Bounded VNDF Sampling for the Smith–GGX BRDF (Supplementary Document)

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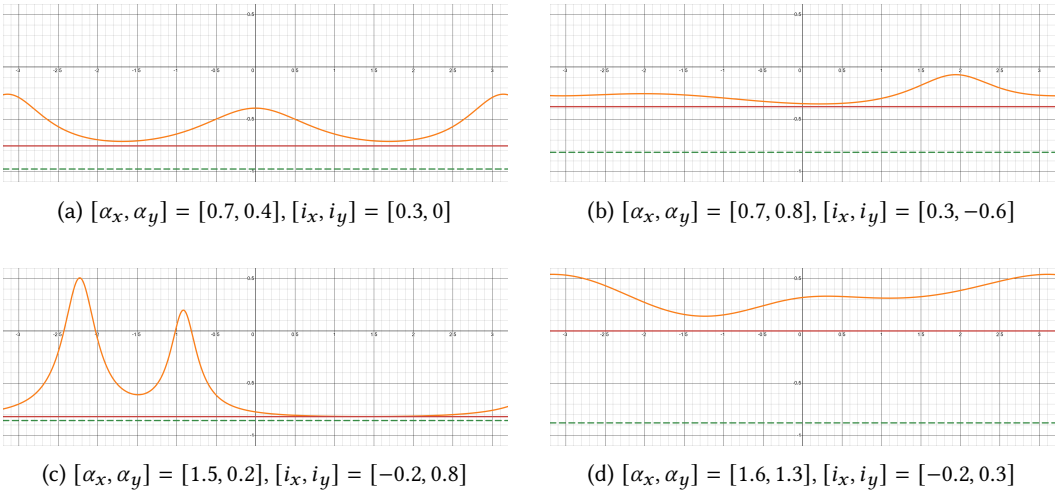

(a) $[\alpha_x, \alpha_y] = [0.7, 0.4]$, $[i_x, i_y] = [0.3, 0]$

(b) $[\alpha_x, \alpha_y] = [0.7, 0.8]$, $[i_x, i_y] = [0.3, -0.6]$

(c) $[\alpha_x, \alpha_y] = [1.5, 0.2]$, $[i_x, i_y] = [-0.2, 0.8]$

(d) $[\alpha_x, \alpha_y] = [1.6, 1.3]$, $[i_x, i_y] = [-0.2, 0.3]$

Fig. 1. Plots of the previous spherical cap (green dashed line), our spherical cap (red line), and the reflection vector bound projected into the unit-roughness space (orange line). The horizontal axis is the longitude ϕ of the tangent-space reflection vector. The vertical axis is the cosine of the spherical cap angle (i.e., $\acute{o}_z$). Our spherical cap bounds the orange line more tightly than the previous spherical cap.

1 INTERACTIVE VISUALIZATION OF OUR LOWER BOUND

Fig. 1 shows plots of the previous and our spherical caps using different anisotropic roughness parameters and incoming directions. Online interactive graph is available at the following URL: https://www.desmos.com/calculator/lpui8k1cky.

2 KULLA AND CONTY'S MULTI-SCATTERING APPROXIMATION

Kulla and Conty [2017] approximated the multi-scattering term with a diffuse reflection model:

$$f_{\mathrm{ms}}(\mathbf{i}, \mathbf{o}) \approx F_{\mathrm{ms}} \frac{(1 - E(\mathbf{i}))\,(1 - E(\mathbf{o}))}{\pi\,(1 - E_{\mathrm{avg}})} \chi^+(\mathbf{o} \cdot \mathbf{n}), \tag{1}$$

where $E_{\mathrm{avg}} = \int_{S^2} E(\boldsymbol{\omega}) |\boldsymbol{\omega} \cdot \mathbf{n}| / \pi \mathrm{d}\boldsymbol{\omega}$ is the bi-hemispherical reflectance without the Fresnel term, and it is given by a lookup table or a fitted analytical approximation. For the multi-scattering Fresnel term, Hill [2018] found the following approximation:

$$F_{\mathrm{ms}} \approx \frac{F_{\mathrm{avg}}^2 E_{\mathrm{avg}}}{1 - F_{\mathrm{avg}}(1 - E_{\mathrm{avg}})}, \tag{2}$$

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where $F_{\mathrm{avg}} = 2\int_0^1 F(\mu)\mu \mathrm{d}\mu$ is the average Fresnel term which can be approximated analytically [Kulla and Conty 2017]. Although this model is more expensive than Turquin's model [2019], it satisfies the reciprocity unlike Turquin's model.

REFERENCES

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