Motivation and Challenge

Interactive ray tracing framework (http://www.cgv.tugraz.at/mrt)
- Targets massively parallel hardware architectures
- Different integrators (Whitted-style, Path tracing, ...) and applications
- Batch processing of a variety of ray loads (coherence, first-hit vs. any-hit, ...)

Investigate efficient ray traversal methods (predominantly bounding volume hierarchies)
- Monolithic ray traversals [Aila12] and multi-kernel approaches [Garanzha10, Schiffer14]
- Exploration and experimentation with alternative traversal algorithms
- Detailed statistical evaluation for research purposes

System Infrastructure and Features

High Performance Computing Module encapsulates target hardware architectures
- Object-oriented interface to CUDA and OpenCL
- Kernel language module and runtime compilation framework for optimal performance
- Fast memory manager based on [Masmano08] for host and device memory

Ray traversals are implemented on the basis of functor objects
- Functors define interfaces representing parts of the algorithm (e.g. traversal step)
- Functor interfaces can be implemented in different ways (launch configurations, persistent threads, ...)
- Each functor has a dedicated statistics class capturing detailed runtime information
- Functors and statistics can be configured and evaluated as part of the scriptable scene graph

Results and Discussion

Experimental evaluation of the infrastructure for multiple GPU-based ray traversal algorithms
- Improved Code Quality due to clean, modular structuring and functor reuse
- Support for optimization and selective statistical evaluation
- Memory Manager: Can improve performance of multi-kernel approaches by 10-25%

References

[Aila12] Understanding the Efficiency of Ray Traversal on GPUs -- Kepler and Fermi Addendum, HPG 2012
[Garanzha10] Fast Ray Sorting and Breadth-First Packet Traversal for GPU Ray Tracing, EG 2010
[Laine13] Megakernels Considered Harmful: Wavefront Path Tracing on GPUs, HPG 2013
[Masmano08] Implementation of a constant-time dynamic storage allocator, 2008
[Schiffer14] Efficient Multi-Kernel Ray Tracing for GPUs, GRAPP 2014