OpenGL Fixed-function Lighting Equation

surface result color

$$\mathbf{c} = \mathbf{e}_{cm}$$ *emissive*

$$+ \mathbf{a}_{cm} * \mathbf{a}_{cs}$$ *global ambient*

$$+ \sum_{i=0}^{n-1} (att_i)(spot_i) \left[\mathbf{a}_{cm} * \mathbf{a}_{cli} \right.$$ *per-light ambient*

for each light source

$$+ (\mathbf{n} \odot \overrightarrow{\mathbf{VP}}_{pli}) \mathbf{d}_{cm} * \mathbf{d}_{cli}$$ *diffuse*

$$\left. + (f_i)(\mathbf{n} \odot \hat{\mathbf{h}}_i)^{s_{rm}} \mathbf{s}_{cm} * \mathbf{s}_{cli} \right]$$ *specular*

$$f_i = \begin{cases} 1, & \mathbf{n} \odot \overrightarrow{\mathbf{VP}}_{pli} \neq 0, \\ 0, & \text{otherwise}, \end{cases}$$

diffuse squashes specular

OpenGL Lighting Equation Terms

half-angle

$$\mathbf{h}_i = \begin{cases} \overrightarrow{\mathbf{VP}}_{pli} + \overrightarrow{\mathbf{VP}}_e, & v_{bs} = \texttt{TRUE}, \\ \overrightarrow{\mathbf{VP}}_{pli} + (0 \quad 0 \quad 1)^T, & v_{bs} = \texttt{FALSE}, \end{cases}$$

local viewer assumption

infinite viewer assumption

distance attenuation

$$att_i = \begin{cases} \dfrac{1}{k_{0i} + k_{1i}\|\mathbf{VP}_{pli}\| + k_{2i}\|\mathbf{VP}_{pli}\|^2}, & \text{if } \mathbf{P}_{pli}\text{'s } w \neq 0, \\ 1.0, & \text{otherwise}, \end{cases}$$

inverse square fall-off

spotlight attenuation

$$spot_i = \begin{cases} (\overrightarrow{\mathbf{P}_{pli}\mathbf{V}} \odot \hat{\mathbf{s}}_{dli})^{s_{rli}}, & c_{rli} \neq 180.0, \overrightarrow{\mathbf{P}_{pli}\mathbf{V}} \odot \hat{\mathbf{s}}_{dli} \geq \cos(c_{rli}), \\ 0.0, & c_{rli} \neq 180.0, \overrightarrow{\mathbf{P}_{pli}\mathbf{V}} \odot \hat{\mathbf{s}}_{dli} < \cos(c_{rli}), \\ 1.0, & c_{rli} = 180.0. \end{cases}$$