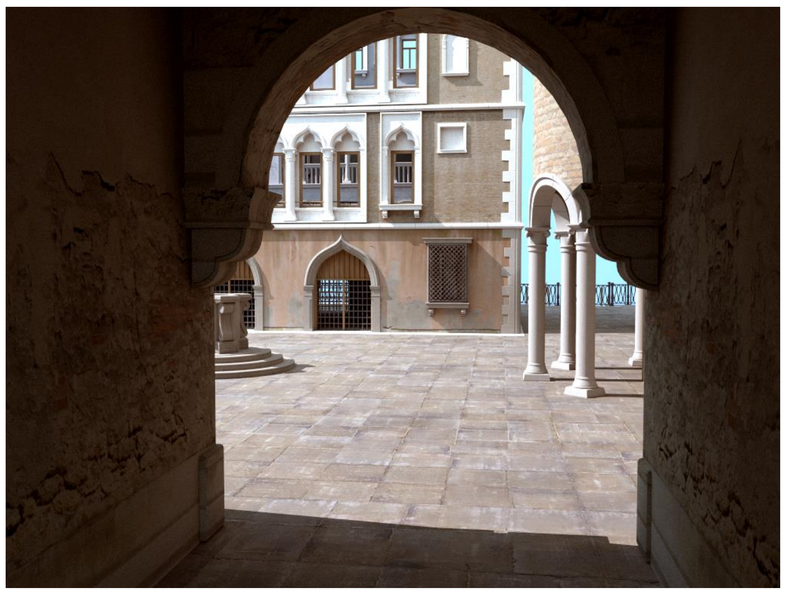
The Split Grid – A Hierarchical 1D-Grid-based Acceleration Data Structure for Ray Tracing

– Pablo Bauszat, Marc A. Kastner, Martin Eisemann, Marcus Magnor –
Computer Graphics Lab, TU Braunschweig, Germany



Motivation

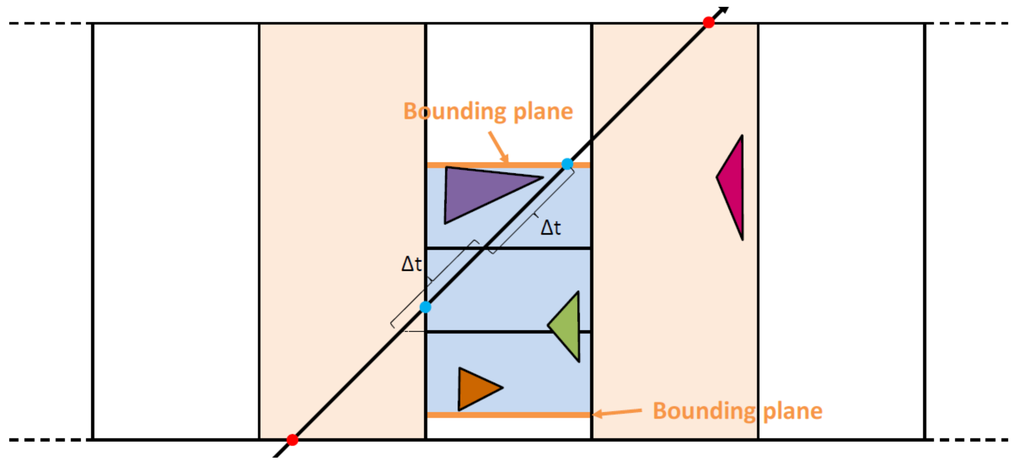
Efficiency of acceleration structures for ray tracing is defined by fast traversal performance, low construction time and small memory footprint. Current state-of-the-art approaches such as kd-trees or Bounding Volume Hierarchies (BVHs) rely on computational expensive construction heuristics (e.g. the Surface Area Heuristic) for fast traversal performance. Grid-based structures are faster to build but consume large amounts of memory or do not adapt well to the underlying scene geometry. Combining concepts of hierarchical grids, kd-trees and BVHs, our approach is based on the idea of nesting 1D-grids and utilizes the merits of the underlying approaches.

The **Split Grid** is …

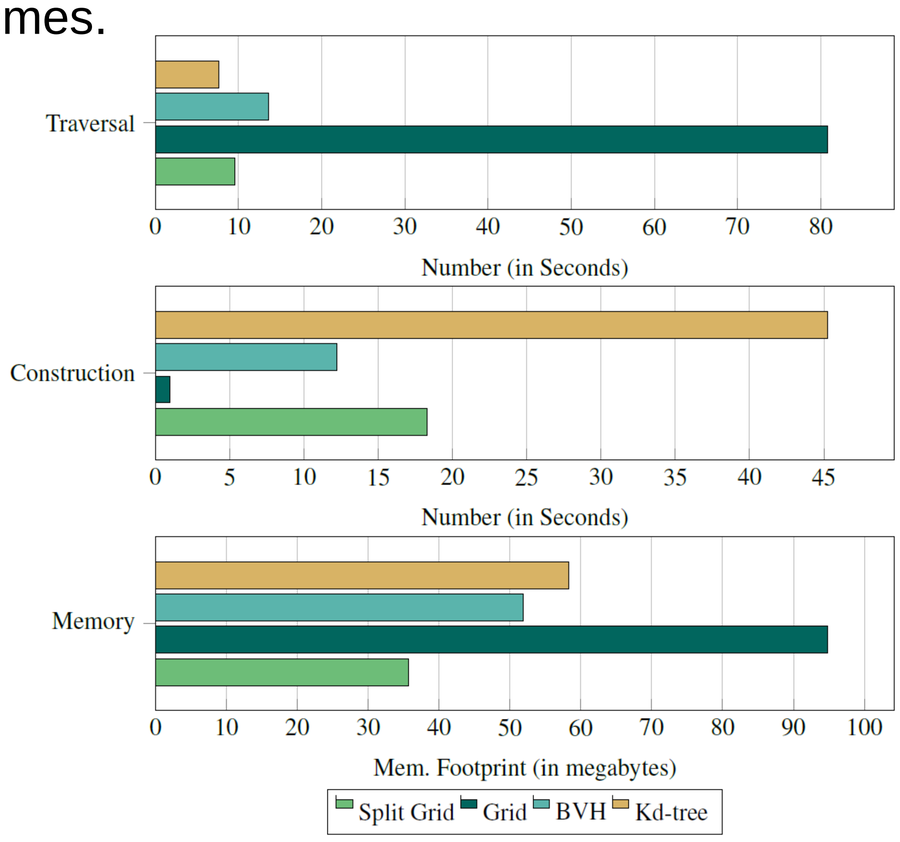
- traversed using a fast and efficient scheme
- compact in storage
- adaptive to the scene geometry
- Built with a very simplistic scheme – no complex heuristic is necessary to achieve high traversal performance!

Our approach

Our **Split Grid** is a hierarchical data structure. Initially, it uniformly divides the scene-space along a single axis into a variable number of grid cells of the same size. Recursively, each cell is further subdivided into an 1D-grid, potentially choosing a different split axis.



Each inner node of the tree stores two additional bounding planes orthogonal to the associated split axis to cut off empty space more efficiently and faster adapt to the scene geometry. Whole sub-trees can be skipped immediately during traversal when rays move through empty space; a property usually reserved for object-space partitioning schemes.



The **Split Grid** achieves competitive traversal and construction performance while having the lowest memory footprint averaged over all scenes.

TECHNISCHE UNIVERSITÄT
CAROLO-WILHELMINA
ZU BRAUNSCHWEIG