Efficient Emitter Sampling for Spectral Path Tracing

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INTRODUCTION

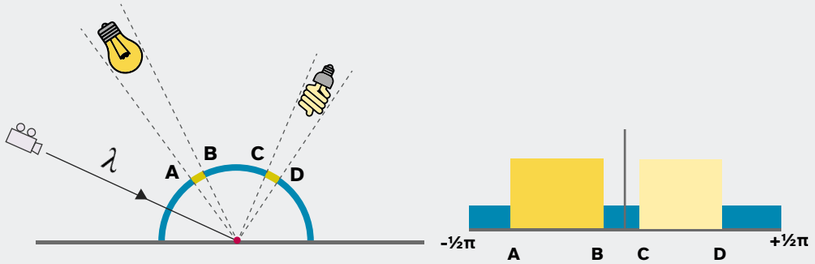
Path tracing is a renowned physically-based rendering method to produce photorealistic images. Trichromatic implementations model light spectrum into RGB values but fail to capture wavelength-dependent phenomena such as dispersion.

Spectral path tracing approaches attempt to model the light spectrum to capture physically-based phenomena faithfully. However, they involve a significant overhead and more samples to produce noise-free images.

We present an approach to reduce variance in images using emitter spectral distributions to better sample emitters for direct illumination.

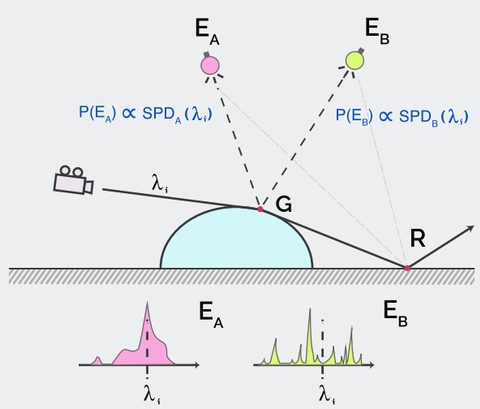
BACKGROUND

Direct Illumination :



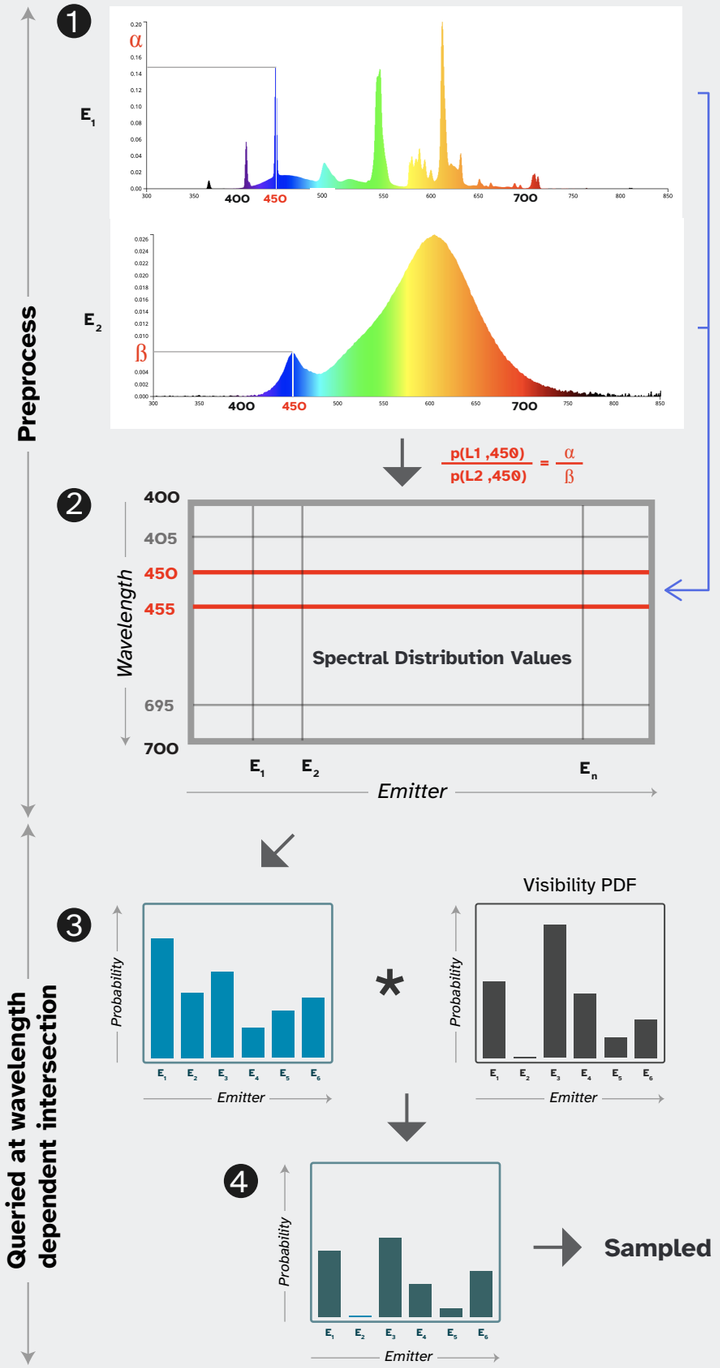
Next event estimation used to sample the hemisphere separately for direct (yellow) and indirect illumination (blue)

