ADVANCED TUTORIAL

Monte Carlo and Quasi-Monte Carlo Methods in Computer Graphics

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Photorealistic images synthesis consists of computing functionals of the solution of a Fredholm integral equation of the second kind. The tutorial provides an understanding of the mathematical problem and the tools needed to implement high performance high quality image rendering software as used in industry for product design and movies.

Structured in three parts, we first introduce the global illumination problem and high performance ray tracing, followed by a part on algorithmic aspects of randomized and deterministic quasi-Monte Carlo methods. The third part combines the previous ones by presenting rendering algorithms for light transport simulation. The tutorial is self contained, gives a lot of references for further study and research, and points out open problems.

The presented techniques like high performance ray tracing, the high speed generation of (t, s)-sequences, parallel adaptive quasi-Monte Carlo integration, the simultaneous simulation of Markov chains using sorting, or treating weak singularities in a robust way have many applications outside the domain computer graphics, too.