TAMING THE SHADOW TERMINATOR

Matt Jen-Yuan Chiang, Yining Karl Li, Brent Burley

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Please refrain from photographing or recording.

THANK YOU!

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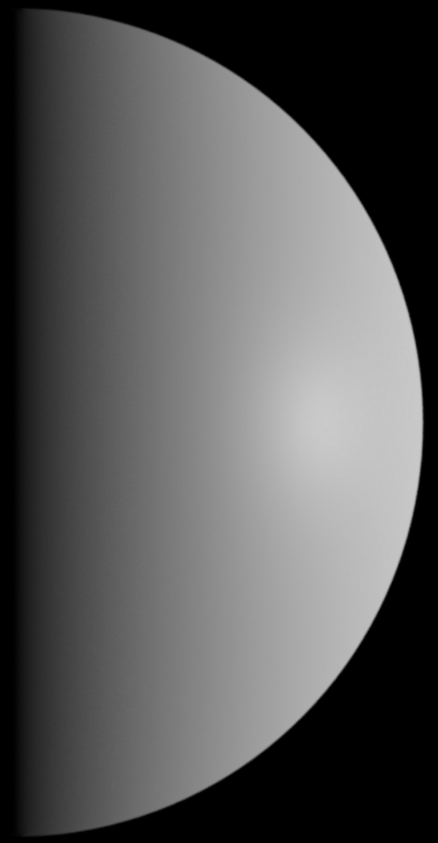

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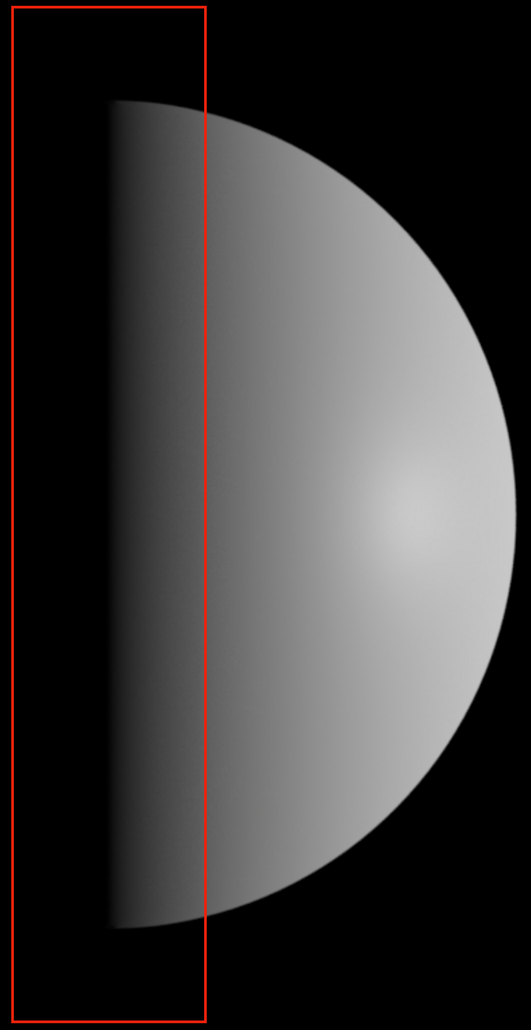

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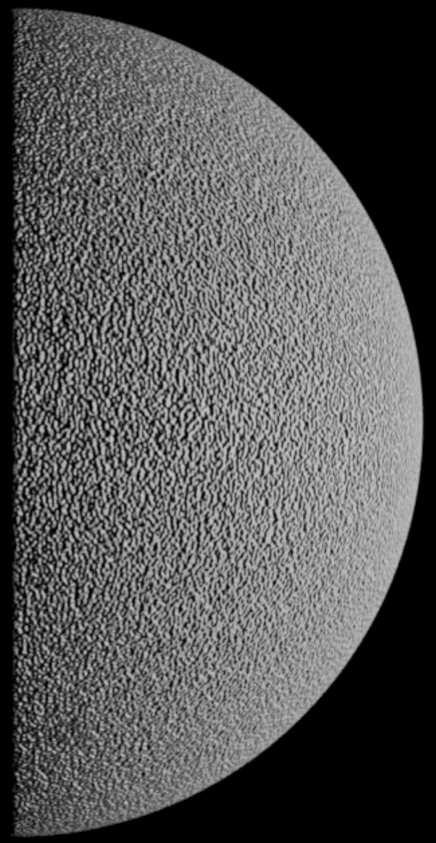

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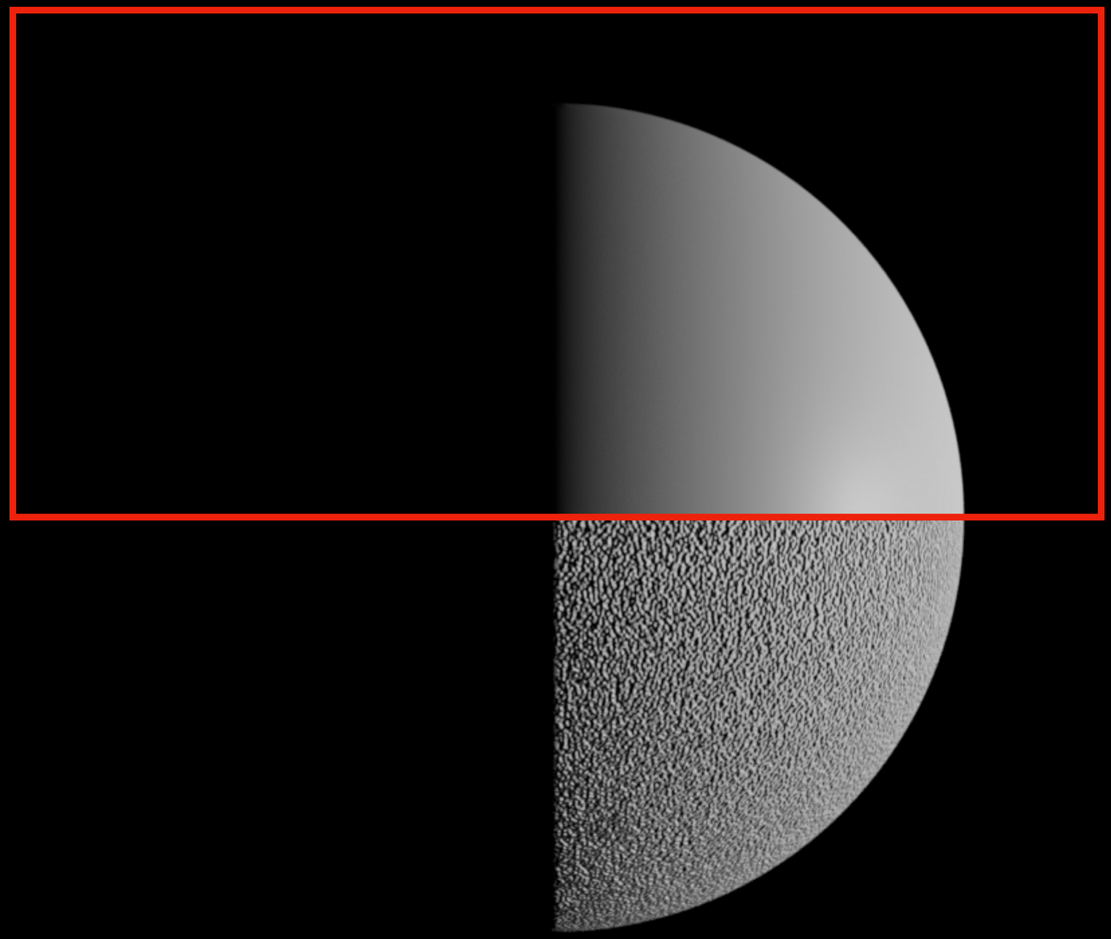

A long-standing issue in CG!

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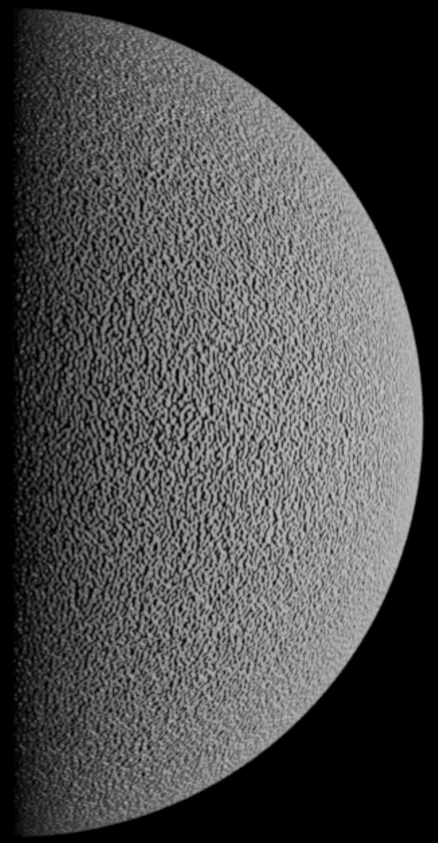

Our solution

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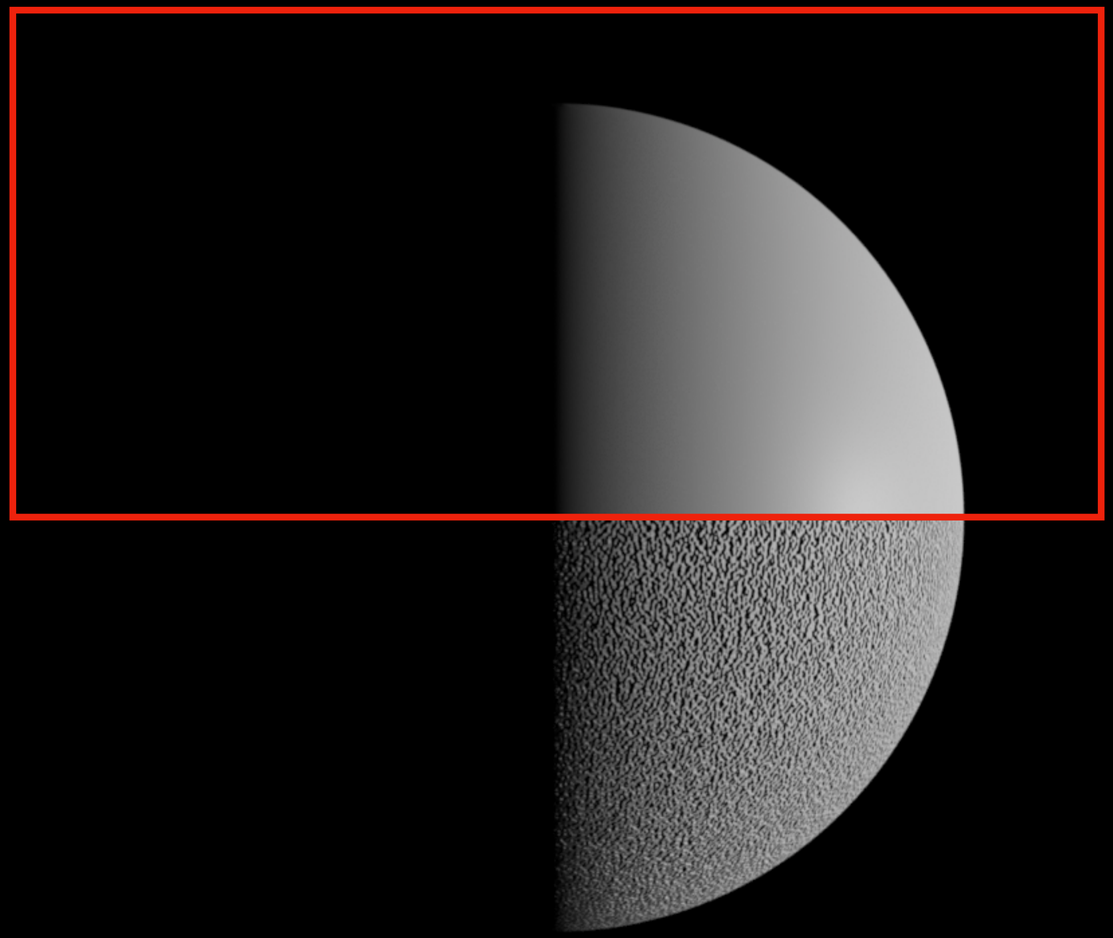

Our solution

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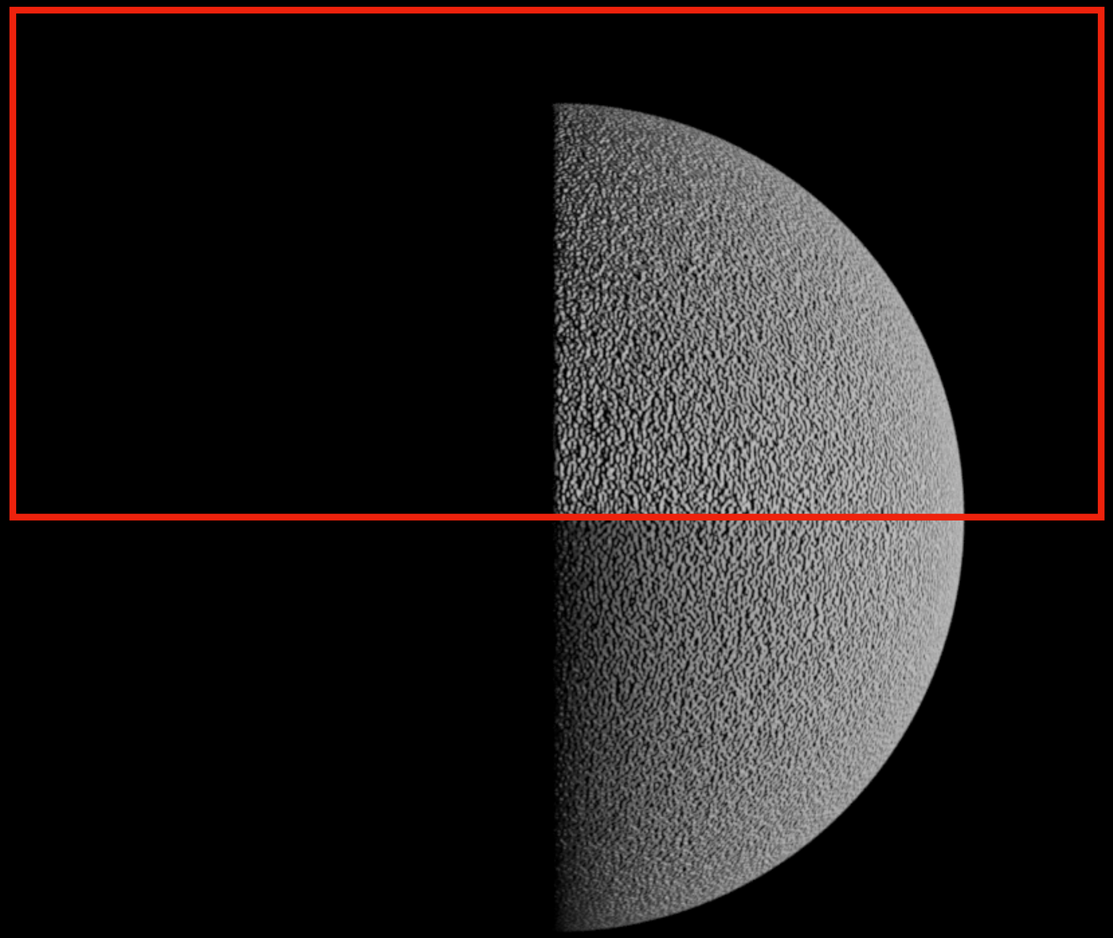

before (top) vs. after (bottom)

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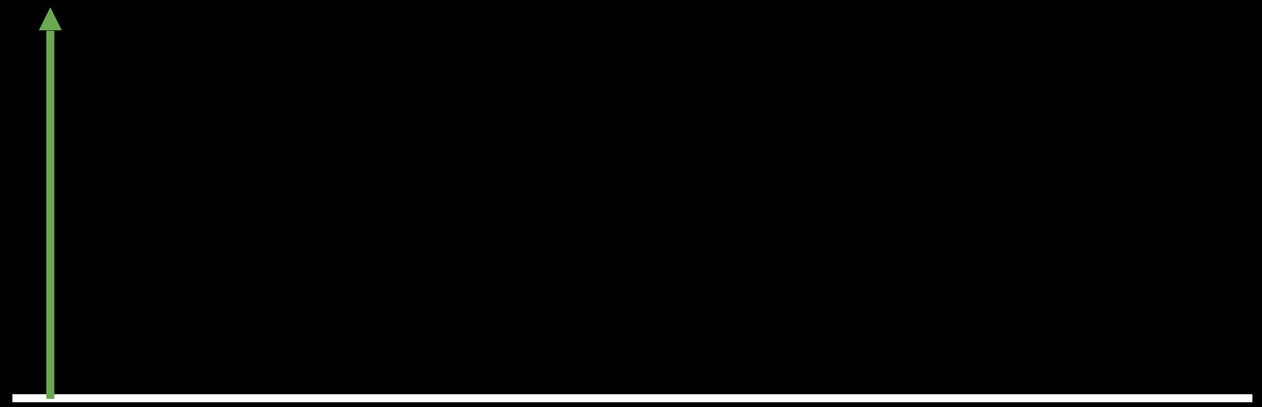
Problem Setup

