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From 3-D Gaming to Physics Simulation: Tracking Particles Through Faceted Geometries in Monte Carlo Radiation Transport Simulations

Matthew Ryan Martin
Kansas State University
Len J. Lorence, Manager (Org. 15341) Brian C. Franke, Technical Advisor
Sandia National Laboratories

Accurate and realistic representation of structures and materials during simulations causes large performance reductions on radiation transport codes. To represent a model in a CAD format requires the use of NURBS (non-rational uniform b-splines) and other complex surfaces that are slow to query and require large amounts of memory. Current implementations of querying realistic models are like ray tracing, and as such suffer from the same disadvantages of slow run time. Representations of these models change as the drafting programs used to make them are updated. This quickly renders most models incompatible with a particle tracking system. A proposed solution to these problems is the use of faceted geometries as a close approximation to the model. Faceted geometries are represented in an industry wide recognized STL (stereo-lithography format) which almost all of today's CAD systems are capable of generating. In addition to compatibility, this file format is static and remains unchanged while other proprietary formats are updated. Querying geometries represented in this format is a well-studied problem in the realm of 3-D games. Through the use of BSP (binary space partitioning) trees, ray shooting queries are performed much faster than in the equivalent evaluation of a complex surface. This practice is transferred to radiation transport simulation to achieve gains in performance and compatibility.

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