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Assessment (posudek vedoucího) of the Master's thesis titled

"Physically-based Cloud Rendering on GPU"

submitted by Oskar Elek

In his thesis, the candidate deals with one of the harder problems in contemporary computer graphics: the interactive generation of synthetic images that contain believable clouds. This is a hard problem for several reasons: both the shape of clouds, as well as light propagation within them, are, at least if solved in an entirely physically correct way, intricate problems that are currently still practically impossible to solve exactly - let alone solve at interactive frame-rates. In order to keep the workload of the thesis within manageable levels, the candidate sensibly chose to concentrate on the issue of approximative light transport within clouds. He did not address the generation of believable cloud shapes, and their placement within a scene, which are fairly difficult problems in their own right. Instead, he used various standard volumetric datasets as his "clouds", which were perfectly sufficient tools to perform his tests with.

The GPU-based illumination algorithm which the candidate developed is based on incremental photon tracing, followed by a step in which the photon tracing results are converted into billboards that can be easily incorporated into a realtime rendering pipeline. The algorithm was specifically designed for a flight simulation environment, but could also be used for less demanding tasks, such as architectural rendering. It is tailored to utilize the massively parallel capabilities of modern GPUs, and exploits a key property of clouds: they do change shape over time, but only slowly, so one does not have to re-compute their illumination for every frame.

As one can see from the results section of the thesis, as well as the provided executable, the candidate succeeded in achieving the goals set out at the beginning of the thesis work, and implemented a system which achieves the goal of rendering individual cloud datasets at interactive frame-rates. The system he built is of course a proof-of-concept implementation that could not be directly used in a flight simulator yet - but it conclusively demonstrates that approximative cloud rendering of good visual quality is a real possibility on contemporary GPUs.

The presented work is a solid research result, and it is to be expected that the thesis results will eventually be published at an international venue. Therefore, in the opinion of the supervisor, the thesis can only be recommended for acceptance!

Sincerely,



Alexander Wilkie