Geometric normal



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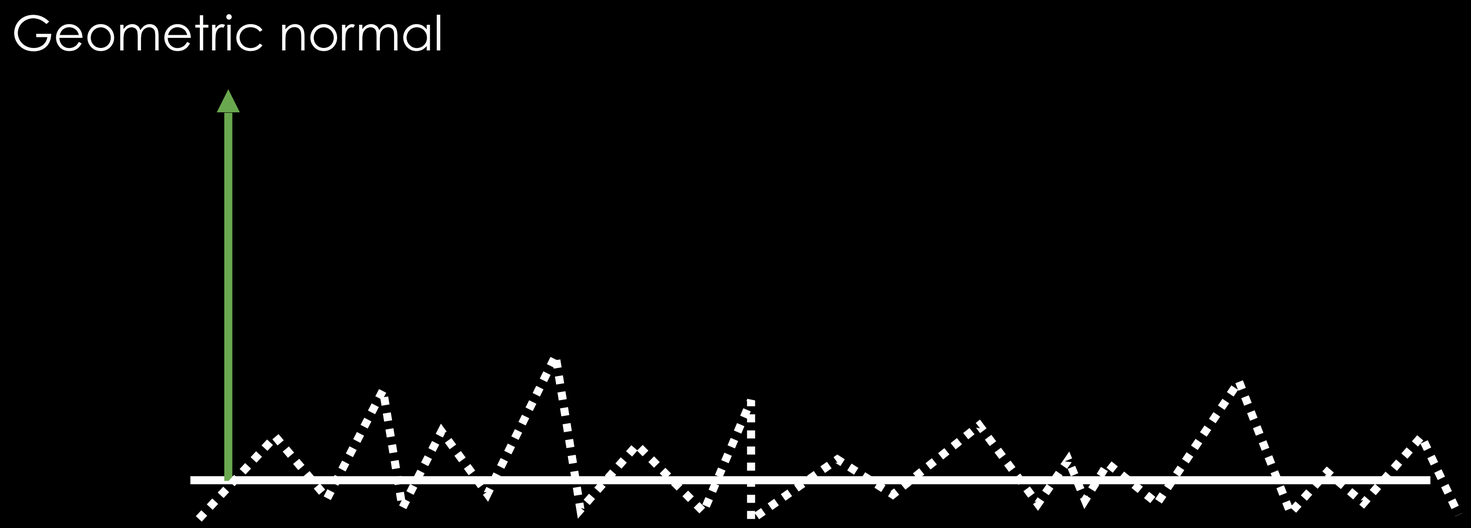
Problem Setup



A bump map provides virtual height fields over a surface

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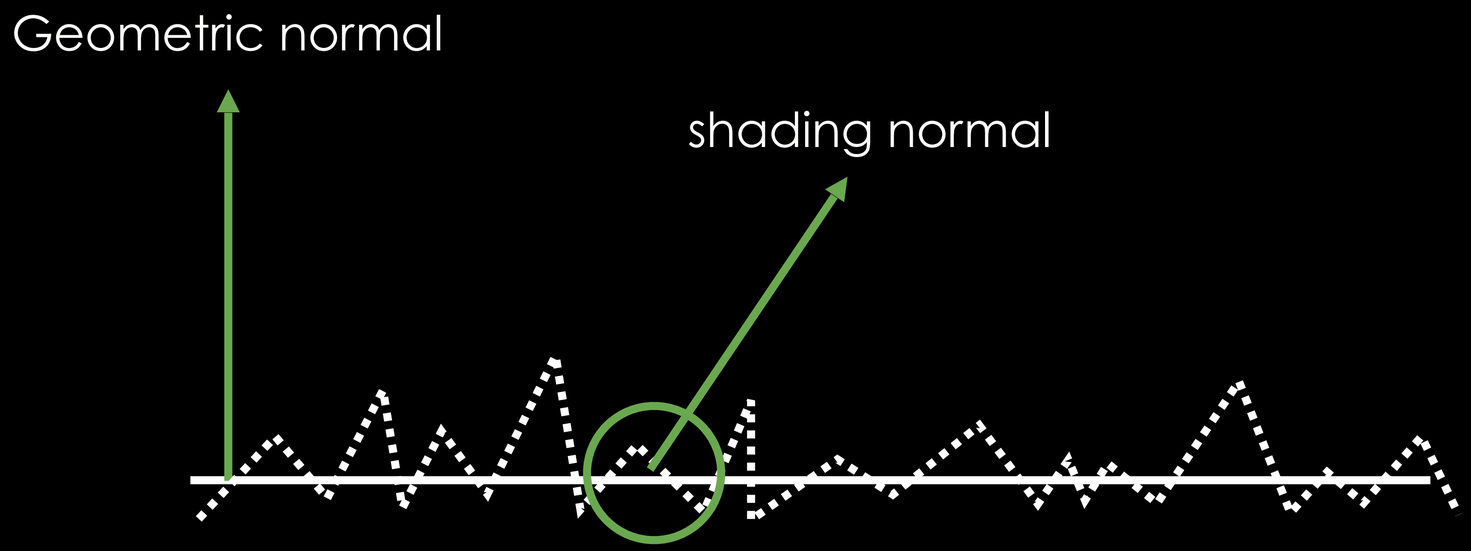
Problem Setup



However, during shading we only know one local shading normal

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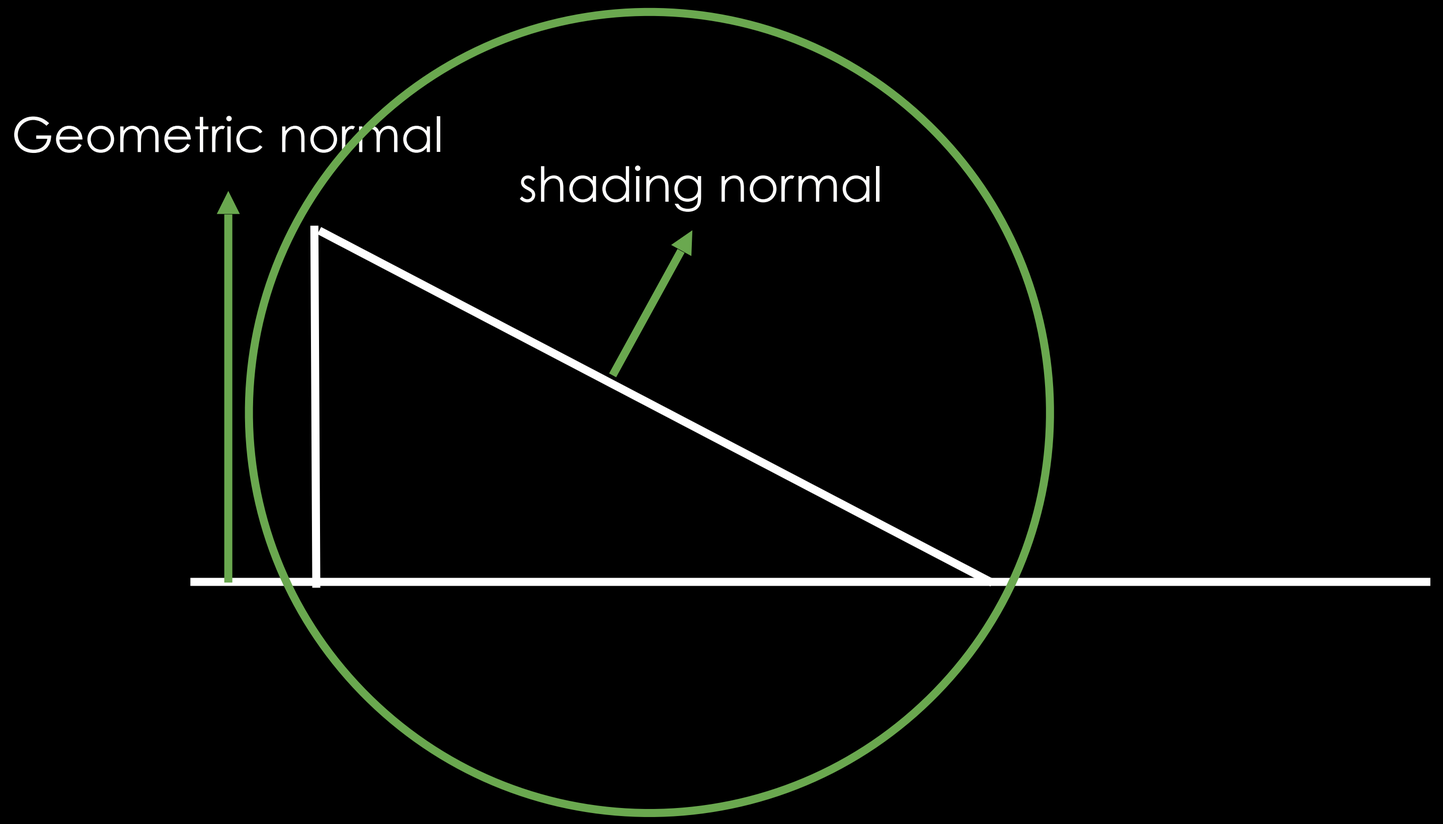
Problem Setup



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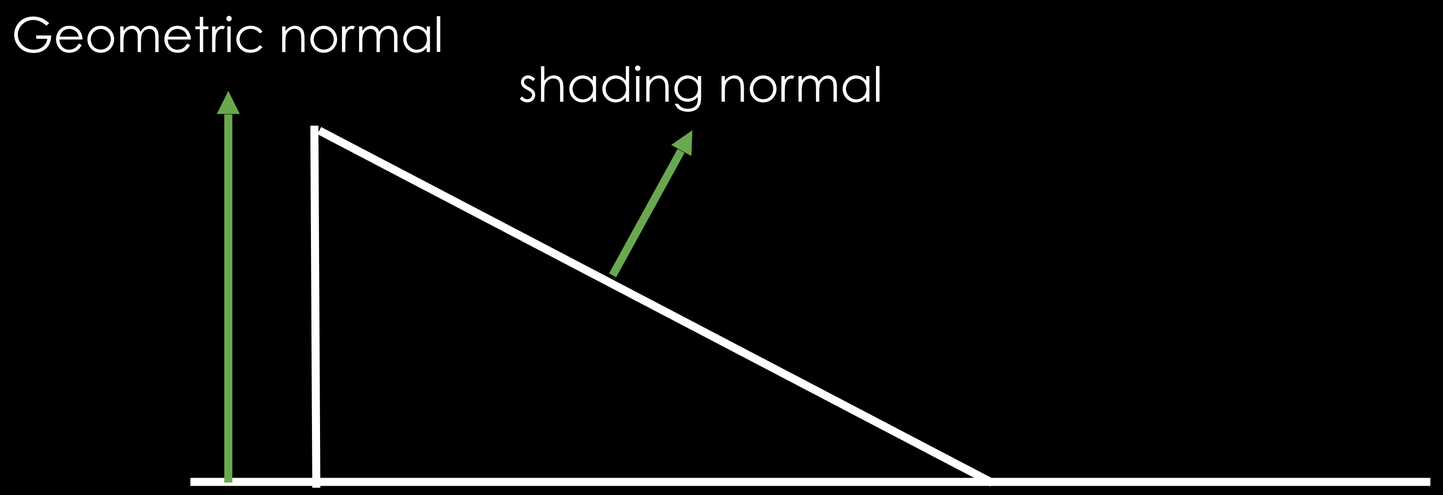
Problem Setup



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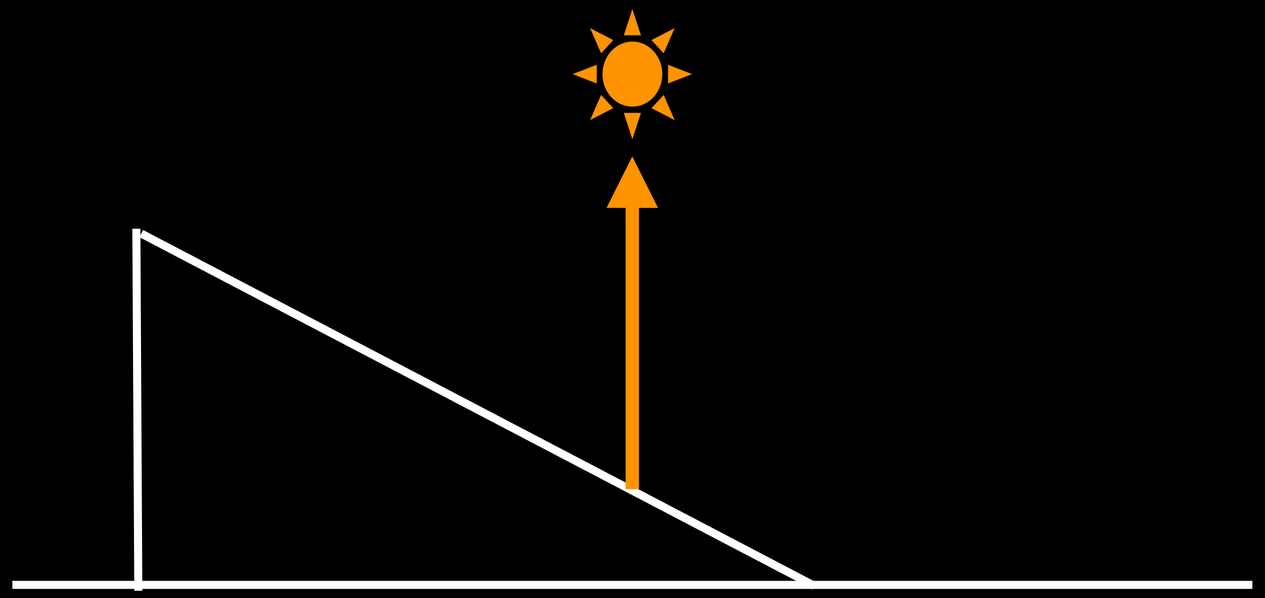
Problem Setup



Let’s move the light moving towards grazing angle

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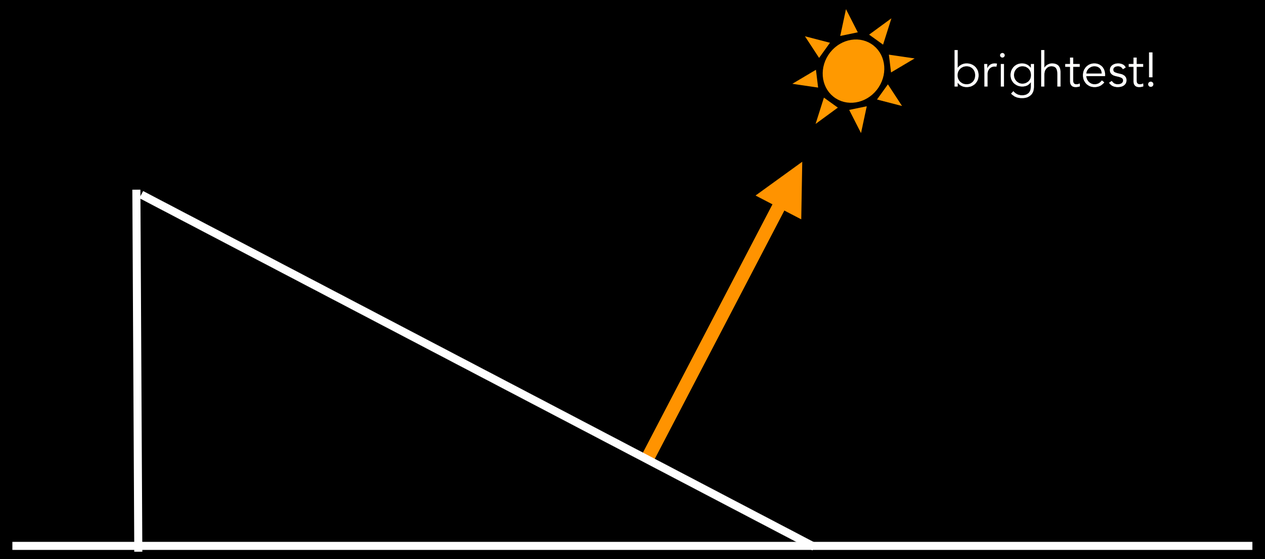
Problem Setup



