Hierarchical View-Frustum Culling for Z-buffer Rendering

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- Recap of last presentation
  - What is frustum culling
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What is frustum culling?

- Limiting the objects which are rasterized to be just the objects that are visible
- Saves vertex shader computations

Frustum culling using BVH

- Check AABB of node
  - If inside, draw all children
  - If outside, discard all children
  - If intersects, recurse deeper
- Fast AABB-frustum incidence test
  - Split into 6 AABB-plane tests
  - If one fails, the test fails

My implementations

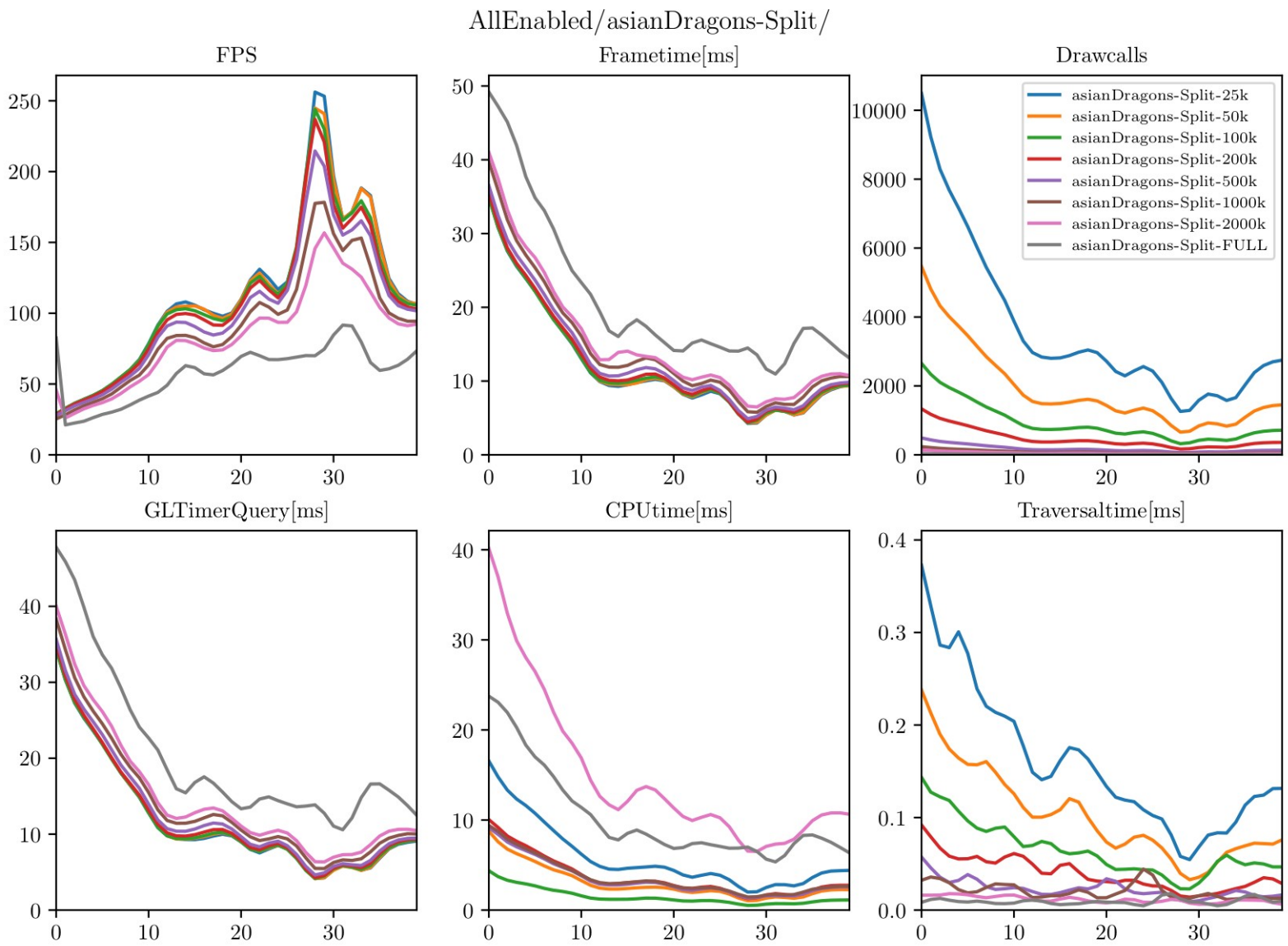
- SDL2, OpenGL
- Several simple scenes to test with
  - Scene contains objects + camera animation

