INTERACTIVE RENDERING OF COMPLEX FENESTRATION MATERIALS FOR ARCHITECTURAL DAYLIGHTING DESIGN

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ABSTRACT

Complex fenestration systems, such as prismatic and laser cut panels, can be used to redirect daylighting and more evenly illuminate interior spaces in a building, reducing the need for electric lighting. However, it is challenging to incorporate these materials into architectural design due to the counter-intuitive behavior of light refraction through these panels.

In this thesis, I present a method for rendering and visualization of complex fenestration materials. A hybrid method of shadow volumes for per-pixel hard shadows for direct illumination and patch-based radiosity for indirect illumination is first proposed for interactive rendering. This rendering technique can relight a mesh with about 1500 surfaces in an interactive speed, which makes it possible for architects to use in the schematic architectural design process. This algorithm enables simulation of the direct and indirect illumination from the sun and sky throughout each day for different months of the year. The rendering result is validated with Radiance both qualitatively and quantitatively.

A simple method to model 4D Bidirectional Transmission Distribution Function measurement data of complex fenestration materials is then used to simulate complex fenestration systems by leveraging the hybrid rendering method. The user can interactively explore the rendering results for different times and days to select appropriate materials early in the design process.