Let’s move the light moving towards grazing angle

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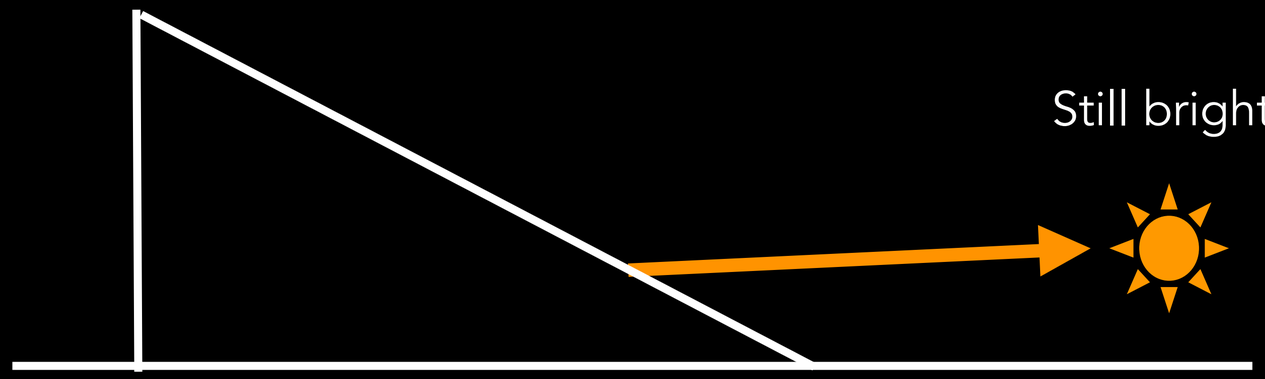
Problem Setup



Let’s move the light moving towards grazing angle

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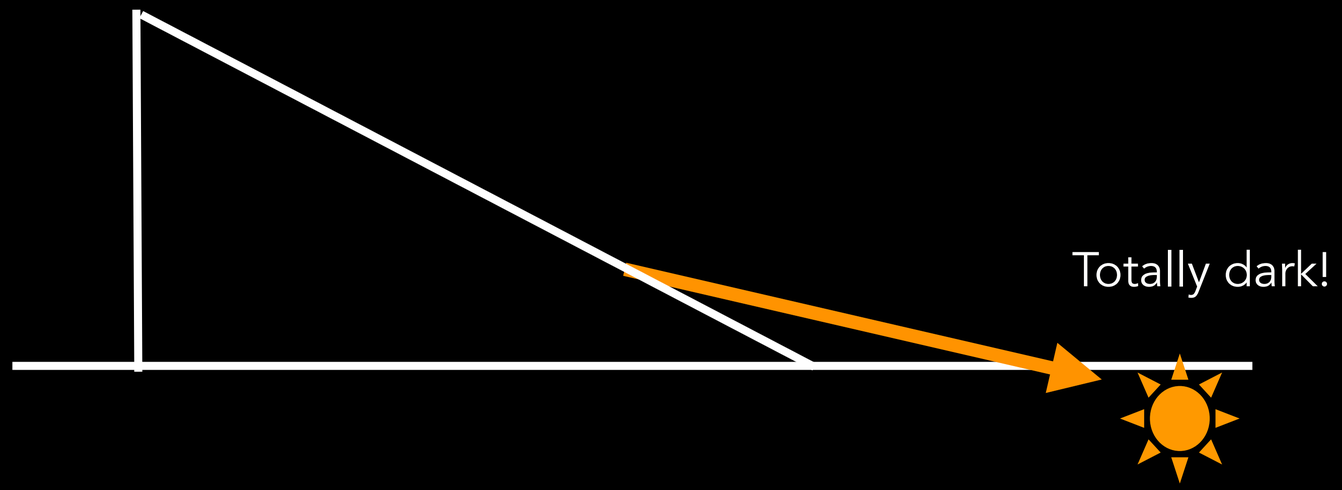
Problem Setup



Let’s move the light moving towards grazing angle

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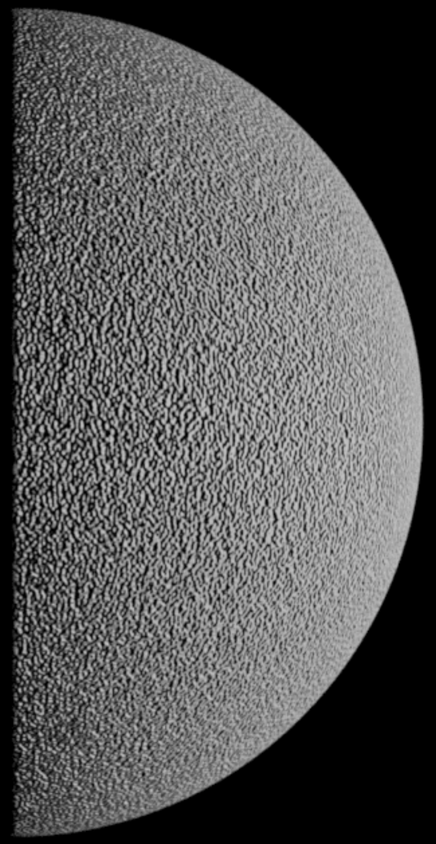
Problem Setup



The lack of shadowing causes sudden falloff

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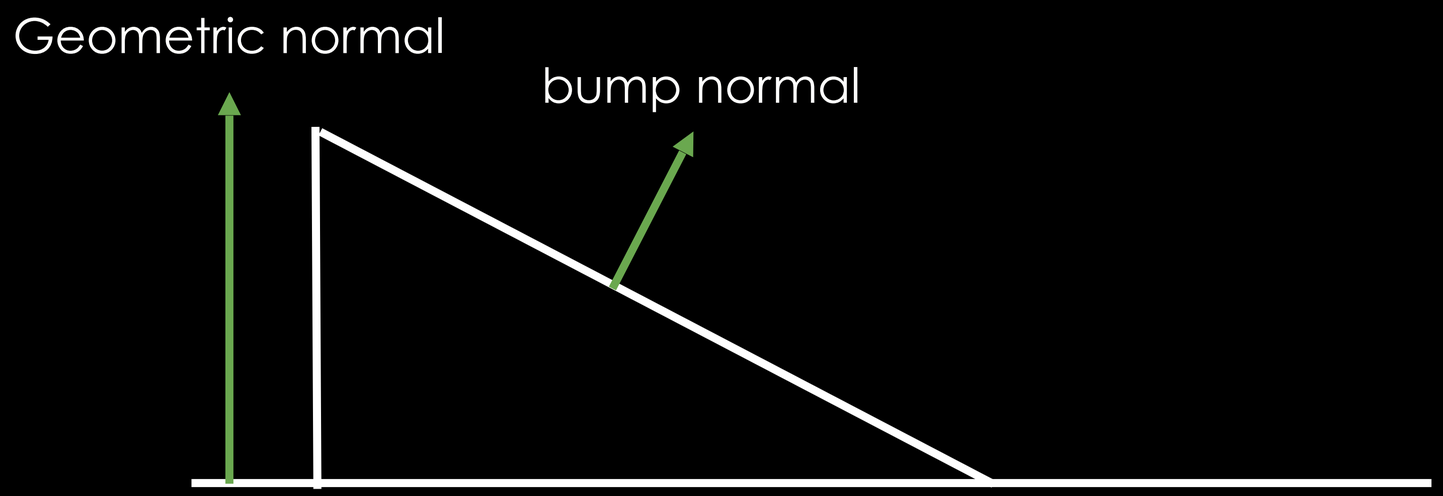
Approach



How to estimate surrounding height fields for proper shadowing?

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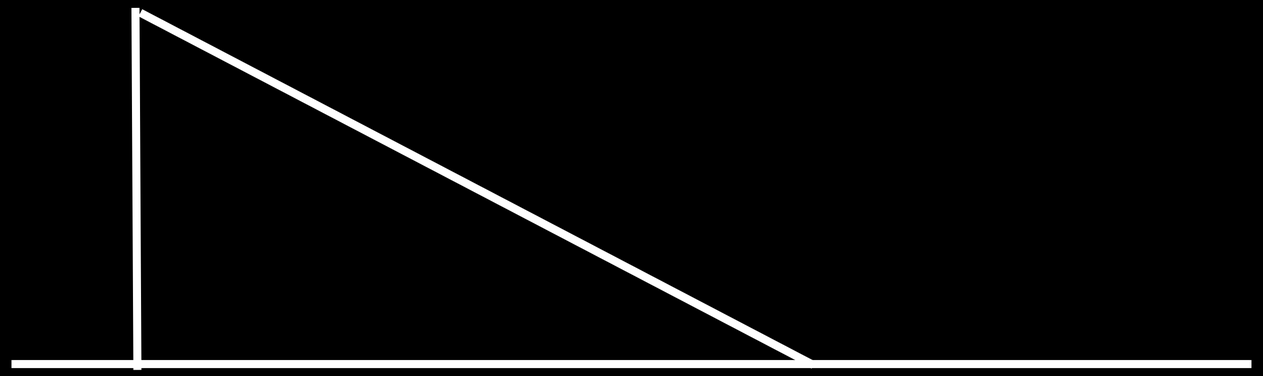
Inspiration [Schüssler et al. 2017]



Vincent Schüssler, Eric Heitz, Johannes Hanika, and Carsten Dachsbacher. 2017. Microfacet-based normal mapping for robust Monte Carlo path tracing. *ACM Transactions on Graphics (TOG)* 36, 6 (2017), 205.

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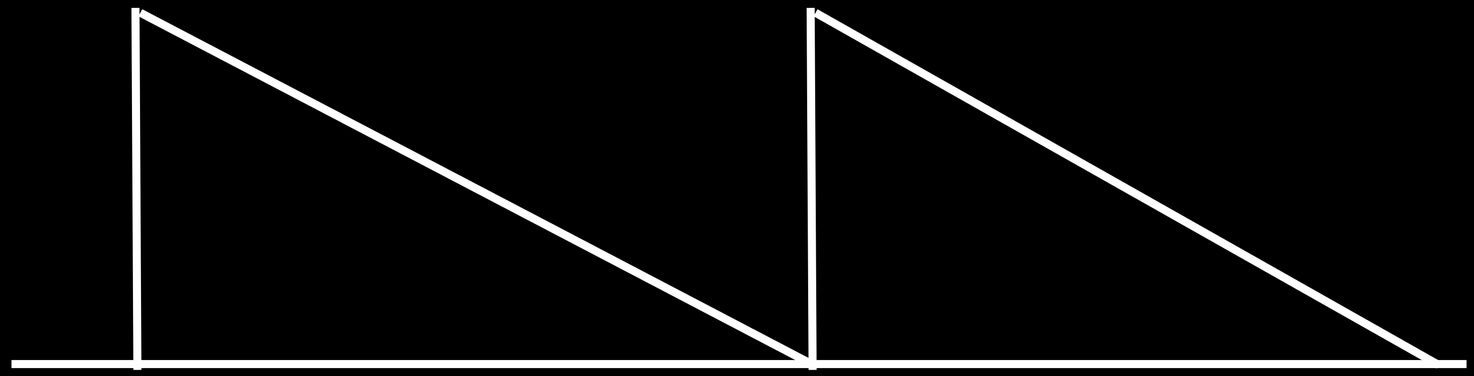

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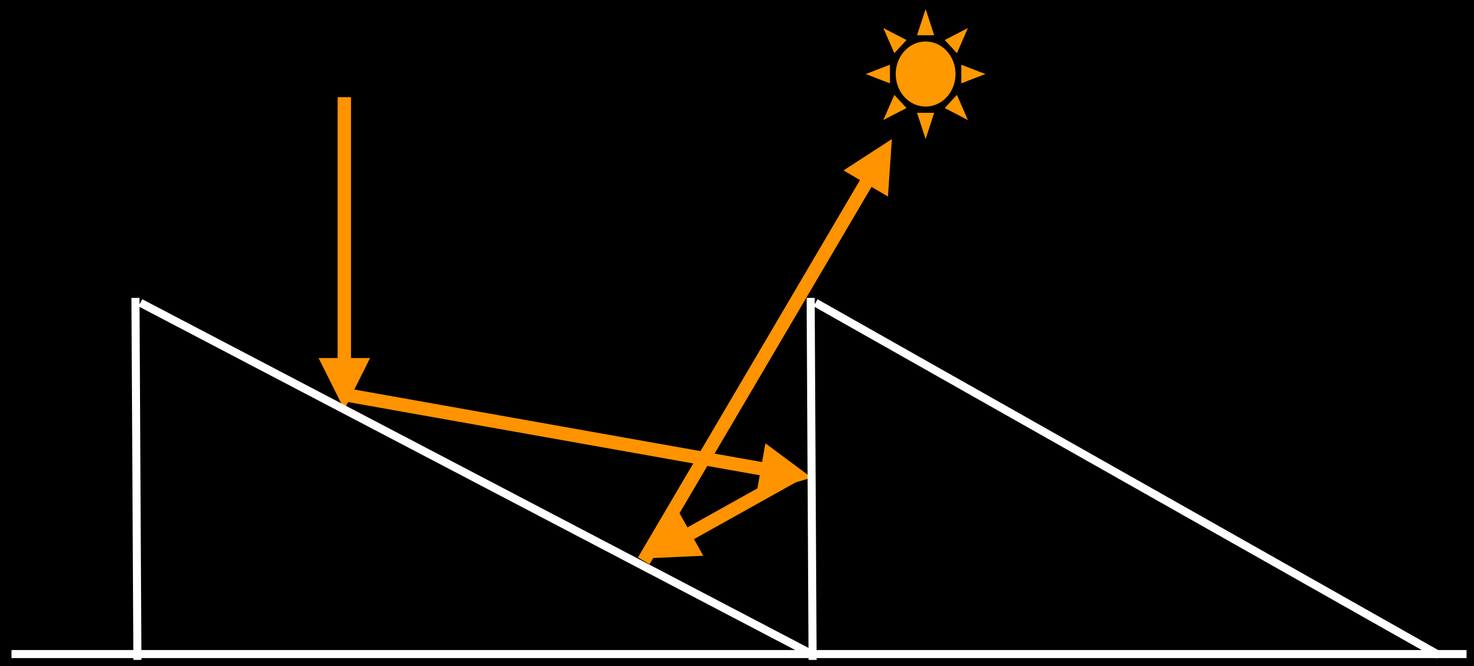

Their primary goal is to inject physical basis to bump/normal mapping

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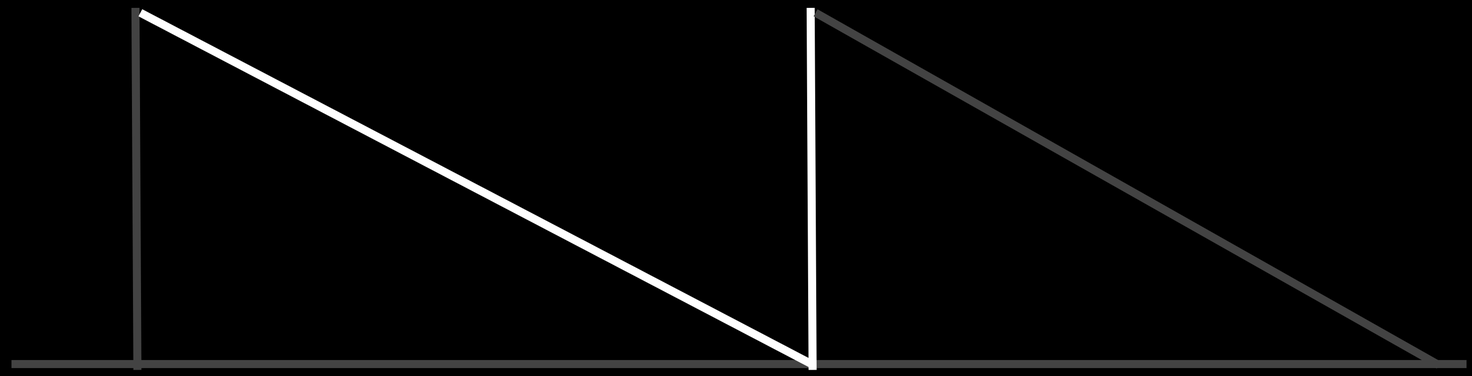
Vertical Secondary Facet