Measurements

- Both Nvidia (desktop) and Intel (integrated) GPUs
- Measurements
  - FPS, Frametime
  - # of draw calls
  - GL_TIME_ELAPSED – Actual time to draw on GPU
  - CPUtime – Time to traverse + driver calls
  - Traversaltime – time to traverse w/o driver calls
- 10 measurements for each scene, averaged

Measurements – Scene 1

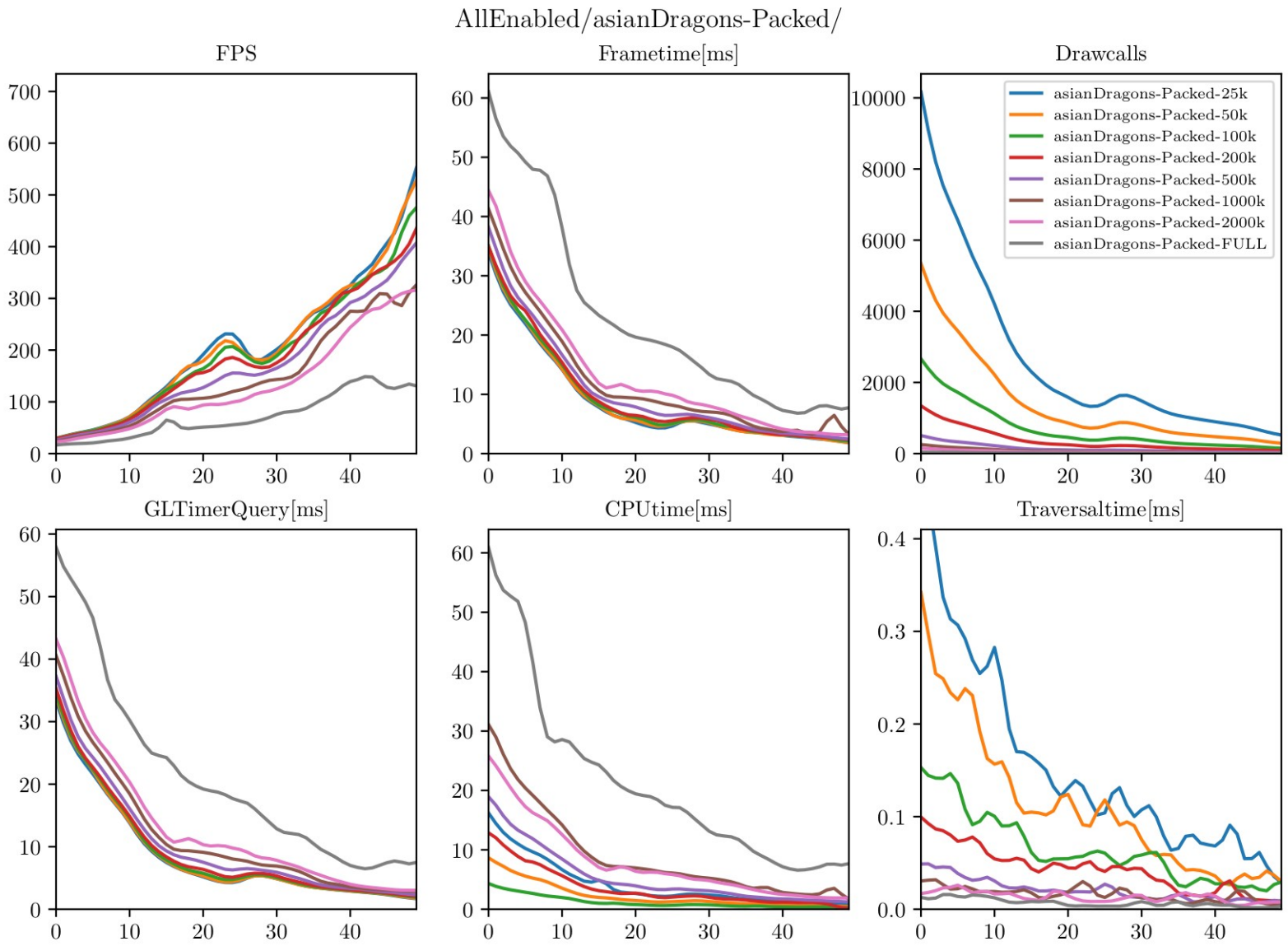
60 instances of asianDragon.obj (7.6M tris each) spaced out



