CUDA SPICE CIRCUIT SIMULATOR

FINAL DEMO PRESENTATION

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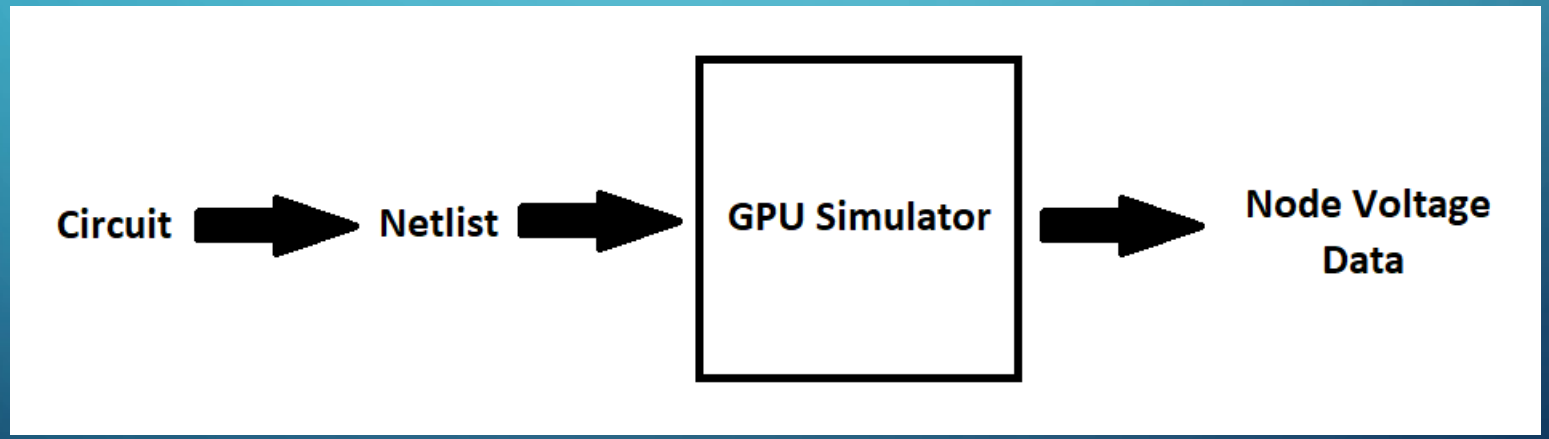
GOAL

- Use GPU to accelerate circuit solution, especially for very large circuits (e.g. VLSI design)
- Parse arbitrary circuits, simulate on GPU, and output useful information



