

GPGPU Accelerated Cardiac Arrhythmia Simulations

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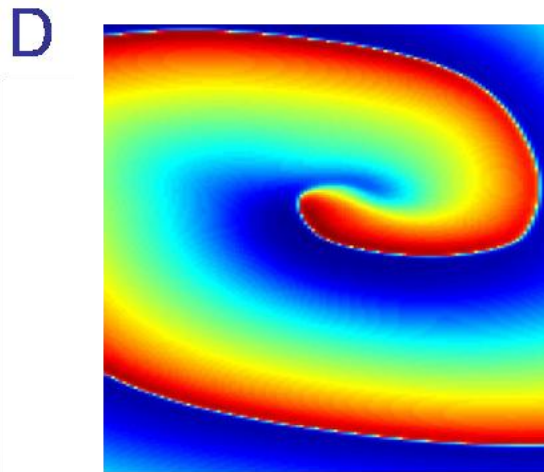
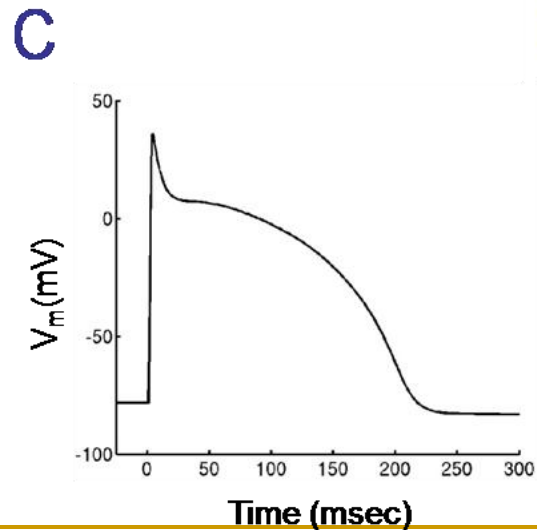
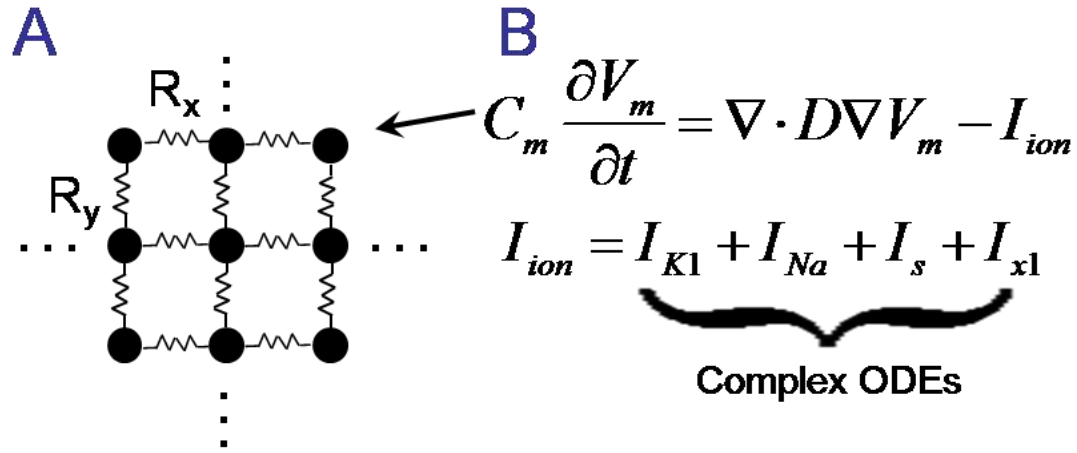
1. University of Delaware