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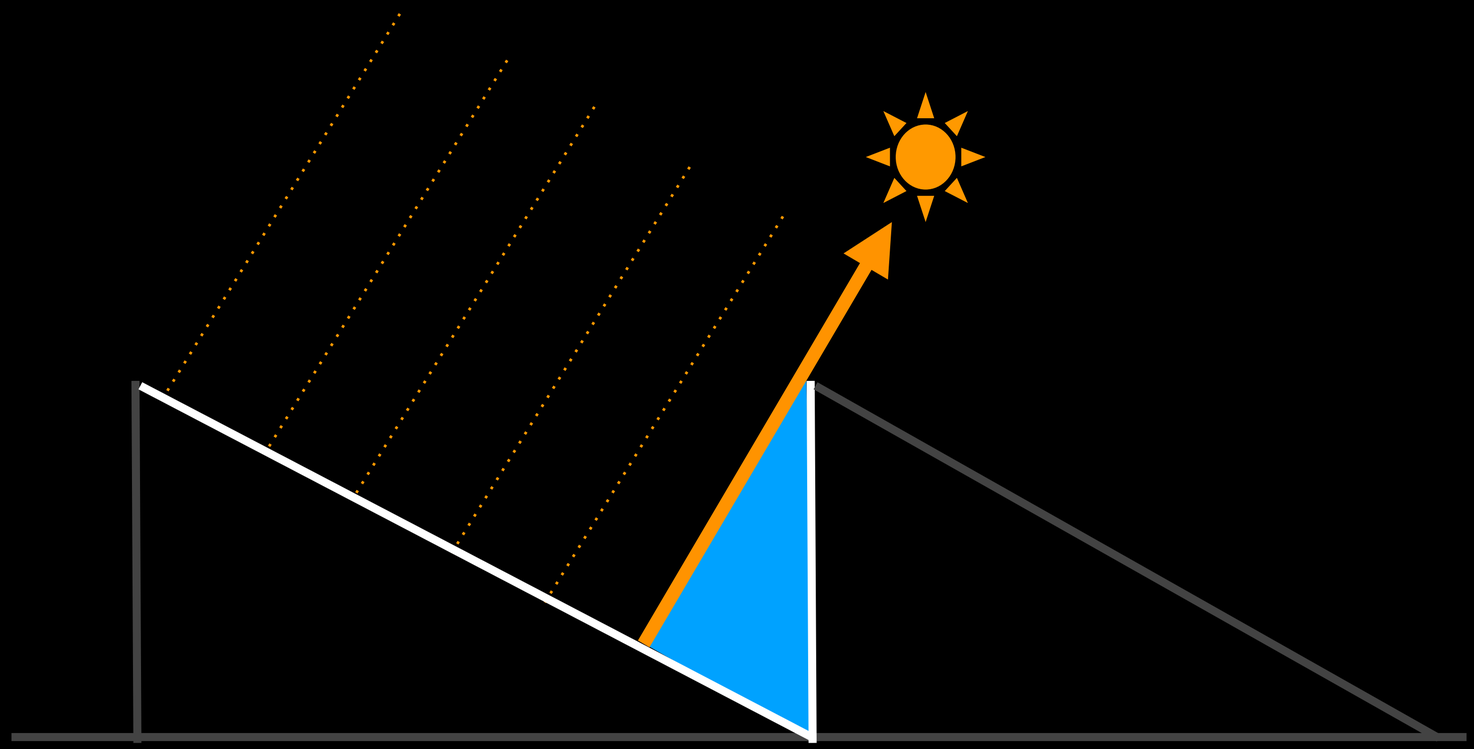
Vertical Secondary Facet



The facet configuration can help with providing shadowing!

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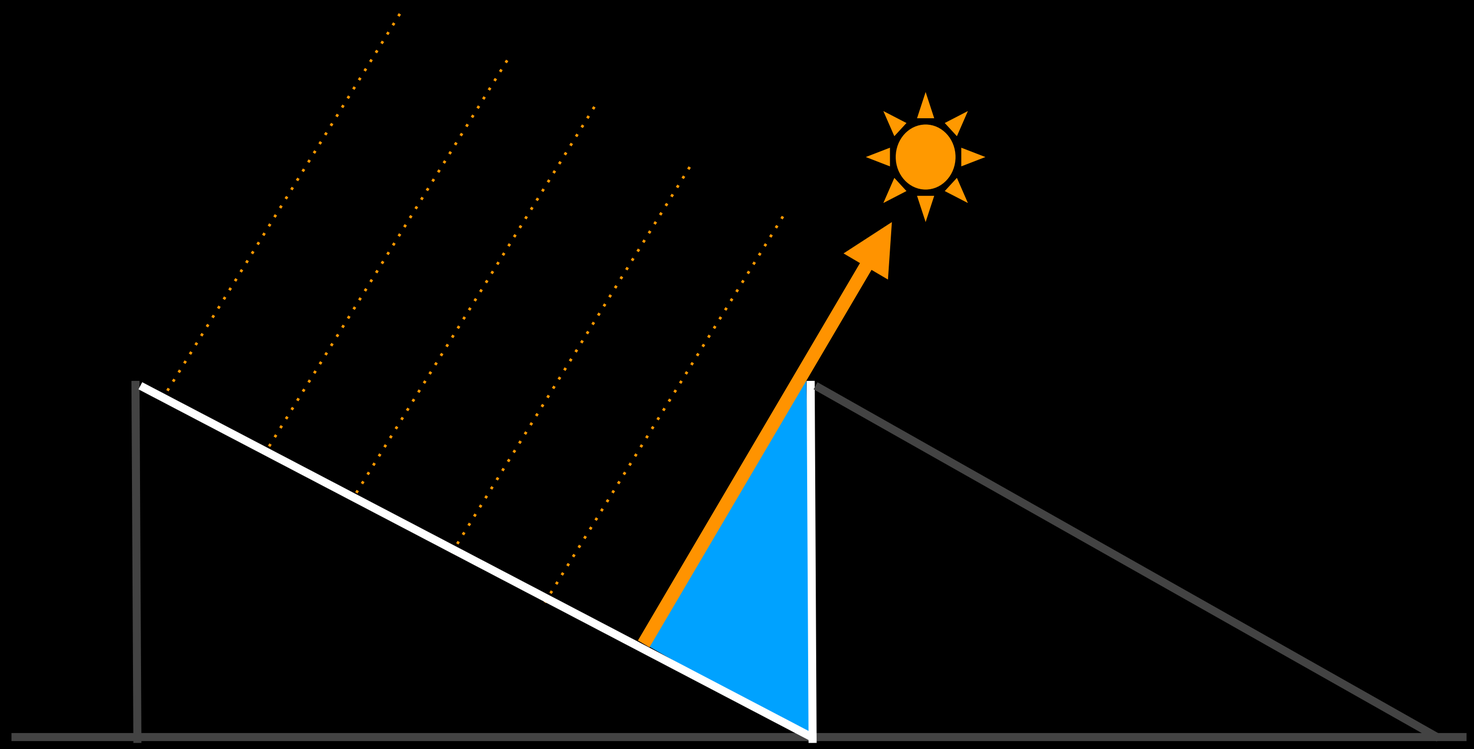
Vertical Secondary Facet



One potential issue is that it doesn’t maintain peak brightness.

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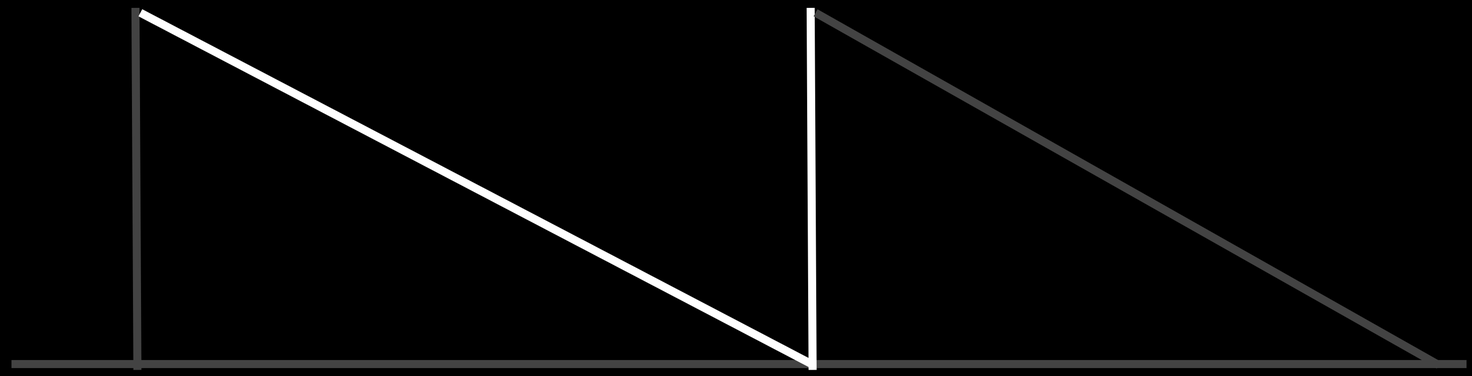
Vertical Secondary Facet



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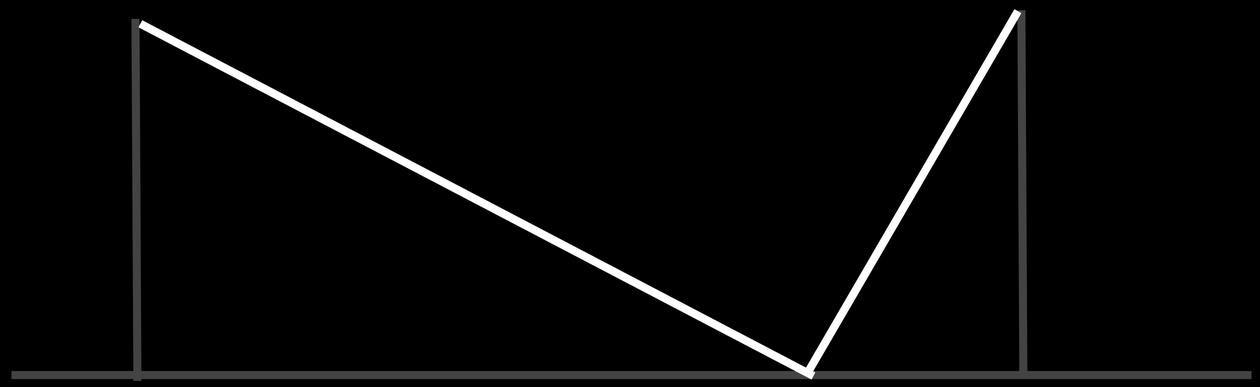
Our Solution



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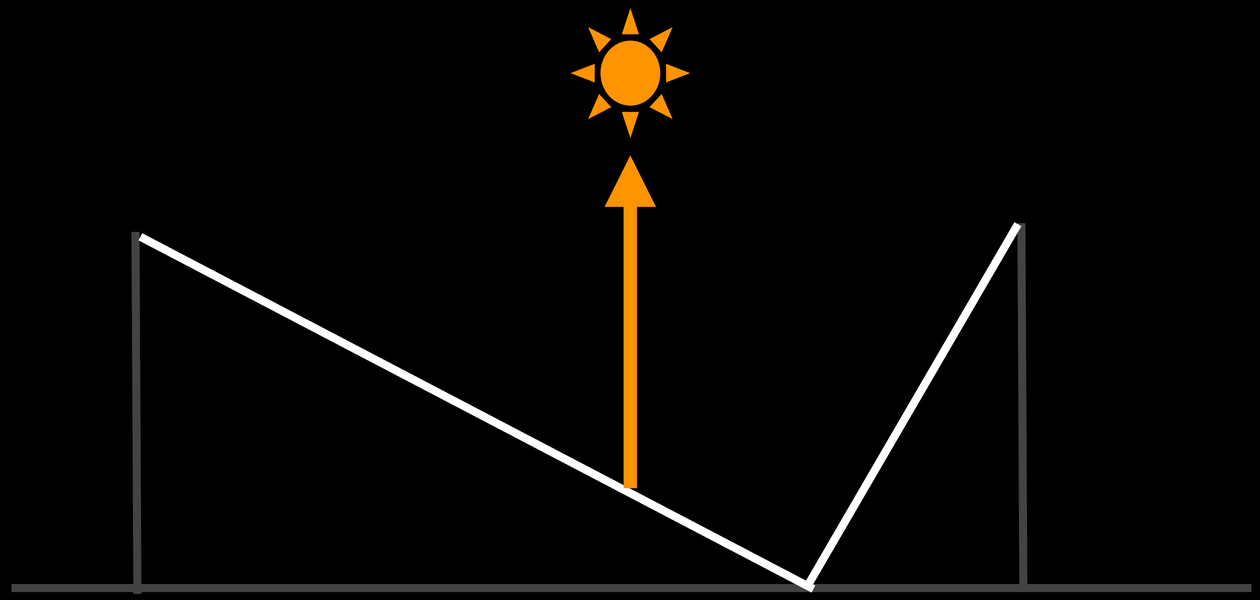
Our Solution



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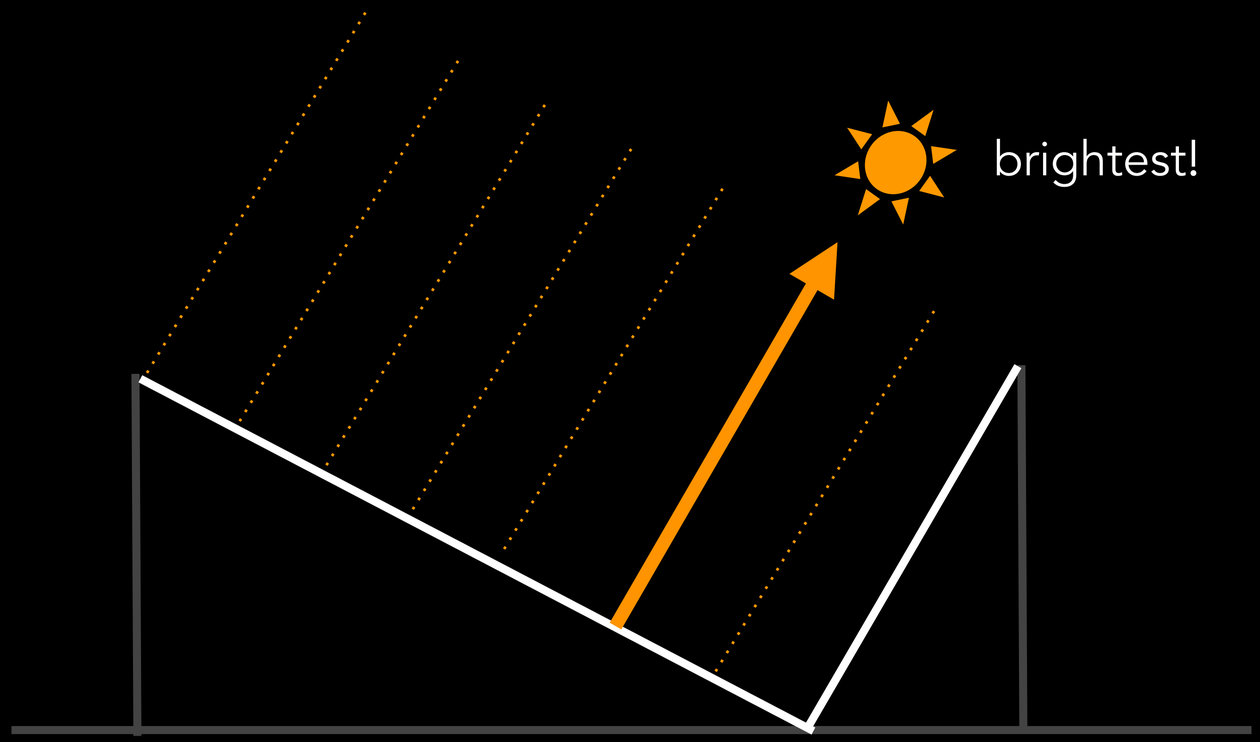
Our Solution



Our solution maintains the peak brightness.

