} + \sum_j A_j^{\text{shadow}} A_j^{\text{dist}} I_{Lj} B_j \left[ k_d (\mathbf{N} \cdot \mathbf{L}_j) + k_s (\mathbf{N} \cdot \mathbf{H}_j)^{n_s} \right]$$

$$A_j^{\text{dist}} = \min \left\{ 1, \frac{1}{a_j + b_j r_j + c_j r_j^2} \right\}$$

## Direct plus indirect illumination

$$I_{\text{total}} = I_{\text{direct}} + k_r I_{\text{reflectedRay}} + k_t I_{\text{transmittedRay}}$$

## Reflection direction

$$\mathbf{R} = 2(\mathbf{V} \cdot \mathbf{N})\mathbf{N} - \mathbf{V}$$

## Refraction direction

$$\eta = \frac{\eta_i}{\eta_t}$$

$$\cos \theta_i = \mathbf{N} \cdot \mathbf{V}$$

$$\cos \theta_t = \sqrt{1 - \eta^2 (1 - \cos^2 \theta_i)}$$

$$\mathbf{T} = (\eta \cos \theta_i - \cos \theta_t)\mathbf{N} - \eta \mathbf{V}$$

Note that total internal reflection (TIR) occurs when the square root term above is imaginary.