2. The George Washington University

Motivation

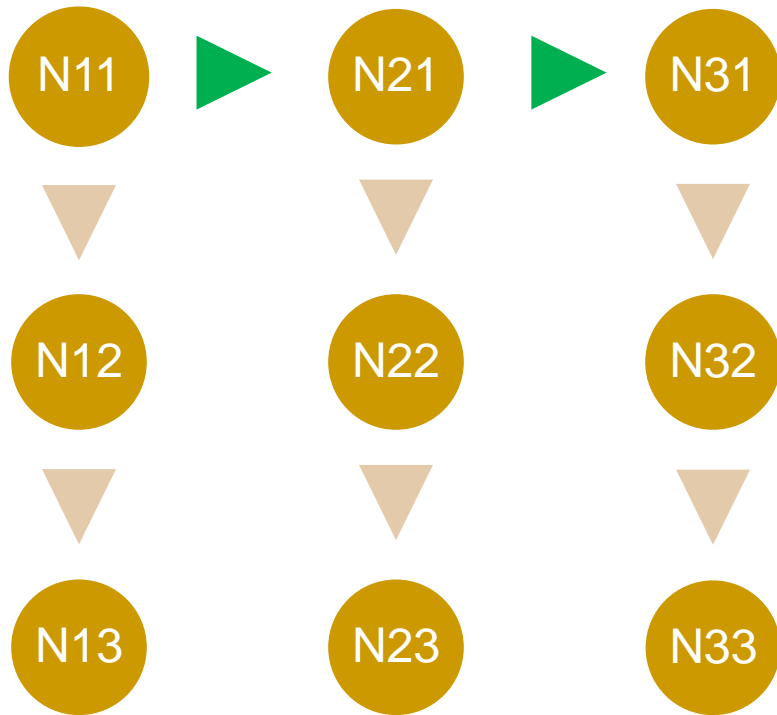
- Cardiac arrhythmia
 - ~300,000 people/year in the US
 - Cure
 - Image-guided ablation therapy
 - Simulation improves efficacy
 - Problem
 - Sequential execution of simulation too slow!
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Simulation: Cardiac Model

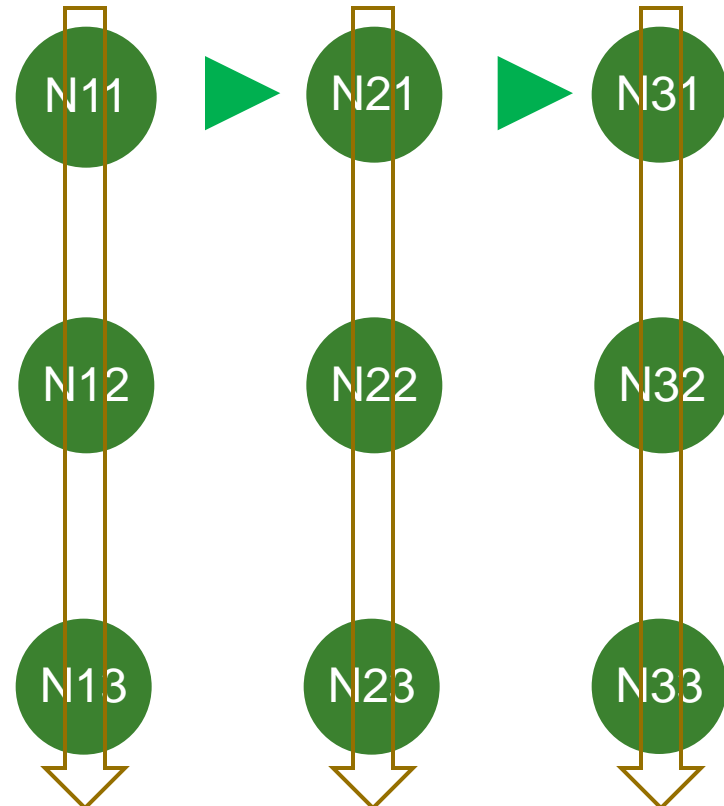


Acceleration Concept

Sequential (Running on CPU)