Sampling Paths with High Throughput :

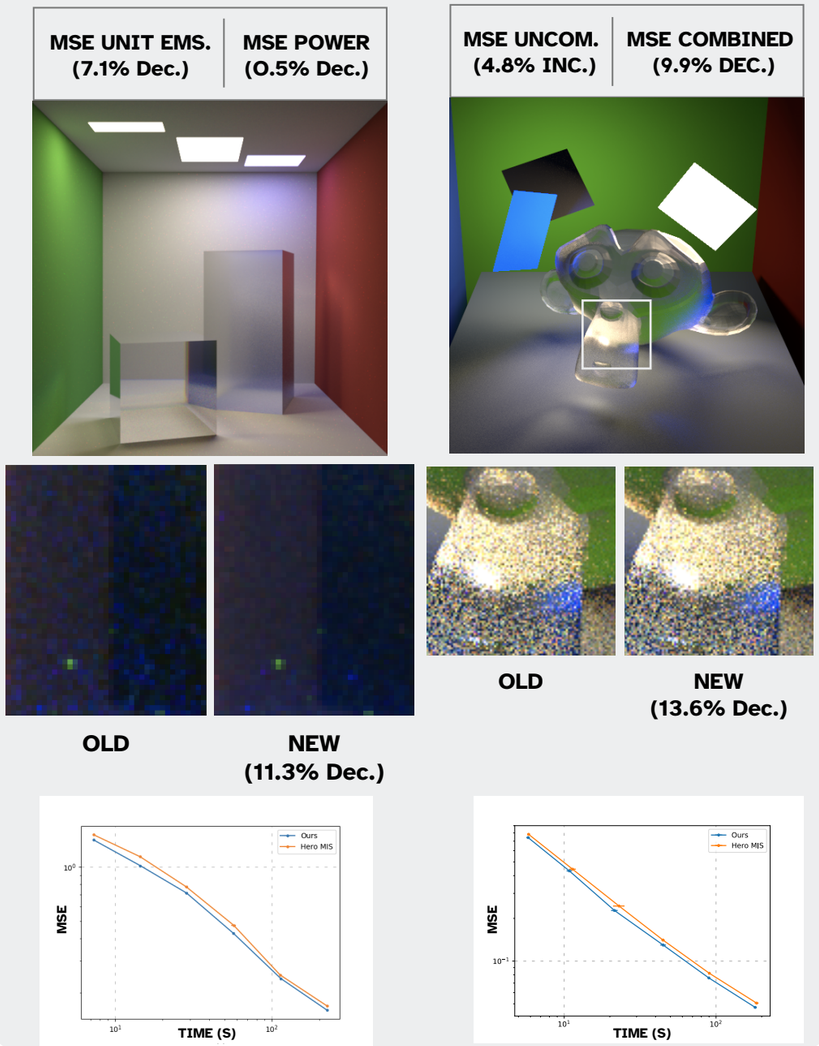


A light ray intersects a dispersive medium at point G where a secondary ray is shot to either of the emitters (NEE). We propose that the probability of sampling an emitter should be proportional to its emission value at wavelength λ_i.

METHOD



RESULTS



CONCLUSION & REFERENCES

Our approach improves next event estimation in spectral path tracers by accounting for the correlation between the propagated wavelength and emitter power distributions. It provides a 5-15% decrease in MSE across compared scenes and requires a small preprocessing overhead. Finally, it combines well with existing approaches such as visibility distributions and is easy to incorporate into other implementations. In the future, it can be extended when modeling fluorescent materials.

Matt Pharr, Wenzel Jakob, and Greg Humphreys. Physically Based Rendering: From Theory to Implementation
ROBY J., AUBE M.: Lamp spectral power distribution database (https://lspdd.org/app/en/home)