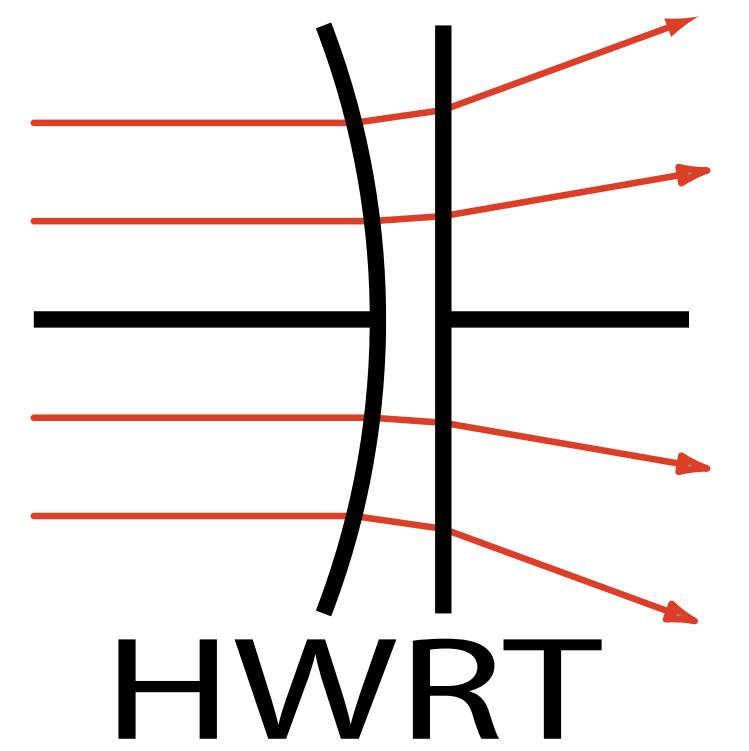


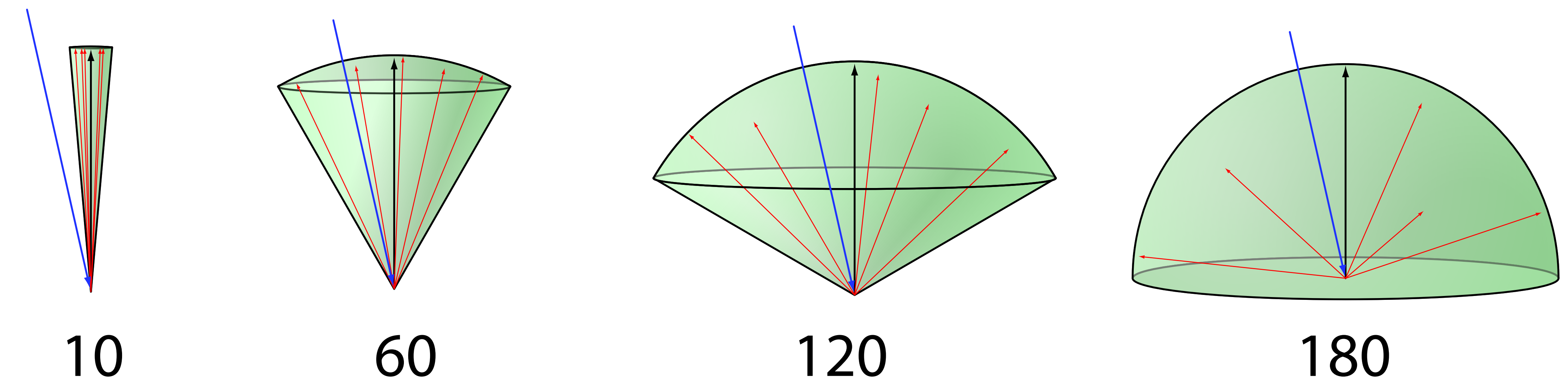
# Comparing Incoherent Ray Performance of TRaX vs. Manta

Daniel Kopta Josef Spjut Andrew Kensler Erik Brunvand Steven Parker  
University of Utah



**TRaX** (Threaded Ray eXecution) is a highly parallel multi-threaded, multi-core processor architecture designed for real-time graphics using ray tracing. Ray tracing allows for highly realistic images by rendering optical effects not easily combined using traditional graphics processing units (GPUs). These effects, such as shadows, transparency, reflection, depth of field, and global and indirect illumination, all require the evaluation of so-called secondary rays. Accelerating these secondary rays is critical because they are what differentiates ray traced images from images rendered using a Z-buffer on a GPU. However, the tendency for secondary rays to have widely varying directions causes reduced spatial coherence, creates memory system bottlenecks and reduces SIMD effectiveness on general CPU implementations of ray tracing. For this reason TRaX was designed to accelerate independent single-ray performance instead of relying on coherent ray-packets in SIMD mode