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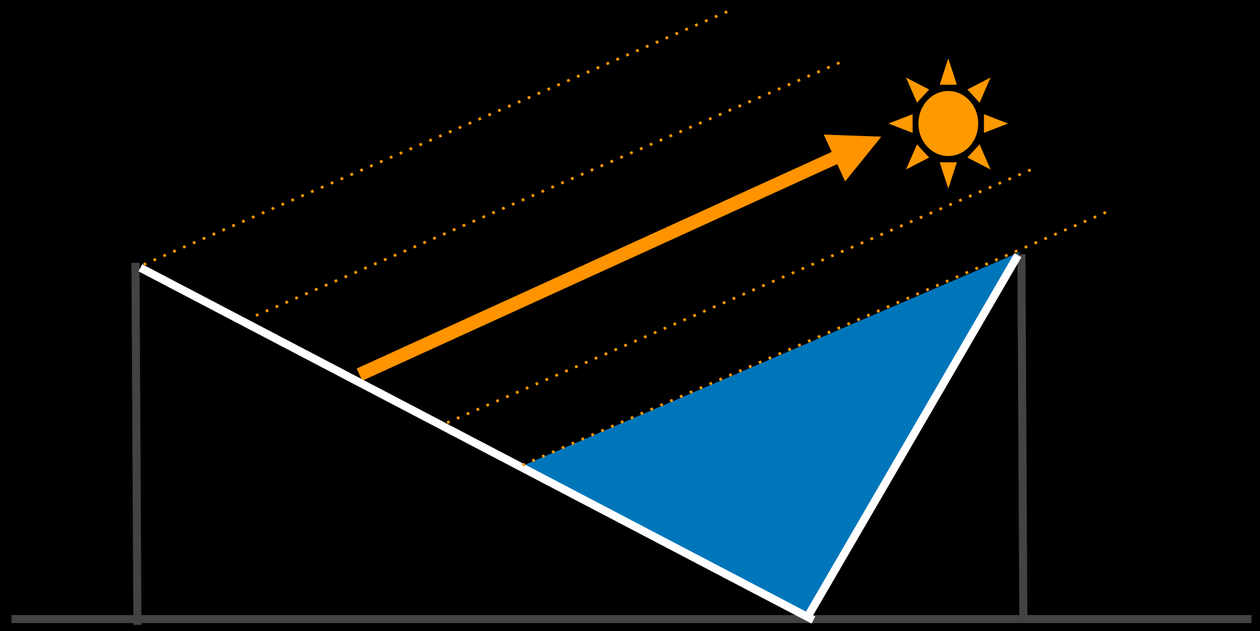
Our Solution



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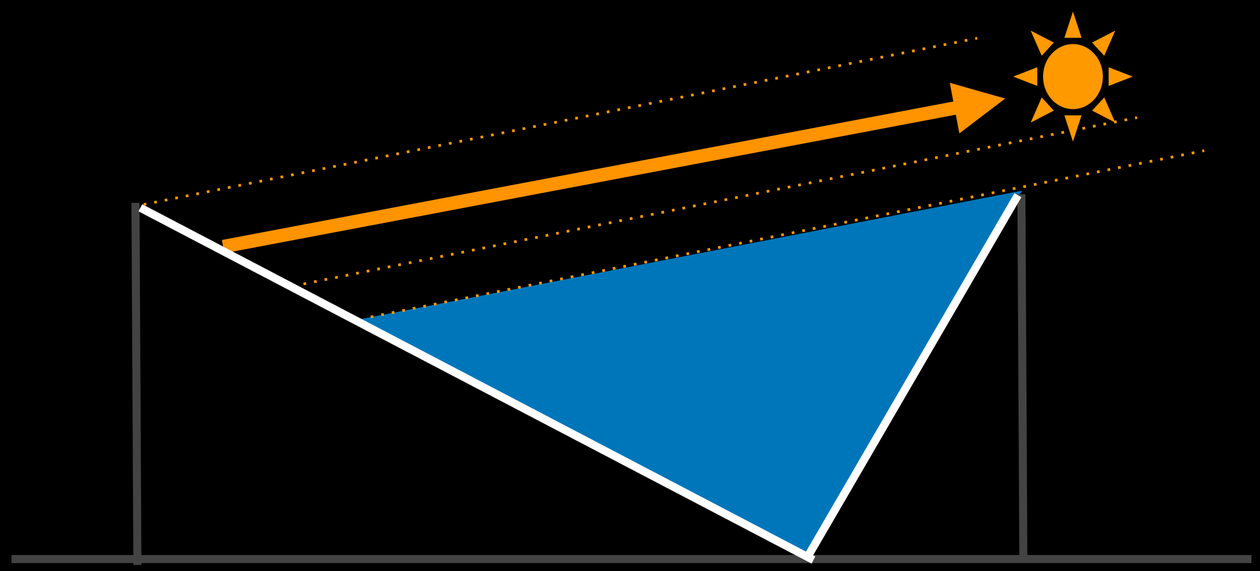
Our Solution



The shadowing goes smoothly towards zero at grazing angle.

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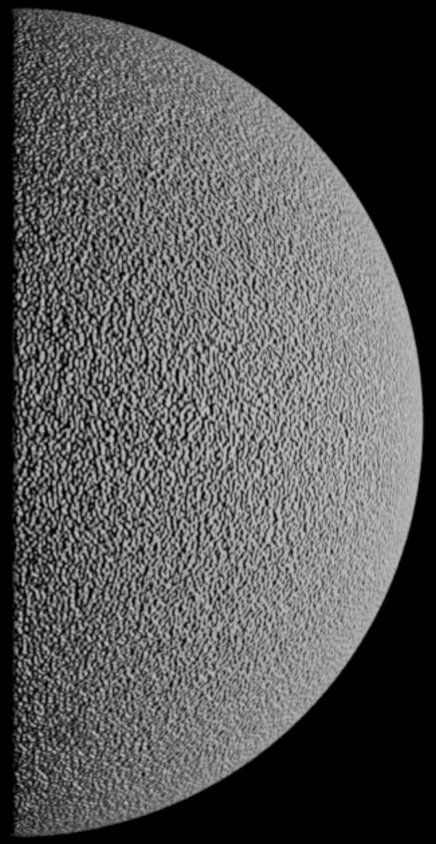

Original bump

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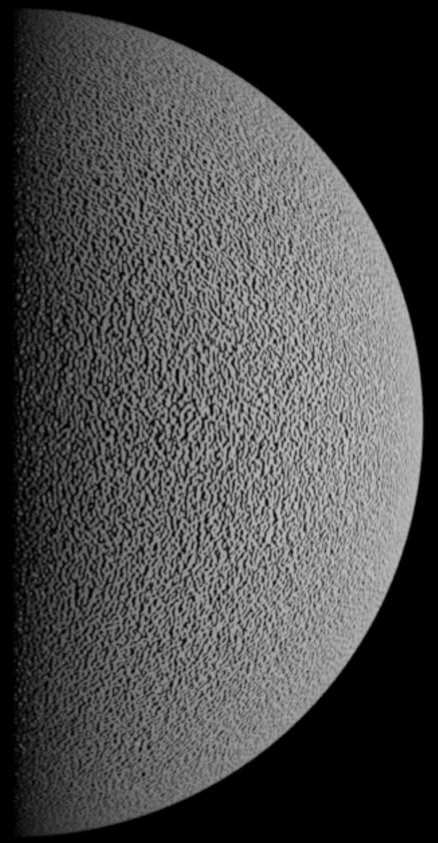

Vertical Secondary Facet

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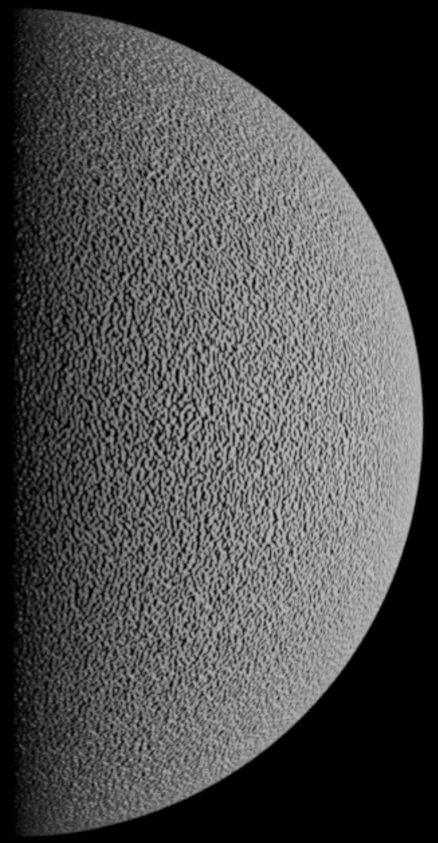

Our solution

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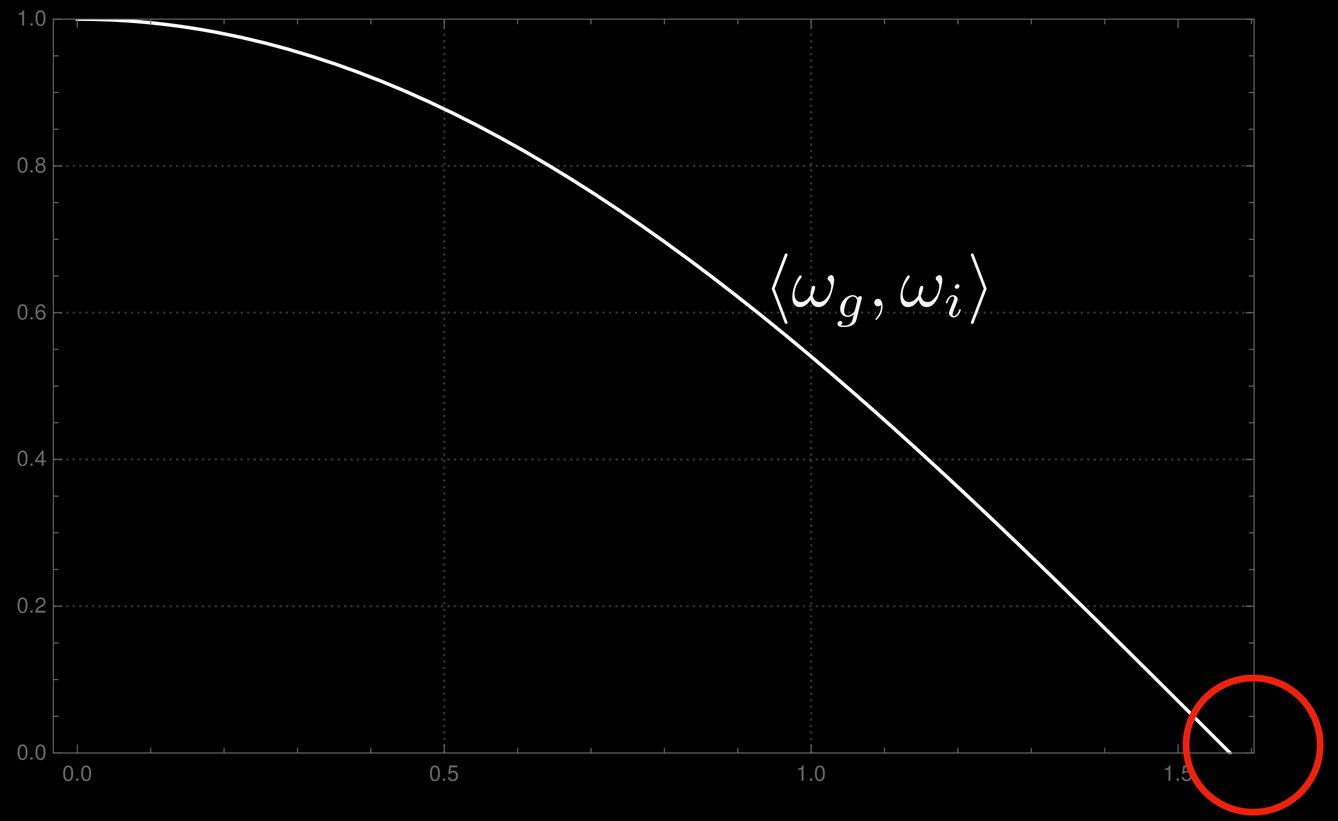

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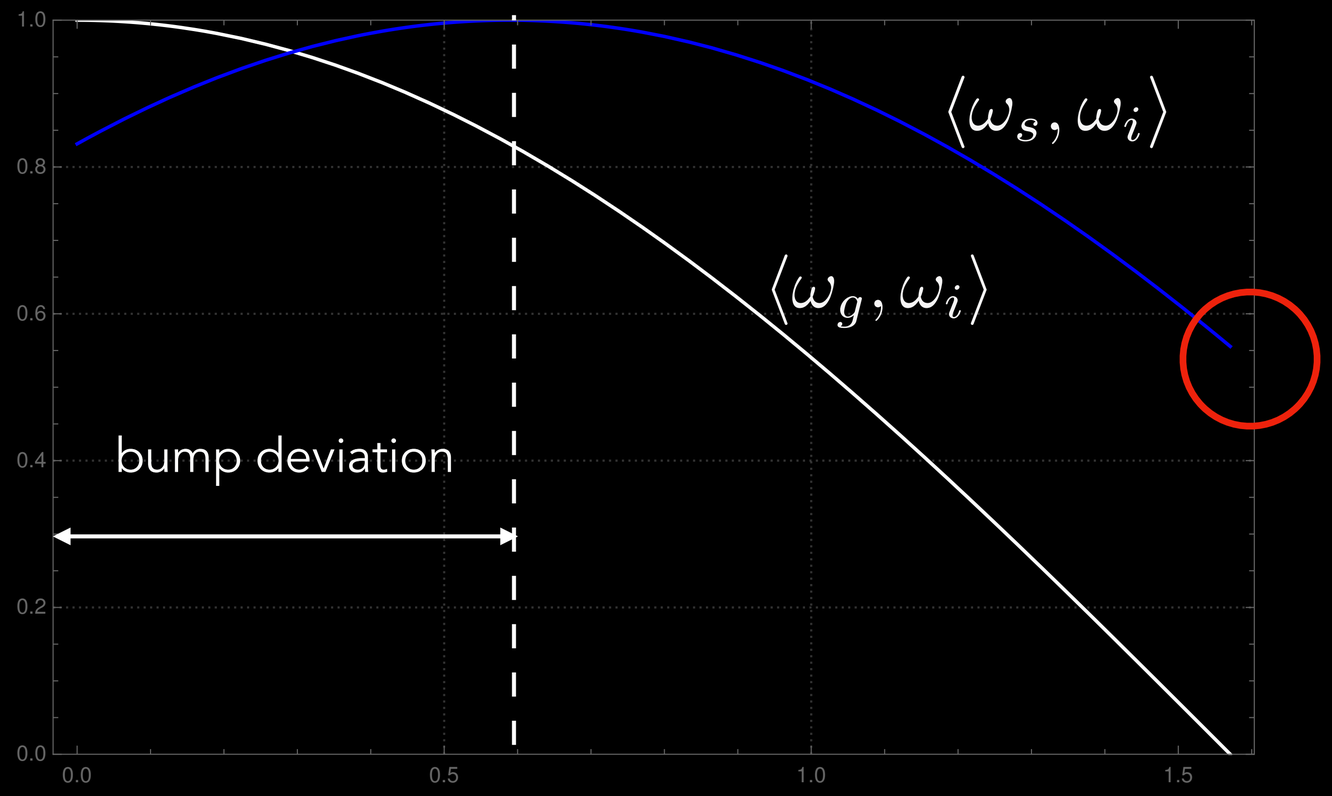
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.5
1.0
1.5
$\langle \omega_s, \omega_i \rangle$
$\langle \omega_g, \omega_i \rangle$
bump deviation