- Windows 10
- Nvidia GTX 1070

Measurements – Scene 2

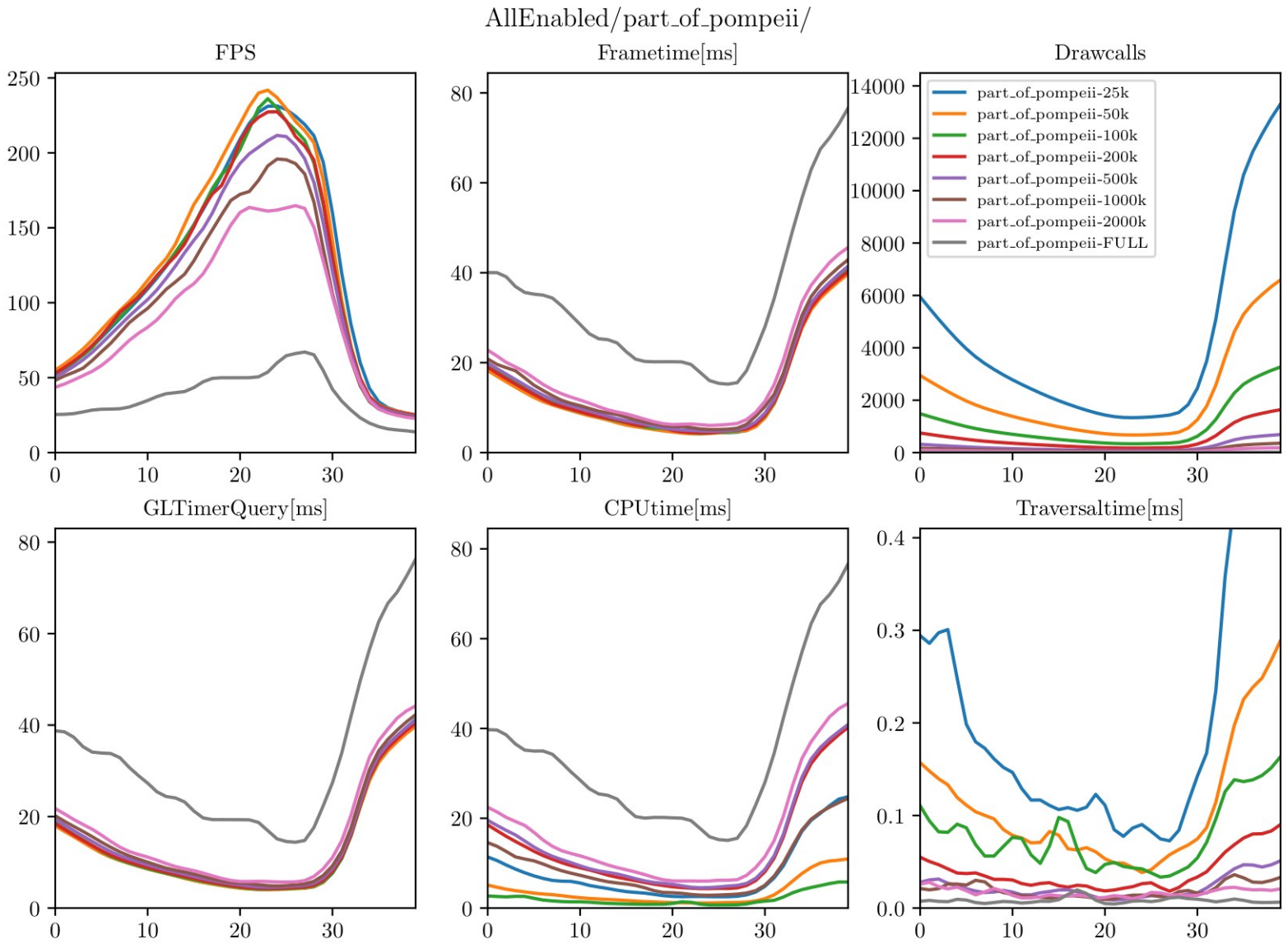
60 instances of asianDragon.obj (7.6M tris each) packed



