Accelerating Quantum Computer Simulation via Parallel Eigenvector Computation

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Quantum-dot cellular automata (QDCA) hold great potential to produce the next generation of computer hardware, but their development is hindered by computationally intensive simulations. Our research therefore focuses on rewriting one such simulation to run parallel calculations on a graphics processing unit (GPU). We have decreased execution time from 33 hours 11 minutes to 1 hour 39 minutes, but current progress has shown that further gains are possible. The calculation of eigenvectors holds particular promise for acceleration. Our research has two components: testing MATLAB's algorithm for these calculations and creating a C-based algorithm to improve on MATLAB's execution time. MATLAB requires 0.2352 +/- 0.0074 seconds to execute this function, while our function requires 0.0674 +/- 0.0143 seconds. Further, our function's iterative and many-threaded nature makes it ideal for parallel implementation in the CUDA language, which is expected to further increase execution speed. At the time of this writing, implementation is ongoing. Our presentation shall focus on our functions' efficiency increases over their MATLAB counterparts, and the application of GPUs' immense computational power to QDCA device simulation.

Information about the Author:
Karl Stathakis is a senior mechanical engineering student with a strong interest in computational algorithms and programming experience in C, MATLAB, and CUDA. After graduation, he hopes to follow this interest in graduate school by simulating the thermodynamics of chemically reacting fluid flows.

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