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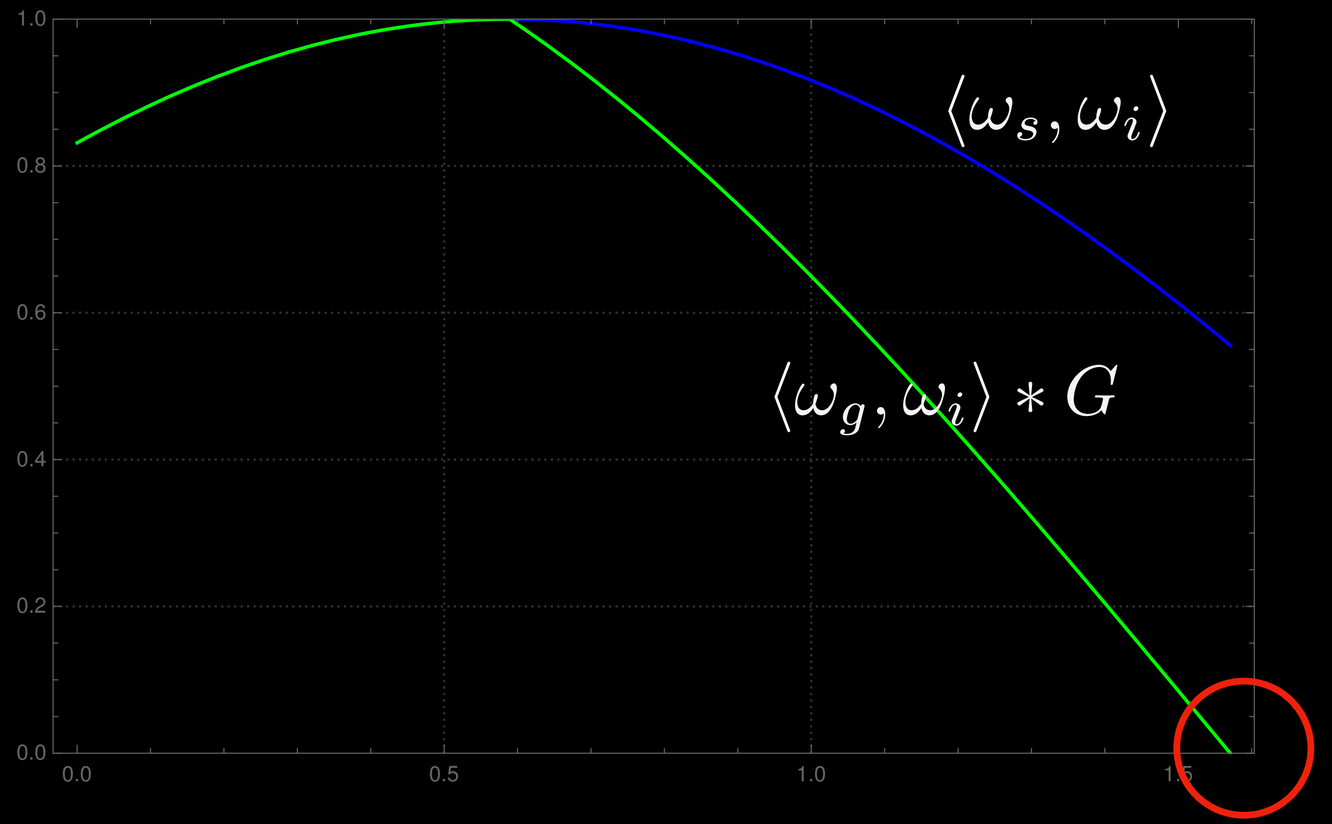

$$G = \min\left[1, \frac{\langle \omega_g, \omega_i \rangle}{\langle \omega_s, \omega_i \rangle \langle \omega_g, \omega_s \rangle}\right]$$

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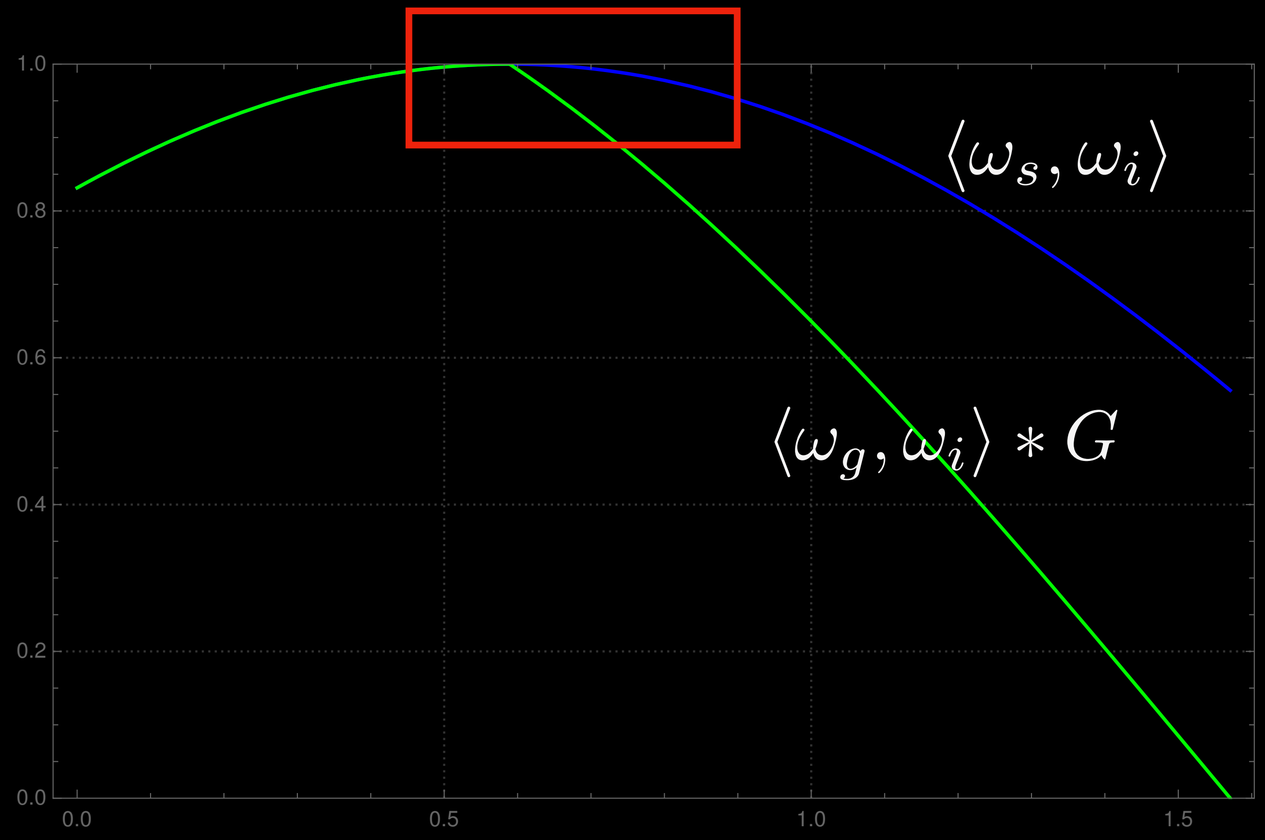

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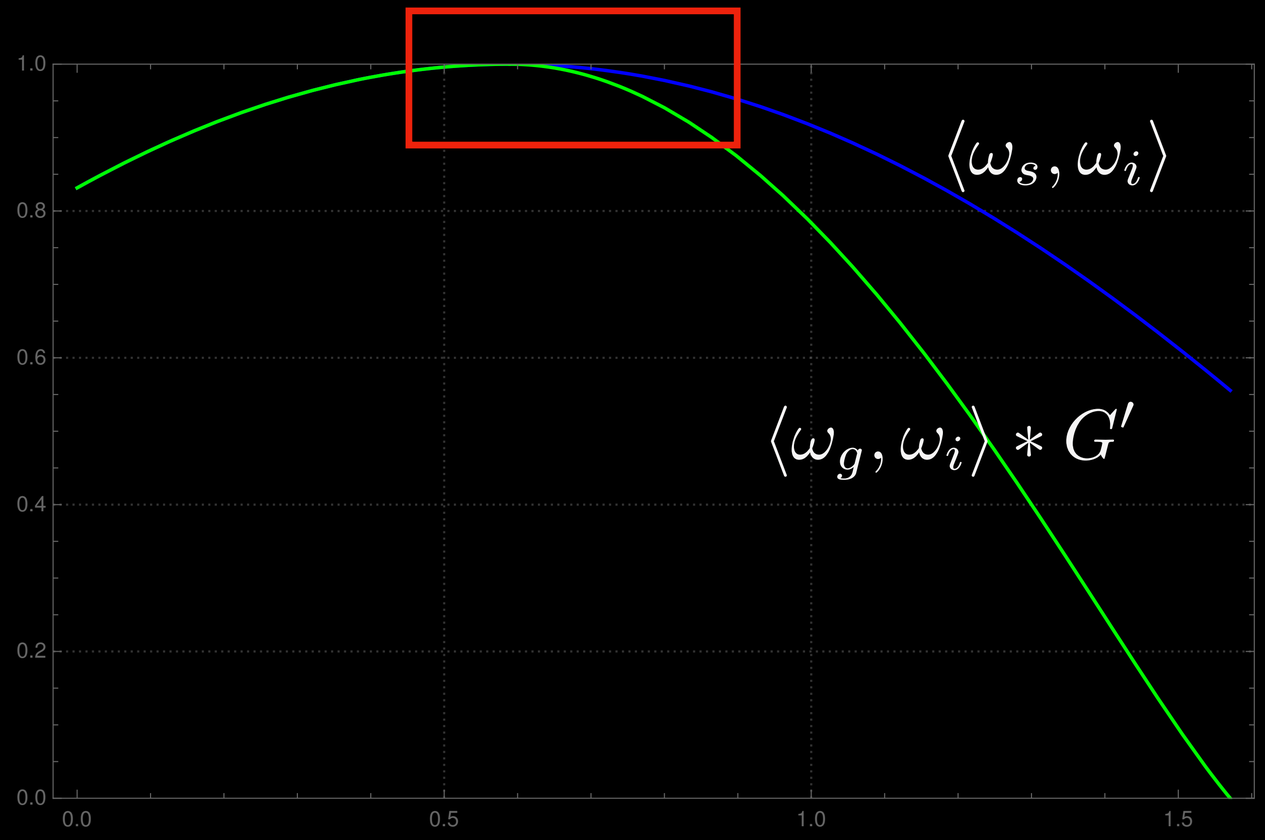

$$G' = -G^3 + G^2 + G$$

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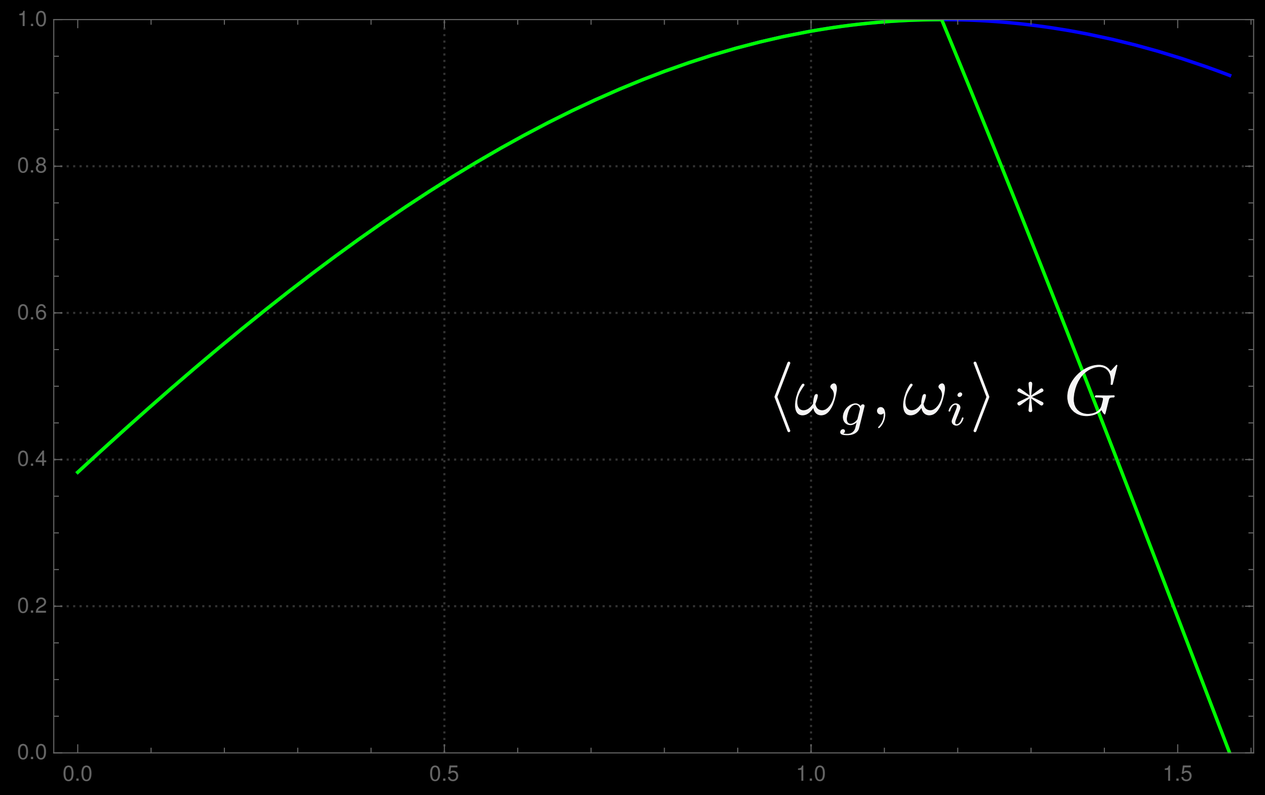

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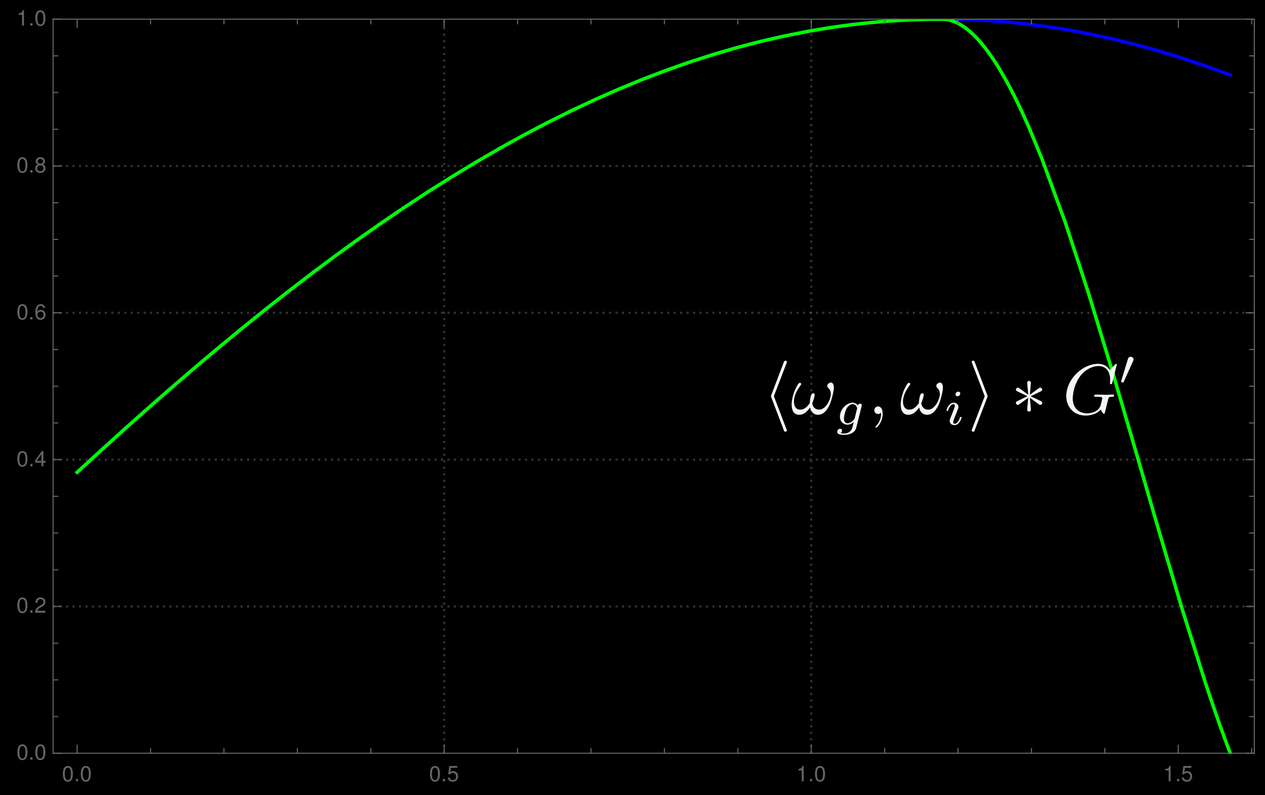

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$$G = \min\left[1, \frac{\langle \omega_g, \omega_i \rangle}{\langle \omega_s, \omega_i \rangle \langle \omega_g, \omega_s \rangle}\right]$$

$$G' = -G^3 + G^2 + G$$

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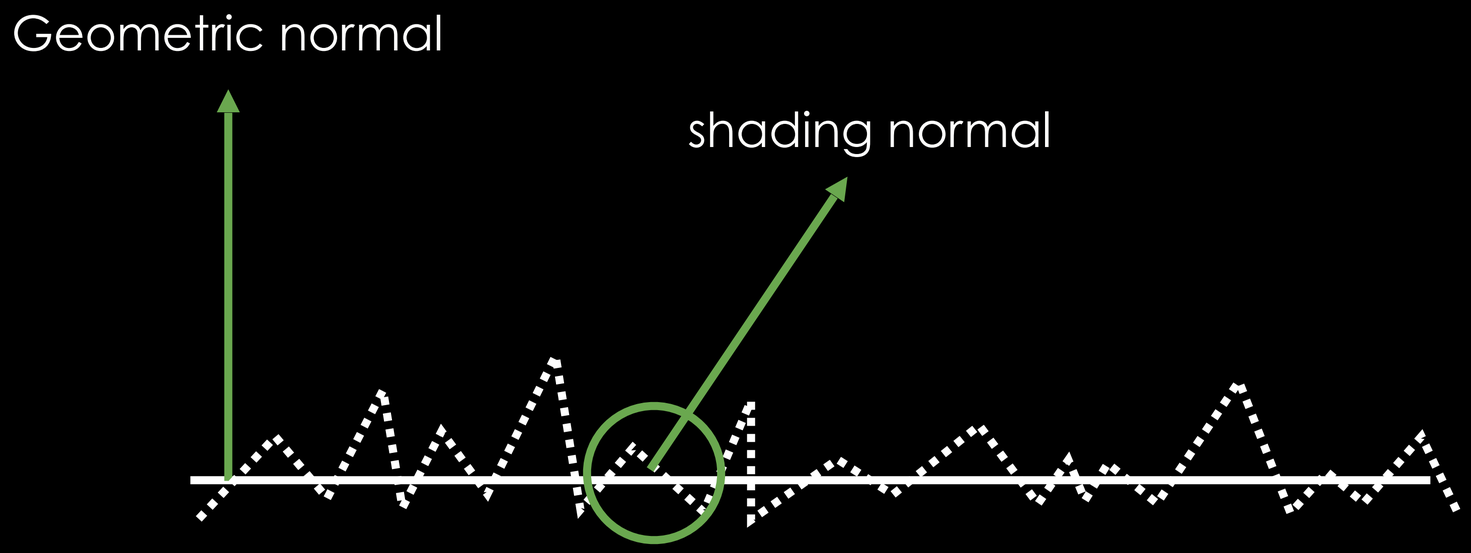
[Estevez et al. 2019]



Alejandro Conty Estevez, Pascal Lecocq, and Clifford Stein. 2019. A Microfacet-Based Shadowing Function to Solve the Bump Terminator Problem. *Ray Tracing Gems* (2019), 127.

