

Out going Flux : 200 = F(w) 201

Physically Based Shading D(w) dw dA = ((w), dw cos (w), w) dA(w) Shading D(w) dw dA = ((w), dw cos (w), w) dA(w) Shading D(w) dw dA = ((w), dw cos (w), w) dA(w) Shading D(w), dw dA = ((w), dw), dA

to go from integrating over Erik Sintorn, 2016 $\partial \overline{\Psi}_{h}(\omega i \partial \theta \delta) = \lambda i (\omega i) \partial \omega \cos(\omega i, \omega h) D(\omega h) \partial \omega i$ diff sol angle to area, we must

only express dus in terms of dA

What is Physically Based Shading?

- Somewhere around 2010, all Movie and Video Game studios started turning towards Physically Based Shading.
- Previously, programmers and artists did "whatever looked good" DA(ww) = DI

to go from integrating over diff sol. angle 20 area, we must only express dus in terms of dA

 $\partial \Phi_h(\omega i \partial \theta \delta) = \lambda_i(\omega i) \partial \omega \cos(\omega i, \omega h) D(\omega h) \partial \omega$

Out going flux: 200 = F(wa) 20m

Photorealistic graphics are a reasonable goal these days

incident

Battlefield 1 (2016)

Battlefield 1942 (2002)



Getting the maths right from the start saves a lot of work down the line. ((()) down and (()) of the work



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Okay, so how do we do it *correctly* then?

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to go from integrating $L_{owe}^{over} = F(\omega_i)L_i$ dif sol. angle to area to we

only express dus in terms or

Optically smooth materials - (((()))) - ((())) The differential area dA(wz) of the microfacets

≥oA= Jur2

n

that have normal wh is:

JA(wh) = D(wh) Jwh JA

 $\partial \Phi_h(\omega i \partial \phi b) = \lambda_i(\omega i) \partial \omega \cos(\omega i, \omega h) D(\omega h) \partial \omega f$

Lgoing Flux: 200 = F(wo) 20m

Okay, so how do we do it *correctly* then?

Microfacet Theory (Torrance and Sparrow, 1967):

≥oA= Jur2

The Microfacet Distribution Function, $D(\omega_h)$, tells us the density of facets with normal = ω_h^{om} integrating over $density = \omega_h^{om}$ integrating over

2016-12-01

only express dw in terms of

cos (win 1 ww) D(ww) dw1

Microfacet Theory (Torrance and Sparrow, 1967): $-L_{i}(\omega_{i})\partial\omega\partialA^{L} = L_{i}(\omega_{i})\partial\omega\cos(\omega_{i},\omega_{h})$

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The Microfacet

Distribution Function,

density of facets with

normal = Whom integrating

dif sol angle to area, we must

only express dus in terms of dA

 $D(\omega_h)$, tells us the

≥oA= Jwr2

O. Foran

Out going flux

 $cos(\omega i)\omega h) D(\omega h) \partial \omega h$

area dA(wh) of the microfacets

Microfacet BRDF: Li(wi) dw dh

Microfacet distribution function

 $(D(\omega_h)F(\omega_i))$ inbegrating diff sol. angle 20 area, we must n. Www. Only express dw in terms of dA

= Li(wi) dou cos (wi, wh

 $\partial \Phi_h(\omega; \partial \phi_0) = \lambda_i(\omega_i) \partial \omega \cos(\omega_i, \omega_h) D(\omega_h) \partial \omega_1$

Out going flux : 200 = F(Wo) 20m

Fresne

area dA(wh) of the microfacets



Microfacet Theory (Torrance and Sparrow, 1967): $\mathsf{brdf} = \frac{G(\omega_i, \omega_o) D(\omega_h) F(\omega_i)}{|n \cdot \omega_i|} \xrightarrow{\mathsf{vertial}}_{\mathsf{h} = \mathsf{Li}(\omega_i) d\omega dA^{\mathsf{L}} = \mathsf{Li}(\omega_i) d\omega \cos(\omega_i, \omega_h)}{\mathsf{h} = \mathsf{Li}(\omega_i) d\omega dA^{\mathsf{L}} = \mathsf{Li}(\omega_i) d\omega$

The differential area dA(wh) of the microgacets How about, $D(\omega_h) = dot(\mathbf{n}, \mathbf{h})^{shininess}$

>0A= Jwr2

To glo from integrating diff sol. angle 20 Hmmm.... math math math math.... No:

 $\frac{dot((winh)}{n,h}) = \lambda_i(w_i) \partial w \cos(w_i,w_i) D(w_i) \partial w}{dot(n,h)} = \lambda_i(w_i) \partial w \cos(w_i,w_i) D(w_i) \partial w}$ $D(\omega_h) \stackrel{\text{identify}}{=} \frac{shininess + 2}{2\pi}$

only express dut in ter

Microfacet Theory (Torrance and Sparrow, 1967): $\overline{\mathfrak{Z}}_{h} = L_{i}(\omega_{i})\partial\omega\partialA^{\perp} = L_{i}(\omega_{i})\partial\omega\cos(\omega_{i},\omega_{h})\partialA$

 $\mathsf{brdf} = \frac{G(\omega_i, \omega_o) D(\omega_h) F(\omega_i)}{|n \cdot \omega_o| |n \cdot \omega_i|} \overset{\text{mention}}{\to} \underset{n \in \mathcal{U}}{\mathsf{flux}} \overset{\text{meident}}{\to} \overset{n}{\to} \overset{\text{meident}}{\to} \overset{n}{\to} \overset{\text{meident}}{\to} \overset{n}{\to} \overset{n}{\to}$

 $F(\omega_i) \approx R_0 + (1 - R_0) (1 - \omega_i) \partial_{\omega_i} \partial_{\omega_i} \partial_{\omega_i} \partial_{\omega_i} \int_{0}^{0} (\omega_i) d\omega_i \partial_{\omega_i} \partial_{\omega$

Other Staturi

2 rue differential area dA(wr) of the microfacets that have normal wh is:

 $\partial \Phi_{h}(\omega i \partial \theta \delta) = \lambda i (\omega i) \partial \omega \cos(\omega i, \omega h) D(\omega h) \partial \omega i$

Out going flux : 200 = F(w) 201

diff sol angle to area, we must only express dus in terms of JA





Material Model

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