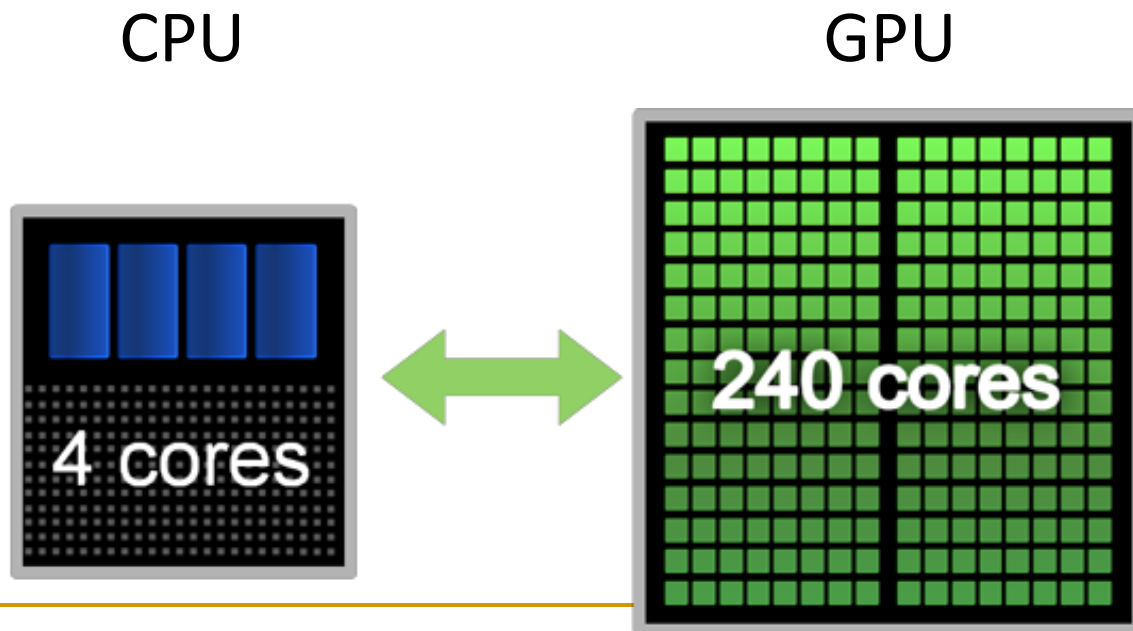


Parallel (Enabled by GPGPUs)



Acceleration Tool—GPU

- Example: NVIDIA Tesla C1060
 - 240 Processing Elements
 - Massively parallel multithreaded
 - Up to 30720 active threads



Acceleration Considerations

- SIMD
 - Large Matrix
 - No (Few) Temporal Data Dependency
 - Acceleration Command—CUDA
 - Using Atomic Functions*
-

GPU Acceleration

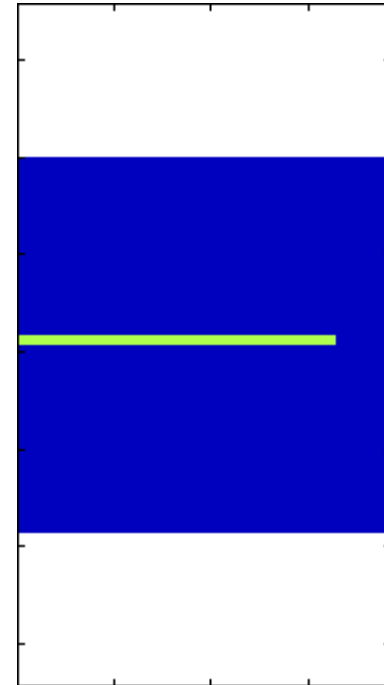
```
for (Xstep=1;Xstep<Nx+1;++Xstep){  
for (Ystep=1;Ystep<Ny+1;++Ystep){  
  GPU_stimulate(); //apply stimulating current  
  GPU_brgates(); // update gating equations  
  GPU_brcurrents(); // update currents  
  GPU_vmdiff(); // update diffusion terms  
} // end Ystep loop  
} // end Xstep loop  
bcs(); // apply boundary conditions
```