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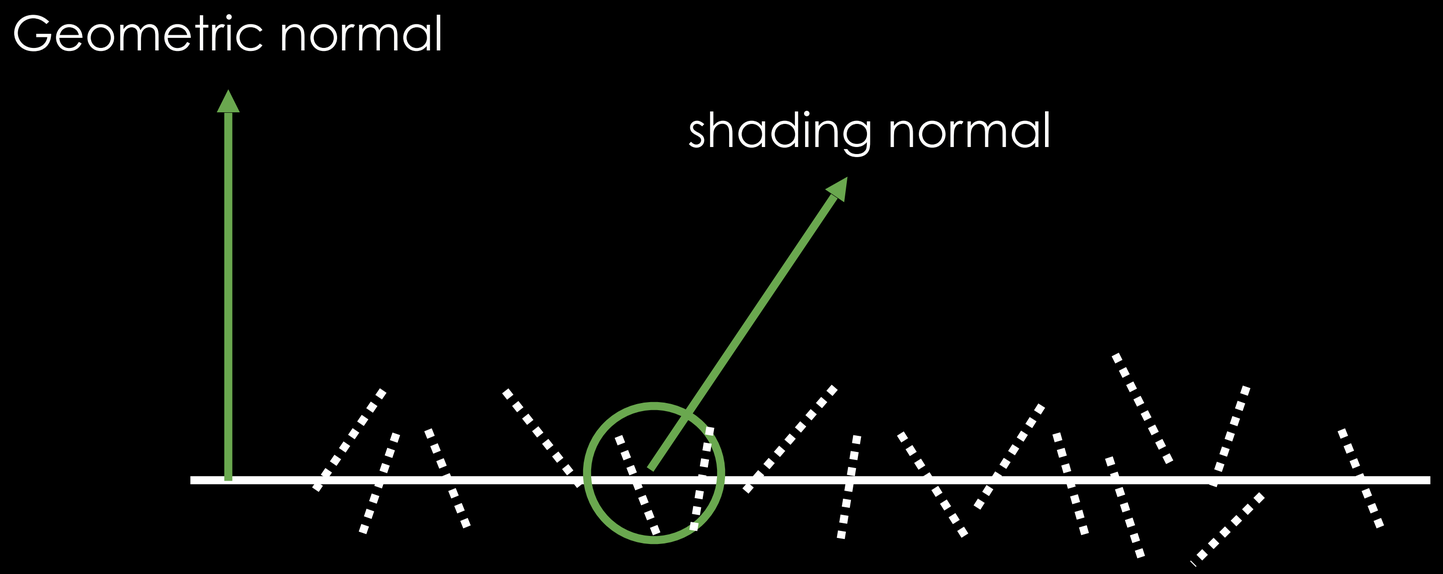
[Estevez et al. 2019]



Alejandro Conty Estevez, Pascal Lecocq, and Clifford Stein. 2019. A Microfacet-Based Shadowing Function to Solve the Bump Terminator Problem. *Ray Tracing Gems* (2019), 127.

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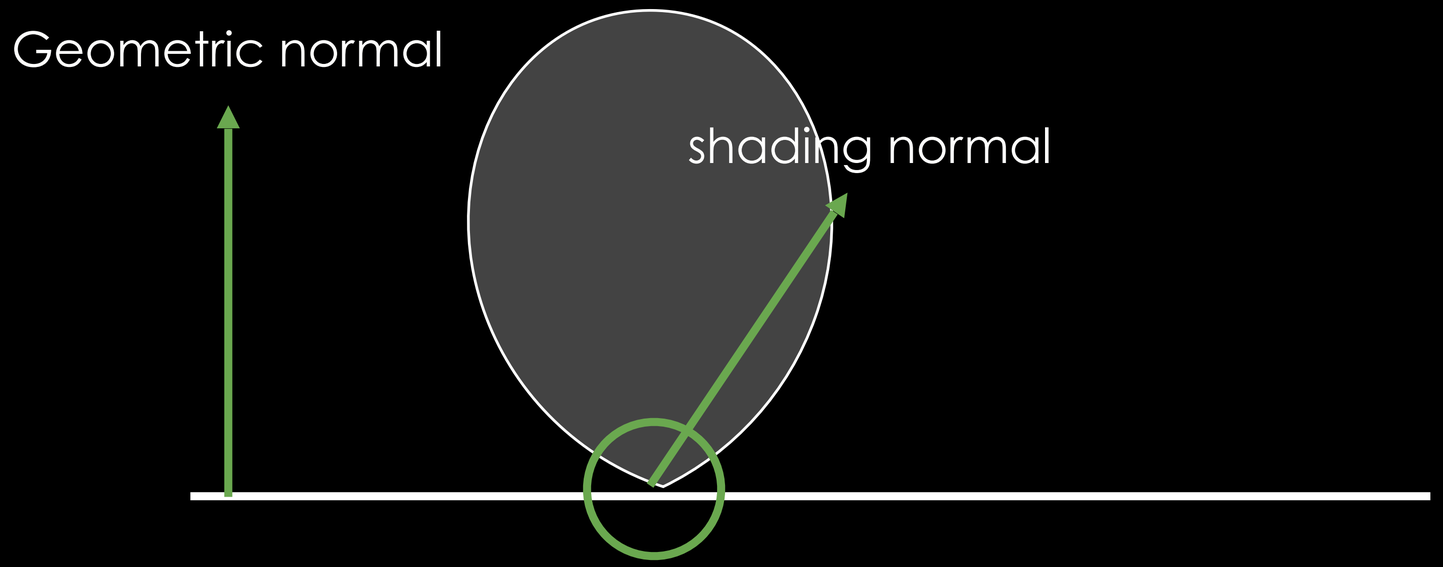
[Estevez et al. 2019]



Microfacet distribution function is used to approximate nearby hight-field

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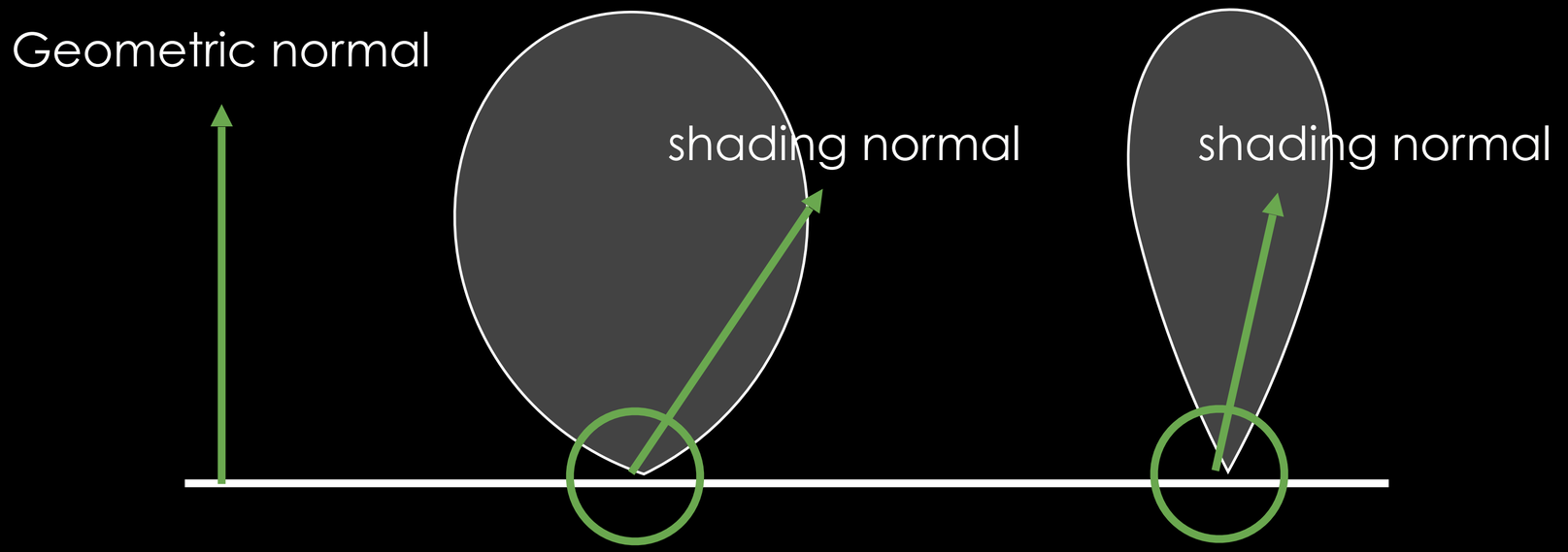
[Estevez et al. 2019]



Roughness of microfacet distribution function is determined by shading normal

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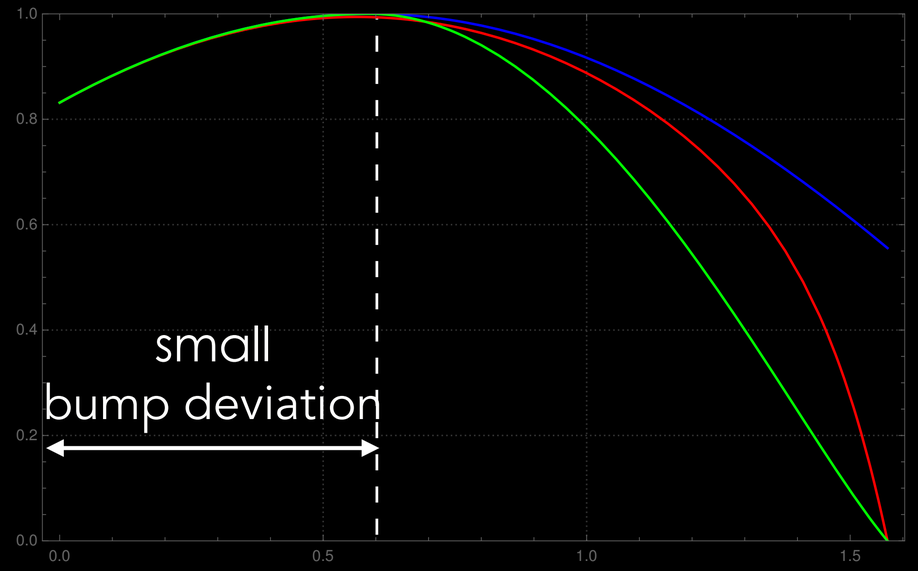
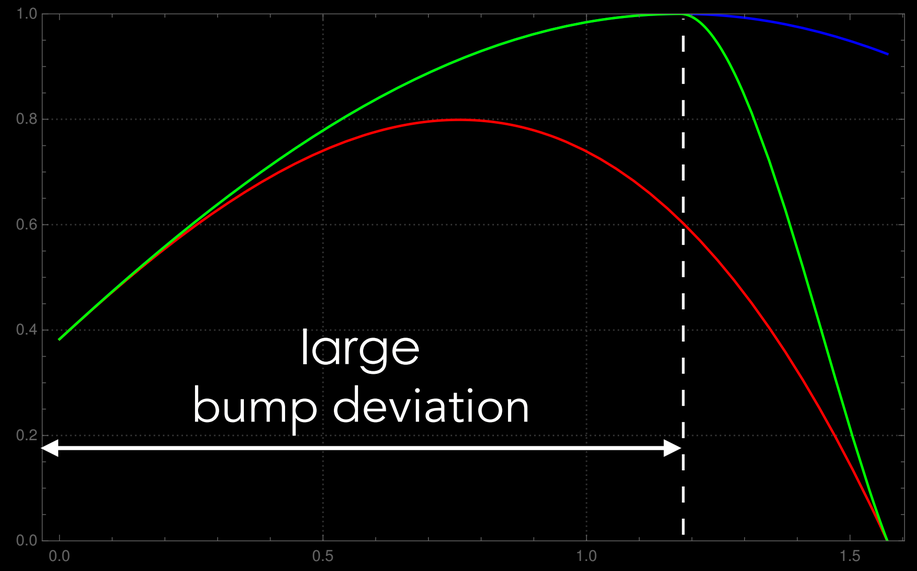
Compare to [Estevez et al. 2019]

Our solution

[Estevez et al. 2019]



$$\frac{3}{16}\pi$$



$$\frac{3}{8}\pi$$

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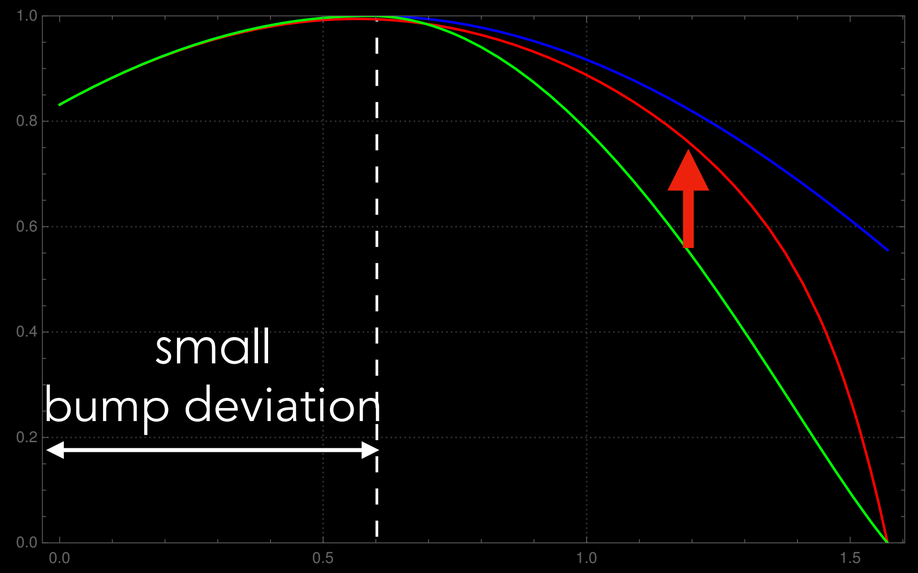
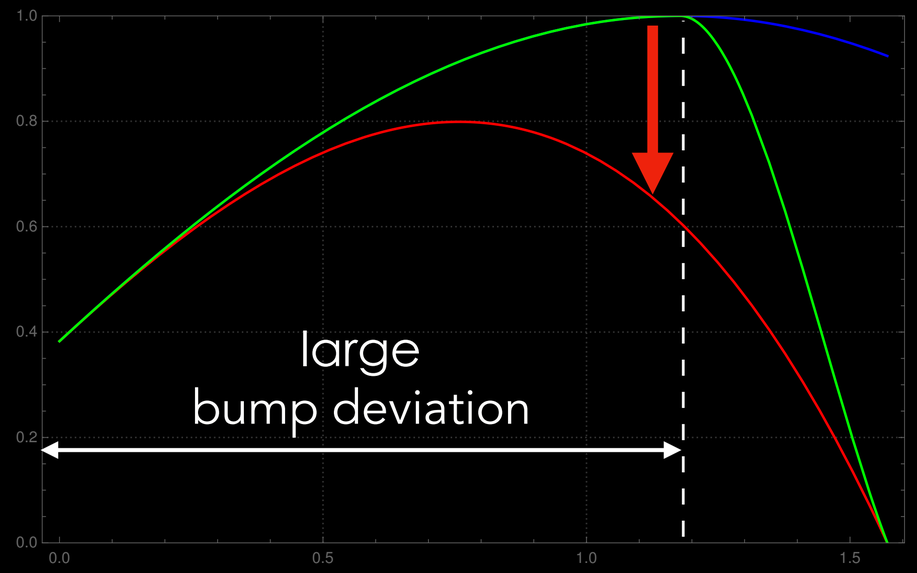
Compare to [Estevez et al. 2019]

