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Prague, February 20th, 2023

Supervisor's assessment of the thesis *„Efficient and Expressive Microfacet Models"*, submitted by Asen Atanasov at MFF UK

The thesis has 100 pages, and is divided into six sections plus four appendices. It is the result of more than 5 years of Ph.D. work, and contains two main contributions. Both of these deal with micro-facet reflectance models for computer graphics, and they introduce two distinct new capabilities to this class of reflectance models. Such models are used to describe glossy solid surfaces, and are generally considered harder to describe than the edge cases of perfectly diffuse and perfectly smooth reflectance. Which is why there is already a considerable body of literature covering their handling and behaviour, but also still unsolved technical issues.

The first three sections of the thesis describe the topic domain, and thoroughly outline the topic area in which the two scientific contributions were made. These sections are well-written and informative, with an excellent review of relevant literature.

The fourth section presents the first of two original scientific contributions made by the candidate: a principled treatment of linearly transformed micro-surface distributions, i.e. of micro-surfaces that are subjected to a user-defined transformation of the distribution function which describes facet orientation. While in computer graphics there has long been a variety of isotropic micro-surface distribution functions to chose from during the modelling process, and while pre-defined anisotropic micro-surface distributions have also been part of graphics for a long time, explicit transformation of a given micro-surface distribution had not been properly investigated. The candidate contributed a thorough and practically useful treatment of the problem: this enables end users to work with transformations in new and creative ways to modify glossy surface appearance in a manner that was so far not possible.

The fifth section presents his second contribution, which was actually published before the first one. Here, a significant step forward over the extant state of the art in this area was made insofar as the concept of multi-scale micro-surfaces had been introduced earlier: but none of the techniques that had been proposed for them up to then were practical, in the sense that they could actually have been used in production software. Beautiful one-off images in conference proceedings one could generate: but memory consumption, ease of use and render times are often secondary considerations in such experimental settings. For a production renderer, algorithms need to be consistently performant, predictable with regard to memory use, and easy to control. As with the first contribution, the candidate solved the issues at hand by first thoroughly analysing the theory behind the problem, and by then combining carefully chosen algorithmic components to yield a technique that passes muster.

Both of these contributions have already found their way into the production software made by the company the candidate works for: as this is professional rendering software with a large user base across the globe, and as the techniques will likely also be used by others, the two contributions made by the candidate can already at this stage be considered to have had an industry-wide practical impact in the area of appearance modelling for glossy surfaces.

To summarise, the thesis presents two relevant and useful improvements on the state of the art in graphics: and as these two improvements were published with the candidate as first author in a reputable journal, the formal conditions for a doctorate at MFF are fulfilled. But this thesis is more than just a fulfilment of formal criteria: it reads well, is very thorough, and a resource for anyone who is interested in the area of micro-surface distributions. And it definitely also counts as a major plus point that with both his contributions, the candidate clearly demonstrates that he is able to perform cutting edge graphics work without losing sight of the ultimate practical utility of his results. So I gladly recommend the thesis for acceptance.

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