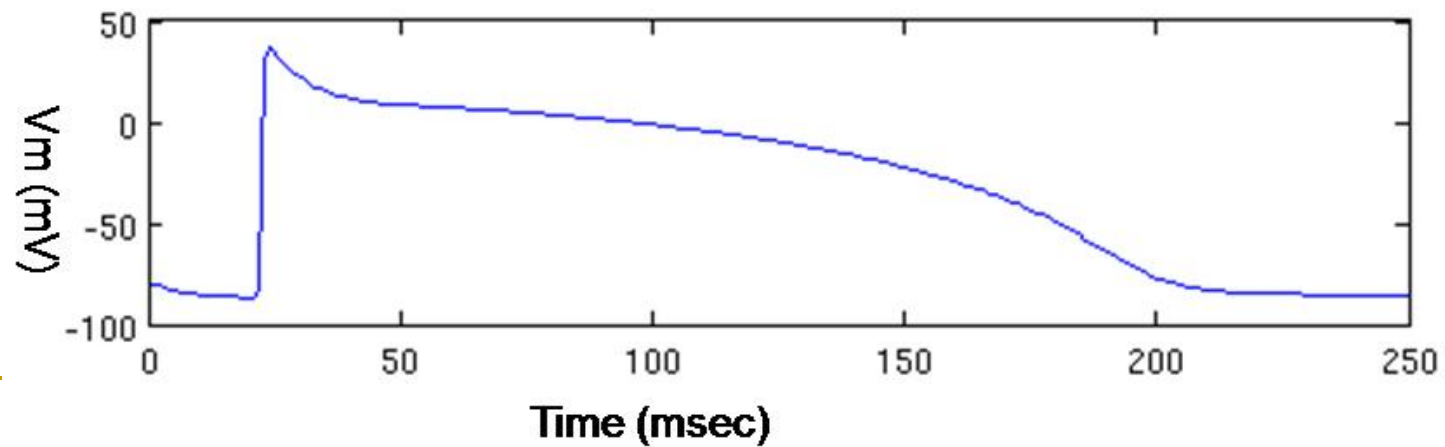
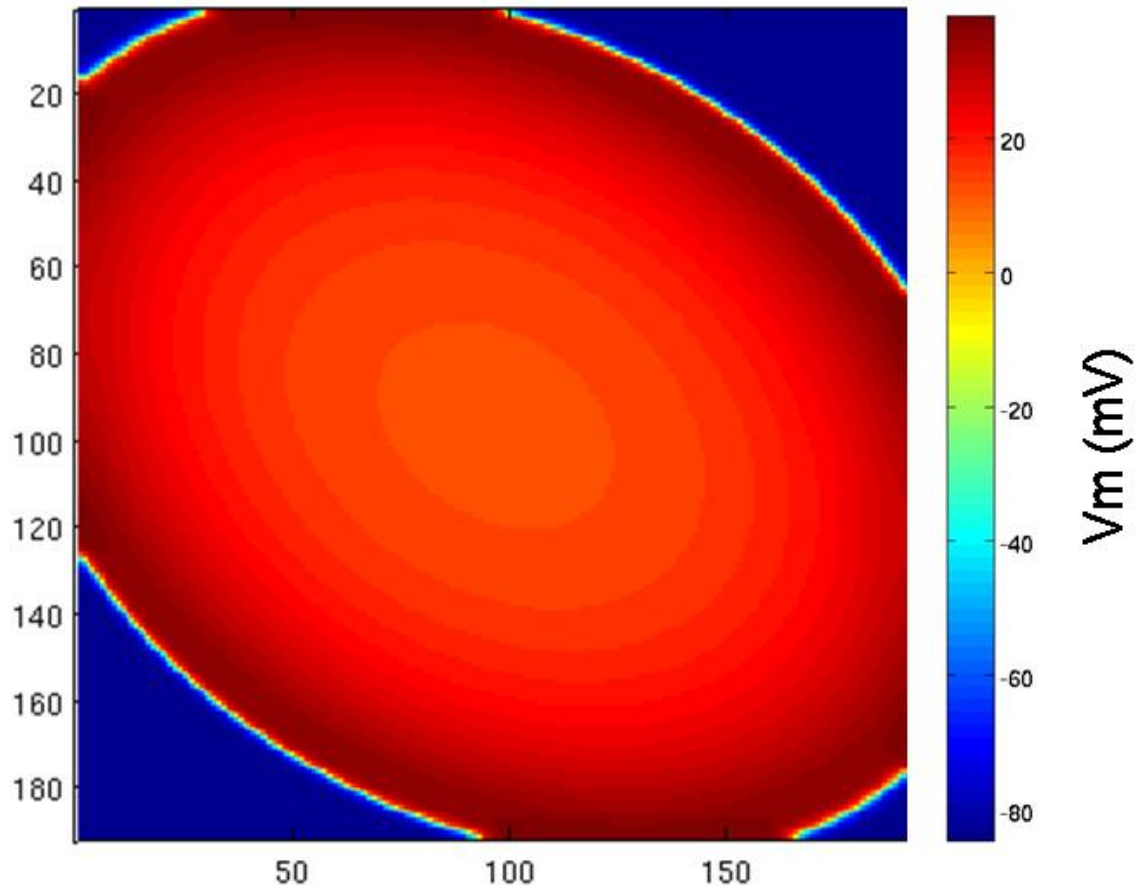
Simulation Results