## Path Tracing

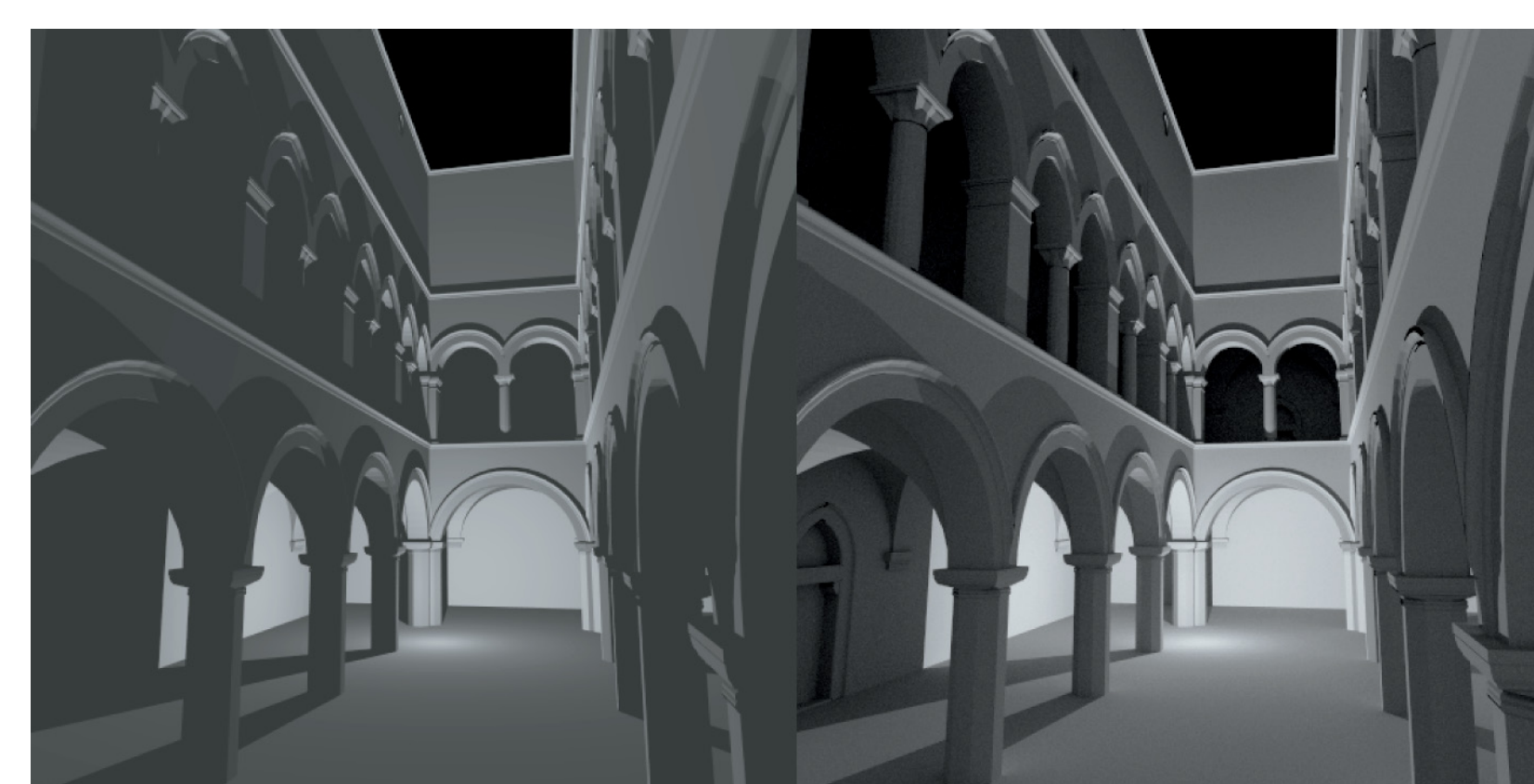


Conference  
Scene



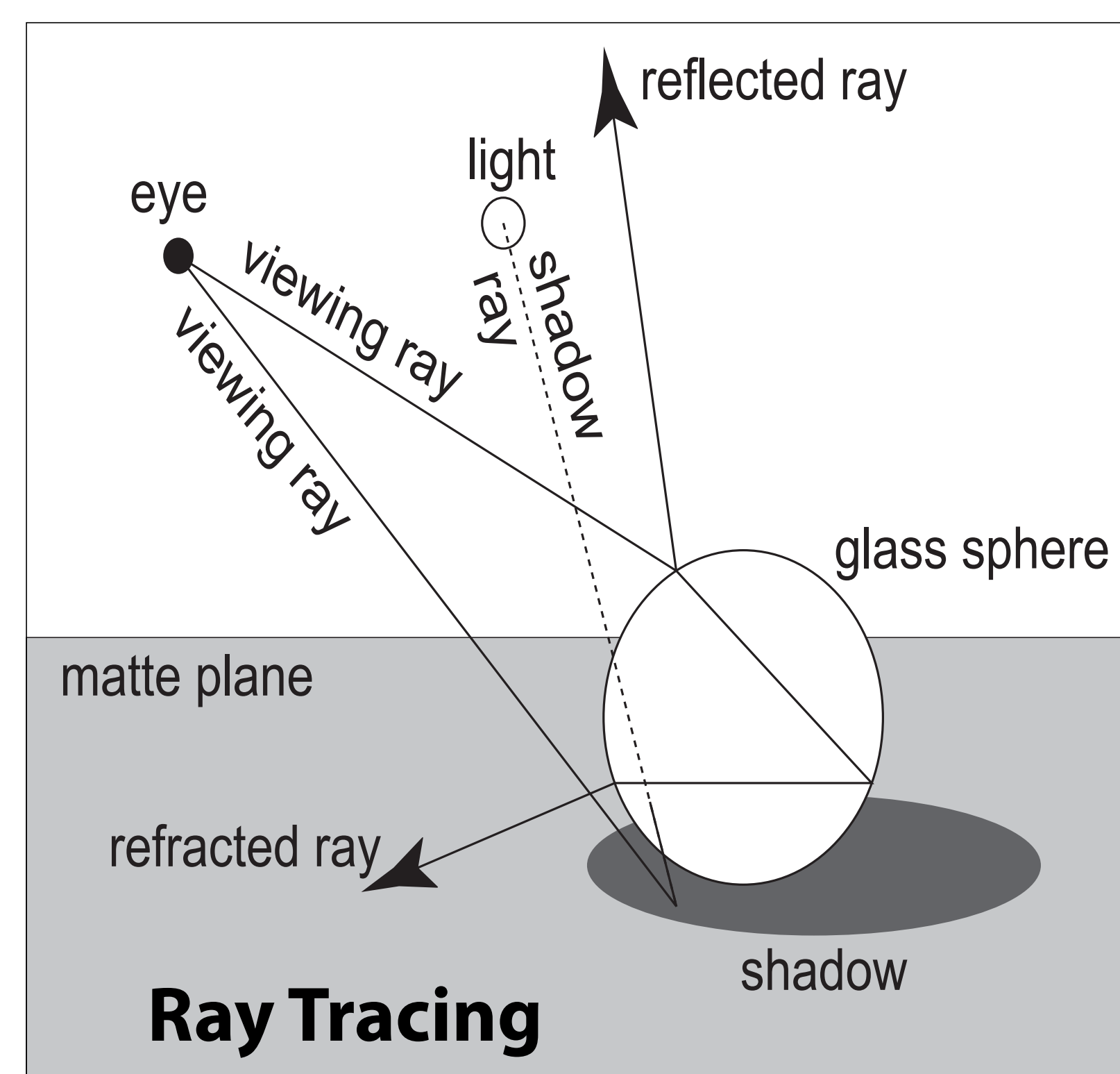
	Ray Casting Only	Conference Scene: 256x256 with 4 samples per pixel			
Manta MRPS	1.61	0.8625 (100%)	0.5394 (65%)	0.4487 (54%)	0.4096 (49%)
TRaX MRPS	1.37	1.41 (100%)	1.43 (101%)	1.43 (101%)	1.40 (100%)
Cache Hit %	88.9	85.1	83.9	83.5	83.2
Thread Issue %	52.4	52.4	52.5	52.5	52.4

Sponza  
Scene



Ray Casting Path Tracing

		Sponza Scene: 128x128 with 10 samples per pixel			
Manta MRPS	1.39	0.7032 (100%)	0.4406 (60%)	0.3829 (51%)	0.3712 (49%)
TRaX MRPS	0.98	1.01 (100%)	0.98 (97%)	0.97 (96%)	0.97 (96%)
Cache Hit %	81.5	77.4	76.3	76.0	76.0
Thread Issue %	50.6	50.9	50.7	50.7	50.9



We sample secondary rays randomly in a cone, and vary the angle of the cone to adjust spatial coherence. We show that sampling maximally incoherent rays on the complete hemisphere exhibits only minor slowdown on TRaX compared to sampling more coherent rays in a confined cone near the normal. We compare this result to a well optimized packet-based ray tracer using SSE SIMD, which suffers significant slowdown as rays become incoherent.

TRaX results are simulated on a single core.  
A full TRaX system would tile many cores on a chip.

