Evaluation on Technologies for Real-time Volumetric Cloud Self-occlusion Rendering

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Clouds are a beautiful phenomenon in nature. The real-time volumetric cloud rendering technologies are already widely used in recent video games. To render photorealistic clouds, we should research and reproduce the properties of the clouds. Among these properties, cloud self-shadowing or self-occlusion is an important cue to the perception of cloud shape. In this study, I investigate four main real-time approaches to render the self-shadow of clouds: i) Secondary ray marching; ii) Exponential shadow map; iii) Beer shadow map; iv) Fourier opacity map. Their memory footprint and render time are tested under different settings and situations. According to the results, secondary ray marching almost does not consume extra memory and is able to render fairly realistic cloud self-shadow, while it needs a long time for rendering when taking many samples. On the other hand, the other three methods store occlusion information in shadow maps. Though shadow maps consume some memory, they can accelerate rendering when at high screen resolution or when lots of cloud need to be rendered in a scene. However, their visual results are not as accurate as secondary ray marching. Based on the evaluation on the four approaches, the artists can choose a suitable one according to their purposes.