

13. 6. 2017

Supervisor's Ph.D. thesis assessment

Ph.D. candidate: RNDr. Jiří Vorba

Ph.D. thesis title: Adjoint-Driven Importance Sampling for Light Transport Simulation

Supervisor / author of review: doc. Ing. Jaroslav Krivánek, Ph.D.

Let me start by stating that I consider Jiří Vorba an independent, creative researcher fully capable of devising and executing novel research ideas in the field of Computer Graphics. I do recommend his Ph.D. thesis entitled "Adjoint-Driven Importance Sampling for Light Transport Simulation" for defense.

Let me elaborate. My collaboration with Jiří Vorba started in 2010 when I supervised his Master's thesis. Jiří was given from me a rather vague description of a potential interesting research idea on combining elements of photon mapping with bidirectional path tracing. Despite the fact that he had no previous experience with or knowledge of light transport simulation, he was able in a very short time to come up with an idea how to achieve the given broad goal and to implement a prototype of the idea. The resulting paper won the best paper award at the CESC seminar. Jiří's idea was fundamental and later it became part of the influential papers on Vertex Connection and Merging / Unified Path Space. This episode was a strong indication of Jiří's aptitude to become an independent researcher, which he has fully confirmed during his Ph.D. studies.

His Ph.D. thesis is based on two major contributions published in ACM Transactions on Graphics (TOG) and presented at the ACM SIGGRAPH conference, which is considered the most prestigious event in the field. Apart from that, he has co-authored another paper in ACM TOG and yet another in Computer Graphics Forum. Jiří's work is based on a synthesis of ideas from fields beyond the boundary of computer graphics, such as machine learning and neutron transport calculations. But His research goes further than merely applying ideas from the literature. It possesses an important element of added value both in terms of theoretical insights and algorithm design.

His first work entitled "On-line Learning of Parametric Mixture Models for Light Transport Simulation" has provided a basis for globally optimized sampling decisions in Monte Carlo-based light transport calculations in image synthesis. His was among the first works to show that ideas from statistical learning can be applied in the context of Monte Carlo so that each sample is not

only used as a contribution to the given estimator, but also as a basis for improving further sampling decisions.

His subsequent work entitled "Adjoint-Driven Russian Roulette and Splitting in Light Transport Simulation" started off as a simple application of ideas from neutron transport calculations, but once again, Jiří was able to lift the work by providing a theoretical analysis showing the close relationship between the zero-variance sampling schemes, his previous-work on importance sampling and the new Russian roulette and splitting strategy.

In conclusion, I strongly believe that Jiří's highly original work will have a lasting impact in both the research and the industry applications of light transport simulation. I also believe that this work provides sufficient evidence of Jiří's maturity as an independent and creative researcher.

Kind Regards,
Jaroslav Křivánek