

Fast, Effective BVH Updates for Dynamic Ray-Traced Scenes Using Tree Rotations

*Daniel Kopta, Andrew Kensler, Thiago Ize,
Josef Spjut, Erik Brunvand, Al Davis*

UUCS-11-002

School of Computing
University of Utah
Salt Lake City, UT 84112 USA

July 8, 2011

Abstract

Bounding volume hierarchies are a popular choice for ray tracing animated scenes due to the relative simplicity of refitting bounding volumes around moving geometry. However, the quality of such a refitted tree can degrade rapidly if objects in the scene deform or rearrange significantly as the animation progresses, resulting in dramatic increases in rendering times. Existing solutions involve occasional or heuristically triggered rebuilds of the BVH to reduce this effect. In this work, we describe how to efficiently extend refitting with local restructuring operations called tree rotations which can mitigate the effects that moving primitives have on BVH quality by rearranging nodes in the tree during each refit rather than triggering a full rebuild. The result is a fast, lightweight, incremental update algorithm that requires negligible memory, has minor update times and parallelizes easily, yet avoids significant degradation in tree quality or the need for rebuilding while maintaining fast rendering times. We show that our method approaches or exceeds the frame rates of other techniques and is consistently among the best options regardless of the animation scene.