Point Stimulation

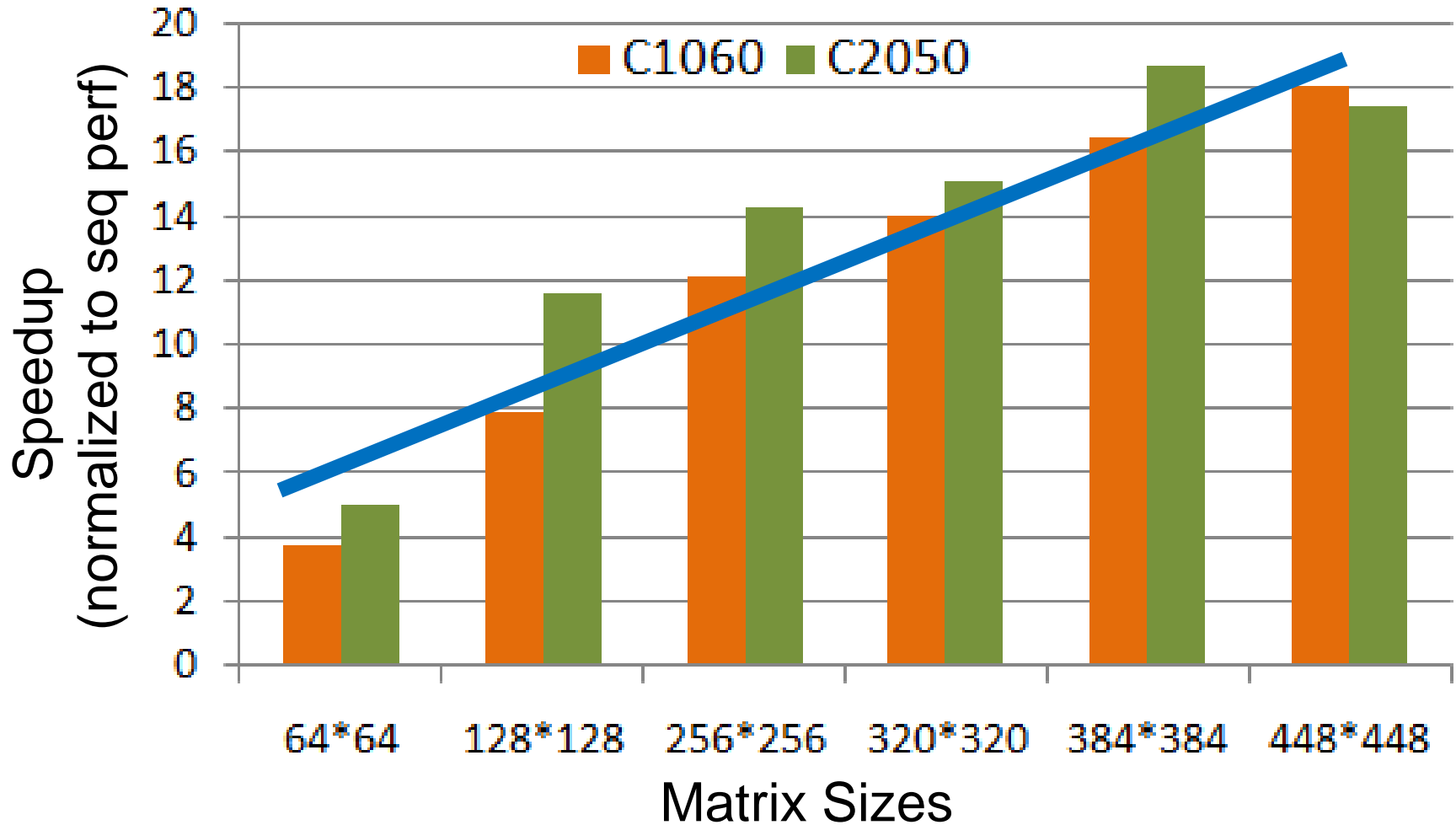


Electrical Rotor Simulation

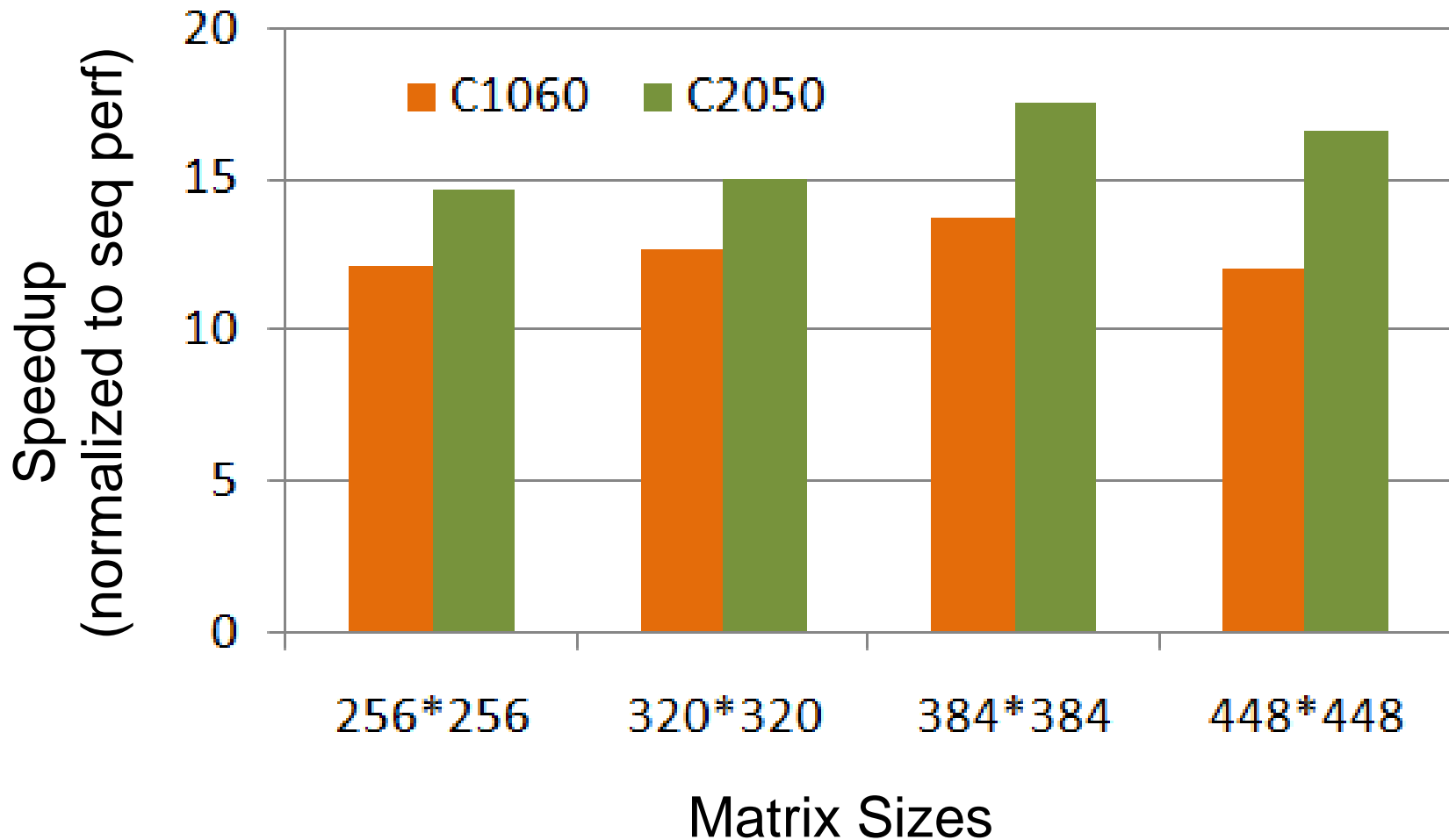


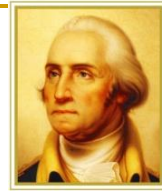


Point Simulation Results



Electrical Rotor Simulation Results





Thank you!

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Please consider GPGPU