Review of the Dissertation Thesis

High-quality shadow rendering from complex light sources
submitted by
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Content of the Dissertation

The dissertation is concerned with shadow mapping algorithms and their improvement based on parametrization of sampling function designed for complex light sources. It is written in English on 77 pages incl. bibliography and structured in 6 chapters. References include 41 bibliographic entries. 7 cited papers with candidate co-authorship are directly related to the topic of the thesis.

The introductory chapters 1 and 2 provide a motivation for the work, state the goals to be achieved, and introduce shadow mapping algorithm and the core of GPU implementation. The issues are summarized in part 2.3.3. In Chapter 3, the methods for reducing aliasing are discussed and several approaches of shadow mapping algorithms are briefly explained.

In Chapter 4, the candidate proposes a new approach based on improved texture warping with paraboloid mapping. The chapter 5 provides experimental results and discussion on performance, limitations and comparison with previous approaches. A single-page Chapter 6 concludes the thesis.

Evaluation of the Dissertation

The text is well structured and is easy to look over but sometimes difficult to read and understand details. It contains many grammar errors that complicate to understand the meaning of sentences. However, the quality and precision of the text improves as the author leaves introductory general description of traditional achievements (Chap. 2,3) and gets closer to his own research work in Chap.5. To illustrate what I mean I give several examples:

- p.8 - The solution *for computing ... is described* in eq. 2.1
  I see no solution. In fact, I see no conditions for this equation as well. Vacuum? Participating media? Probably not ... L_r is received or reflected radiance (see 2 occurrences of this term on the page)?
- p.8 - *cos theta* cannot express "*a geometric relation between point and direction*"
- p.9 - Fig.2.9 for BRDF is confusing, it illustrates mirror reflection with L_i L_r in a plane.
- p.9 - eq.2.4 is not for *all global illumination algorithms* ! Fig.2.4 explains nothing.
- p.10 - Alg.1 is **NOT** an original Whitted's RT alg. It is oversimplified, incorrect and should be rewritten.
- p.10 - Fig.2.5 is just an illustration ...
- p.10 - Fig.2.6 illustrates ... and *shows that the scene is oversampled* ... Compare this text with Fig.2.6 itself.
- p.11 - Path of the rays are traced ... *which is expected to return a color* ... This is a very rough summary of ideas behind !
- p.11 - Explanation for eq.2.5 is incorrect. V is mutual visibility for points, not *for patches.*
- Etc., etc.

Contribution

The work is well motivated and the candidate distinctly states the main objective of research. The candidate has identified a problem that is both interesting from theoretical point of view and relevant in practice. The approach to the problem is technically sound and theoretically well developed. The dissertation offers useful conclusions and accomplishes the main goals that the candidate has set:

- As the main contribution of the Thesis, the new Non-orthogonal Texture Warping method was introduced to cope with shadow aliasing. The technique produces sufficiently fast and good rendering quality.
- The method combines several steps grounded on previous research results and it is well argued.
- The experiments carried out for different scenarios have confirmed the correctness and the advantages of the proposed approach.

The NoTW shadow method and its various modifications would be likely used by other researchers in the field, in particular, in applications where complex lightning solved by other approaches leads to visual artifacts and aliases. As pointed out by the candidate, the correct shadowing techniques are important in a wide context and content-based non-uniform sampling plays the key role in usage of these techniques in practice.

Conclusions

The Dissertation addresses an important and relevant problem in the areas of GPU based rendering. The candidate has well formulated the problem and proposed original solutions. The dissertation offers useful conclusions that are demonstrated on a set of experimental results. However, the introductory theoretical part of the thesis is not described clearly. Thus I conclude that the author proved his ability to solve nontrivial problems in practice but he fell partly short of formulating and presenting scientific results in general. Nevertheless I recommend the thesis for defense.

Brno, January 22nd, 2016

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