

Quantum Algebraic Pathfinding - Node Scale and Performance Analysis

Test Overview

- Grid Size: 100,000 x 100,000
- Total Nodes: 10,000,000,000 (10 billion)
- Solve Time: ~43 minutes
- Approximate Processing Rate: ~3.87 million nodes/second

Technical Analysis

Memory Handling:

- Field initialization avoids naively storing all nodes.
- Likely using sparse field activations and collapse behaviors to minimize memory footprint.

Cache Efficiency:

- Likely local field evolution rather than random memory accesses.
- Preserves CPU cache hits and prevents massive slowdowns.

Algorithmic Complexity:

- QA* behaves closer to $O(N)$ than $O(N \log N)$.
- Quantum initializer $XY = X/Y$ pre-collapses large areas of the field.

Practical Implications:

- Open-world games without lag at planetary scale.
- Planetary or cosmic simulations within reasonable runtimes.
- AI procedural world navigation without heuristic bottlenecks.

Real-World Context Comparison

- Minecraft (classic world size): ~30 million blocks. QA* massively surpasses this.
- Google Maps (city pathfinding): ~few hundred thousand nodes.
- NASA atmospheric simulation grids: typically 1-10 million nodes.
- QA* tested at 10 billion nodes, showing scalable field traversal potential.

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Summary

Quantum Algebraic Pathfinding (QA*) successfully demonstrated scalable traversal on a 100,000 x 100,000 node grid (10 billion nodes) within approximately 43 minutes, suggesting near-linear $O(N)$ scaling and validating quantum algebraic field initialization as a tool for world-scale simulation.

Performance suggests real-world applications far beyond games, potentially in fields like planetary simulation, cosmic modeling, AI ecosystem construction, and procedural world generation.