Our solution

[Estevez et al. 2019]



$$\frac{3}{16}\pi$$



$$\frac{3}{8}\pi$$

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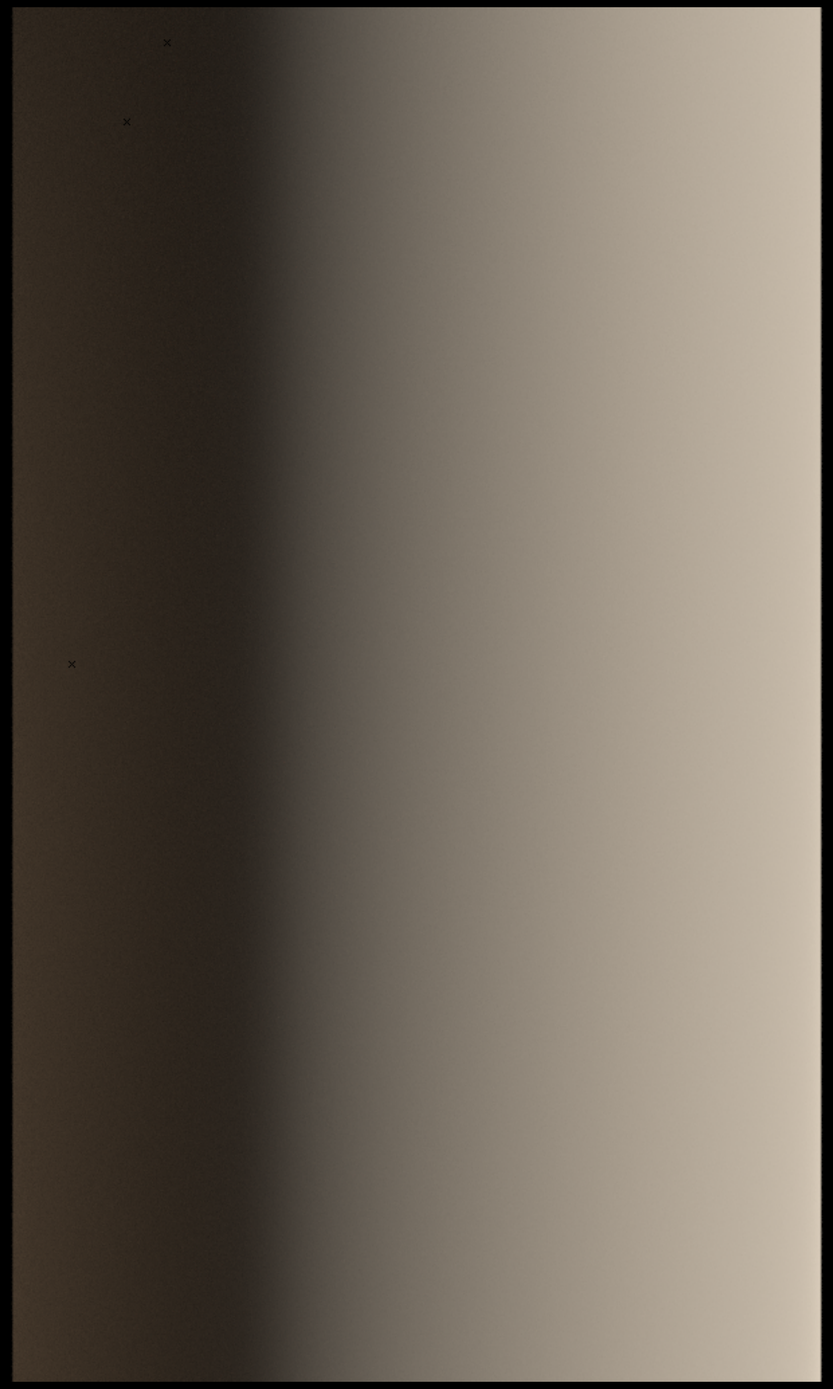

No bump

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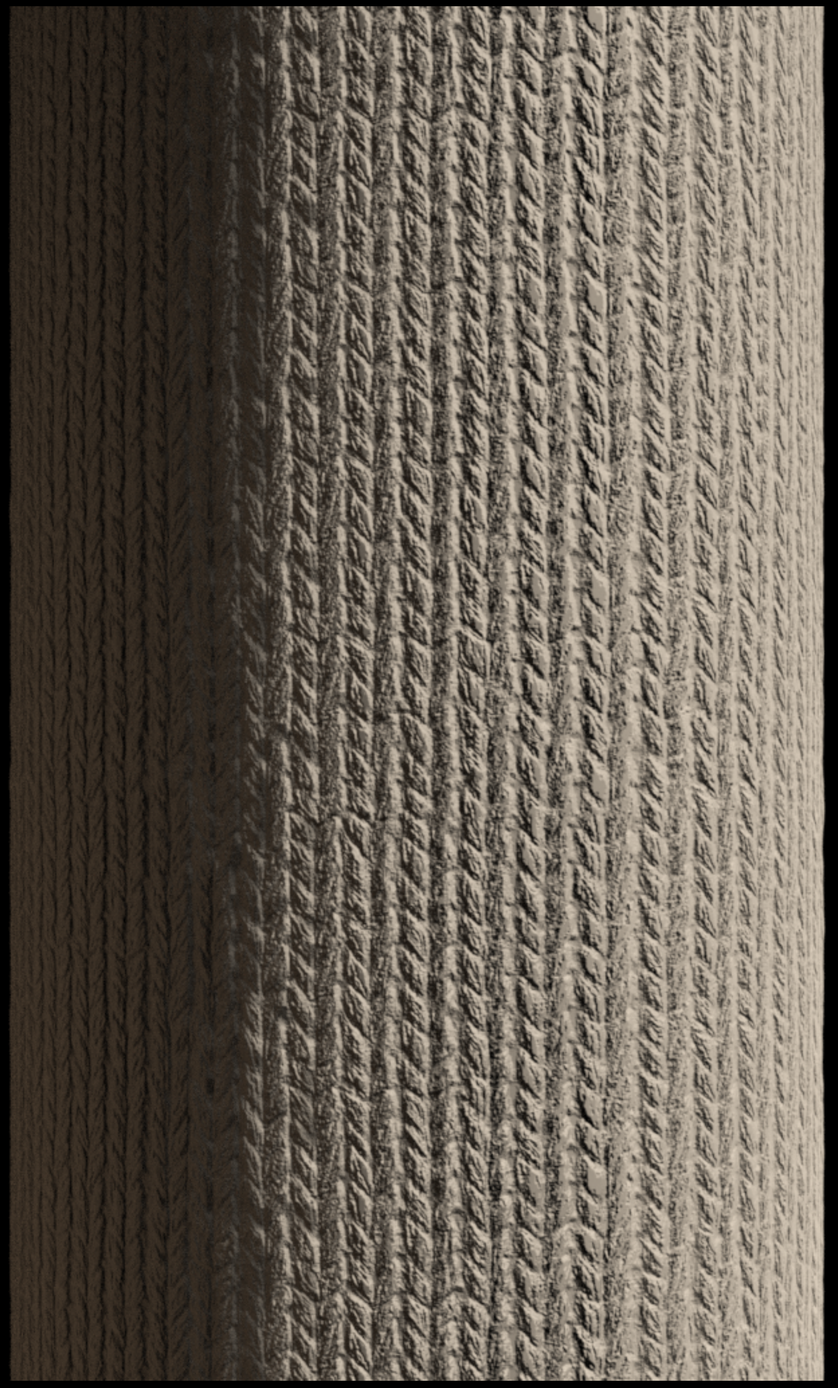

Original bump

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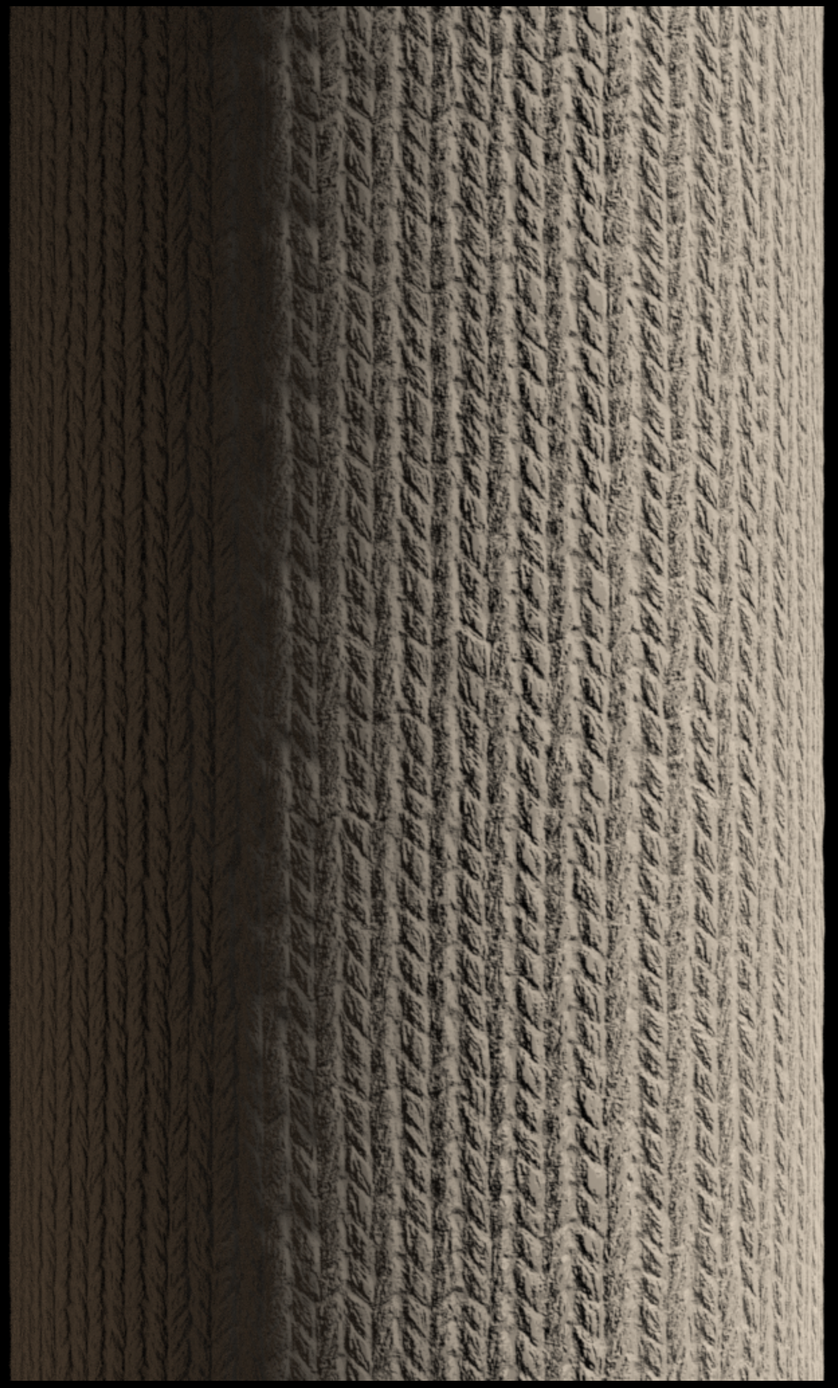

Our solution

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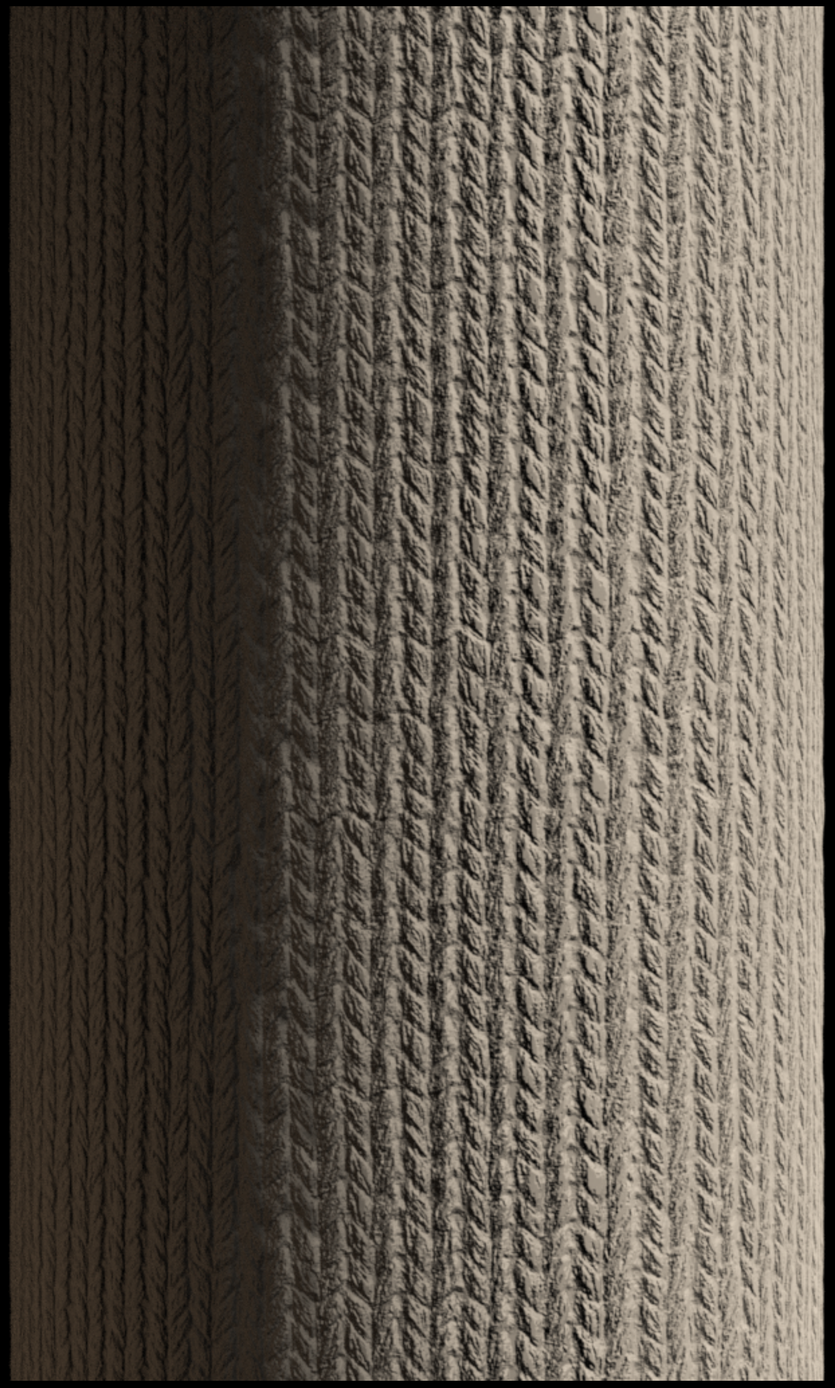

[Estevez et al. 2019]

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No bump

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Original bump

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Our solution

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[Estevez et al. 2019]

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Production example

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Walt Disney
Animation Studios


Walt Disney
ANIMATION STUDIOS

Question?

WALT DISNEY ANIMATION STUDIOS

SIGGRAPH 2019 Schedule

“a kite’s tale”
Sun - Thurs | Times Vary
VR Theater - South Hall J

The Making of Disney’s “a kite’s tale”
Sunday | 2:00PM - 3:30PM
Room 150/151

Predictive & Proactive Pipelines
Sunday | 3:45PM - 5:15PM
Room 153

Machine-Learning Denoising
Monday | 3:45PM - 5:15PM
Room 403 AB

Optimizing Rig Manipulation
Thurs | 10:45AM - 12:15PM
Room 403 AB

Optimizing Large Scale Crowds
Thurs | 2:00PM - 3:30PM
Room 408 AB

Creating Ralphzilla
Thurs | 2:00PM - 3:30PM
Room 408 AB

Taming the Shadow Terminator
Thurs | 3:45PM - 5:15PM
Room 403 AB

We Are Hiring!!!

To hear more about
our job opportunities stop
by and say hello!

MEETING ROOM 410

TWDC Suite
Tues | 11:00 am - 5:00 pm
Wed | 1:00 pm - 5:00 pm

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