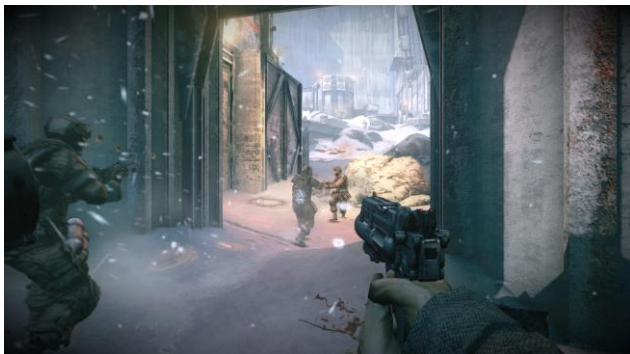


Practical occlusion culling in KILLZONE 3

Will Vale - Second Intention Limited - contract R&D for Guerrilla BV

In KILLZONE 2, we used a geometric occlusion system with zones linked by portals and manually-placed blocker geometry. This was difficult to edit and had unpredictable performance characteristics.



Open multiplayer environment with chokepoint.



Occluded objects drawn as bounding box ghosts.

For KILLZONE 3, we wanted to produce a largely automatic occlusion system requiring less artist involvement. There are three main aspects to this work:

- We generate good quality occluders by automatically selecting suitable physics mesh data during level export. This is augmented by a system of artist tags for overriding the heuristics, and we also allow artists to place simple occluders manually to give the best possible results in critical areas.
- At runtime, we produce an occlusion buffer using software rendering. We find occluder geometry in the view frustum, and rasterise it to a relatively large (360p) depth buffer. This is conservatively down-sampled and compressed for storage in main memory.
- We then use the occlusion buffer to accelerate scene graph traversal and cull away occluded objects. We test candidates using a sequence of three tests - constant time sphere rejection for smaller objects, rasterisation of OBB diagonals, and finally rasterisation of front-facing OBB quads. This gives us relatively fast rejection for visible objects, while the accurate rasterisation test reduces the number of false positives, and saves RSX time.

Key advantages to this scheme are:

- Speed - we typically render 5K occluder triangles and test 2-3K objects using 10-20% of one SPU (with lower elapsed time due to heavy parallelism)
- Scalability - performance is predictably linear in occluders rendered, and linear in tests performed.
- SPU only - we do not spend PPU or RSX time on this system, and unlike traditional GPU-based occlusion culling there is no complex pipeline to manage. This also allows us to cull objects very early and avoid all pipeline costs for them.