Posudek diplomové práce

Matematicko-fyzikální fakulta Univerzity Karlovy

Autor práce	Qingqin Hua
Název práce	Efficient Sampling of Re-radiation Matrices in Fluorescence-capable Rendering Systems
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Studijní obor	Počítačová grafika a vývoj počítačových her

Autor posudku	Mgr. Tomáš Iser	**Role**	Oponent
Pracoviště	KSVI		

Text posudku:

This diploma thesis shows a compression method for storing and efficiently sampling re-radiation matrices, which are matrices representing spectral reflectance and fluorescence data. They are essential for rendering scenes that contain fluorescent materials. Unfortunately, a lot of memory is required for storing such matrices (and their tabulated pre-computed distribution functions) both for the scenes themselves and during rendering. Hence, a compression scheme using Gaussian mixtures is proposed, implemented, and evaluated, including an efficient sampling strategy.

In general, the thesis solved the assigned problem in a satisfying way: the context was well introduced, author's decisions were clearly explained, the method makes perfect sense, was implemented in our research ART renderer, and the evaluation answered a lot of questions that one could ask, at least within the limited available dataset. Furthermore, I was very happy about the proposed future work, which is definitely worth exploring in my opinion.

Additionally, the thesis results were successfully published at the Eurographics Symposium on Rendering 2021 (EGSR 2021) conference, which emphasizes the quality of this work.

Hence, **I definitely do recommend the thesis for defense.**

However, I would also like to point out a couple of issues that I spotted while reading the thesis. First of all, I noticed several typos and incorrect ways of forming English sentences throughout the text. That unfortunately does not help with understanding the concepts. I also found some ideas to be explained in rather clumsy ways; consider the last paragraphs in Section 2.4, pp. 33-34. Furthermore, I would strongly suggest the author to always cite where derivations of equations come from; for example, the derivation of Eq. 3.8-3.11 is impossible to understand just from the text alone and requires additional knowledge and materials. Similarly, it was hard for me to follow the exact numbers when the storage requirements were explained in Section 4.4. Lastly, I think the thesis is missing at least a short mention of Raman scattering, which is an inelastic scattering effect that is also responsible for wavelength shifting in the visible spectrum, and, in fact, often overlaps with fluorescence. (Note that at higher energies (X-rays), Compton scattering is yet another wavelength-shifting effect.)

I would now like to ask a couple of **questions** that I would like the author to think about and answer during the defense:

1) On p. 44, you state that you store the diagonal in its original tabulated form without any alteration. However, for a given incoming wavelength λ_i, the integral over all outgoing wavelengths λ_o must be less than or equal to 1, otherwise energy conservation would be violated. In my opinion, it is theoretically possible for the Gaussian mixture to overestimate the fluorescence, which could break the energy conservation unless the diagonal was appropriately scaled. What is your opinion?
2) Could you provide timings for the renders performed with a tabulated re-radiation, and compare them to those with the Gaussian mixtures? Additionally, how long does fitting a single re-radiation matrix take?

Thank you very much for your answers!

Práci doporučuji k obhajobě.

Práci nenavrhuji na zvláštní ocenění.

Datum 23.08.2021 **Podpis**