- Windows 10
- Nvidia GTX 1070

Measurements – Scene 3

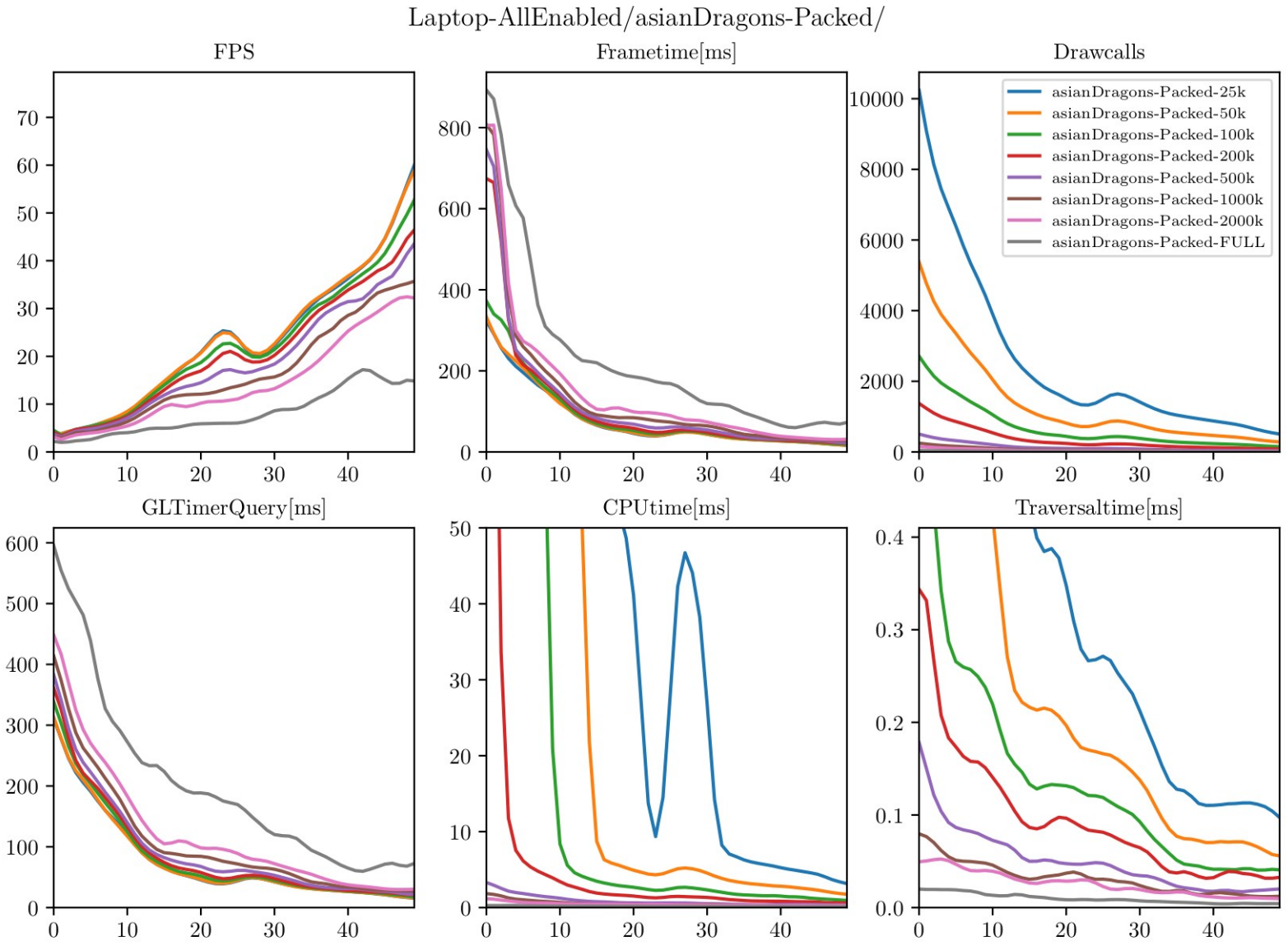
20 instances of part_of_pompeii (16M tris each), flat scene



- Windows 10
- Nvidia GTX 1070

Measurements – Laptop

60 instances of asianDragon.obj (7.6M tris each) spaced out



- Linux
- Intel UHD Graphics 620

Summary

- Frustum culling very effective
  - Further optimalization of AABB-frustum test with modern HW not needed (profiler shows 97% of time spent in OpenGL calls)
- Number of triangles in leaves of BVH should be picked based on target platform
  - (Nvidia drivers cause a lot of overhead)

Sources

- [1] U. Assarsson and T. Moller. Optimized view frustum culling algorithms for bounding boxes. Journal of graphics tools, 5(1):9–22, 2000.
- [2] G. Gribb and K. Hartmann. Fast extraction of viewing frustum planes from the world-view-projection matrix. Online document, 2001.
- [3] D. S`ykora and J. Jelınek. Efficient view frustum culling. In Central European Seminar on Computer Graphics, 2002.