Dartmouth CS87/287 Rendering Algorithms, Fall 2025
Reading Assignment 6

Masking, Shadowing and Interreflection of the Microfacet Model

Figure 9.21 in PBRT 4ed shows masking, shadowing and interreflection effect of a microfacet model. Lots of implementations of the microfacet model ignore the interreflection effect. What is the problem with this and when it become serious (think about roughness)?

(Optional) Can you validate your thoughts in blender? You could create a scene and setup a microfacet model based BSDF; see if you find any issue (visually). Hint: you could use multiscatter GGX in blender for the fix. How does it compare with GGX?

***Anisotropic Beckmann Distribution (Optional, 1 extra credit)**

Given the formula for isotropic Beckmann distribution:

$$D(\theta,\phi) = \frac{1}{2\pi} \cdot \frac{2\sin\theta e^{-\frac{\tan^2\theta}{\alpha^2}}}{\alpha^2\cos^3\theta}$$

try to generalize it to anisotropic Beckmann distribution:

$$D(\theta,\phi) = \frac{1}{2\pi}\frac{2\sin\theta e^{-\tan^2\theta\left(\frac{\cos^2\phi}{\alpha_x^2}+\frac{\sin^2\phi}{\alpha_y^2}\right)}}{\alpha_x\alpha_y\cos^3(\theta)}$$

Hint: Beckmann distribution is highly related to Gaussian distribution. The formula for 2D Gaussian distribution with zero mean is:

$$f(\mathbf{x}) = \frac{1}{2\pi|\boldsymbol{\Sigma}|^{1/2}}e^{\left(-\frac{1}{2}\mathbf{x}^{\mathrm{T}}\boldsymbol{\Sigma}^{-1}\mathbf{x}\right)}$$

The anisotropic Beckmann distribution is applying a scaling transformation along the principle axes to the distribution of normal on the slope space. Consider first convert the measure to slope space, then apply the transformation and then convert it back to polar coordinate space. You can follow this blog for some hint: https://www.reedbeta.com/blog/slope-space-in-brdf-theory/#normals-and-slopes