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Spectral Importance Sampling

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Abstract:

In Monte Carlo rendering, highest visual fidelity is achieved by simulating colour in the spectral domain, i.e. per wavelength. This comes with several challenges in practice, however. First, assets are usually authored in RGB space, since most acquisition devices operate in tristimulus space, and so do texture painting tools. This necessitates spectral upsampling techniques which hallucinate spectra given input tristimulus RGB values. One particularly simple approach to this is a three dimensional function space that combines a sigmoidal function with a quadratic polynomial. The second challenge is noise during rendering. Introducing another dimension (wavelength) as random variable introduces more noise into the solution. This is effectively alleviated using importance sampling. One issue with the simple 3D function space for hallucinated spectra is that it is not possible to analytically draw random variables distributed according to spectral power from them.

This project will investigate a modified function space that lends itself well to importance sampling. This is particularly interesting when representing emissive spectra (as opposed to reflectance spectra). Possible extensions include product importance sampling considerations (sample from the effective spectrum along the whole path, the product of material reflectances and light emission).