PROBLEM STATEMENT

In the context of real-time rendering it is common to ignore or simplify certain physical effects in order to increase rendering performance.

On example is Subsurface Scattering (SSS), which refers to the transmittance of light through materials with low translucency, and is important for the realistic appearance of many materials, e.g. human skin, marble, milk or wax. SSS simulation and rendering is in general difficult and time consuming, and often approximated by simpler models.

MOTIVATION & GOAL

A recent algorithm called Separable Subsurface Scattering (SSSS) enables the approximation of Subsurface Scattering in real-time. It is in principle a post-processing effect that takes less than 1 ms per frame. Unfortunately, the SSSS model used in this method is specifically designed to approximate SSS in human skin.

GOAL:

Since SSSS is specifically tuned for human skin only, the goal of this thesis is to extend this method to support arbitrary materials.

REAL-TIME SSS APPROXIMATION

Most common real-time methods approximate SSS by filtering of irradiance on the surface of the material being rendered. The used filters are based on so-called diffuse reflection profiles, which capture and represent the SSS characteristics of a material. Such profiles are usually generated by simulation of a thin light beam hitting the surface of an infinite half-cube of a material volume. The light distribution on the surface represents the diffuse reflection profile, and subsequent the ground-truth 2D filter.

SEPARABLE SUBSURFACE SCATTERING

The basic idea of SSSS is to approximate the ground-truth 2D filter by a separable filter which can be applied much faster using only two 1D convolutions. The original SSSS algorithm only provides a very limited approximation model which was tuned for SSS in human skin. The developed extensions which support arbitrary materials are presented on the left.

The SSSS algorithm applies the separable approximation filter as a post-processing step in screen-space on the diffuse illumination of the scene.

RESULTS

The extensions enable real-time SSS for arbitrary materials and fully dynamic scenes.