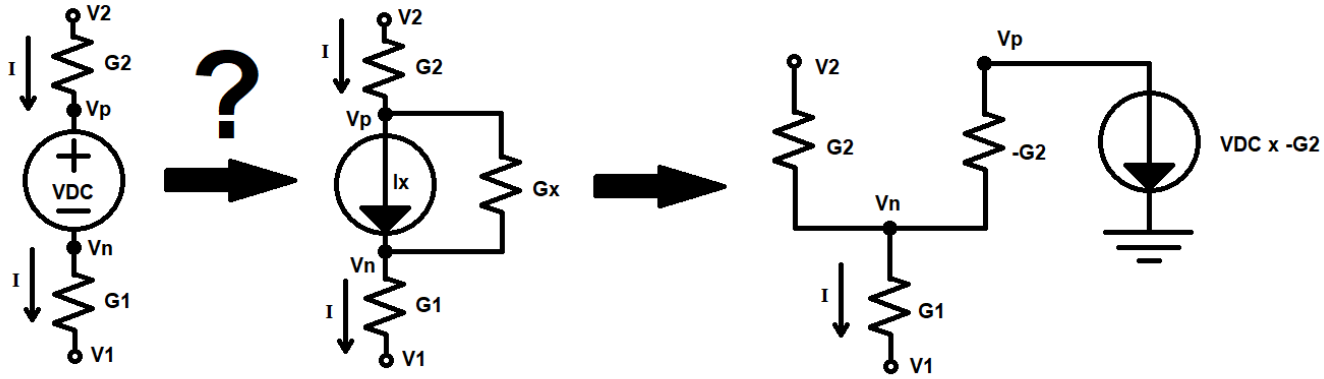
FEATURES

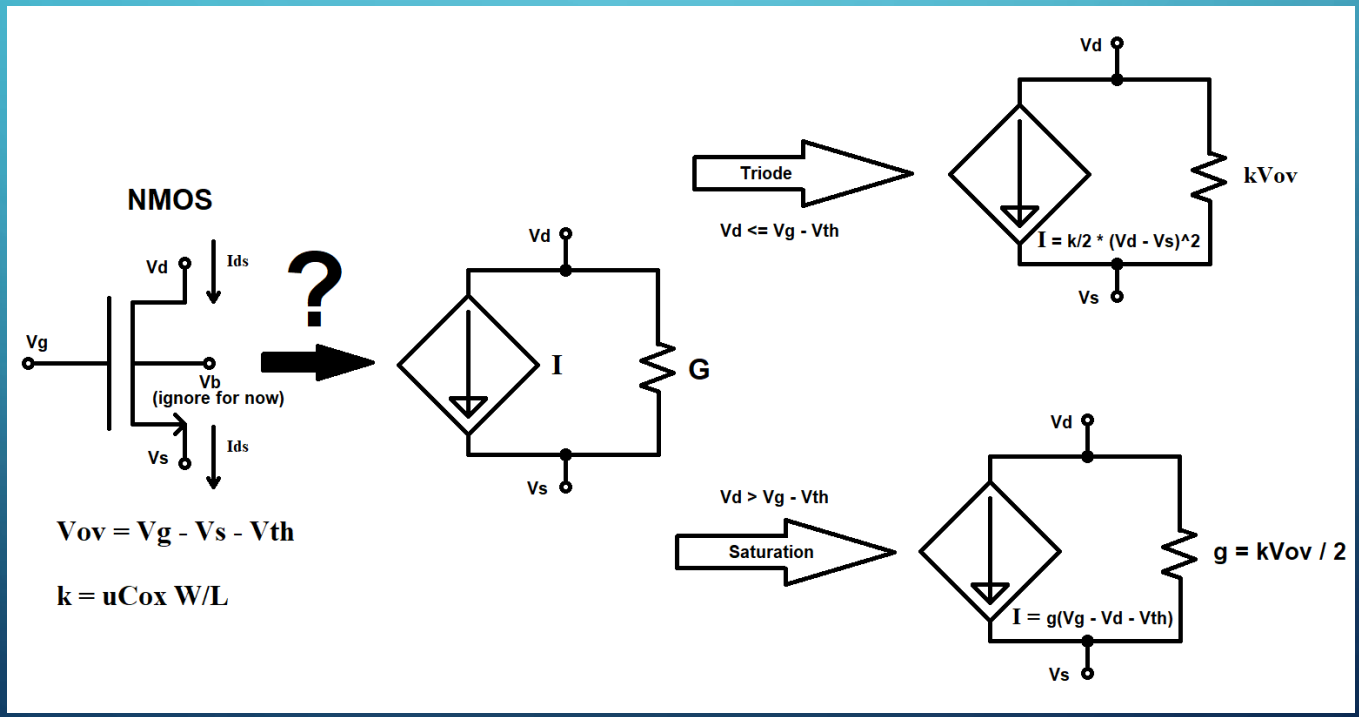
- Simple GUI – file and simulation selection
- Partial SPICE file parsing (capacitors, resistors, DC & pulse voltage sources, DC current and VCC sources, MOSFETs and their model files) on CPU, with copy of netlist on GPU for simulation
- Operating point, DC Sweep, and Transient simulation completely on GPU (except for final output and control loops)
- Outputs solutions to CSV file for easy plotting using Excel or a MatLab script

SOLVING NON-LINEAR CIRCUITS

- Each circuit element is linearized into Conductance (G) and Current (I) elements
- Parallel population of G and I matrices using atomic addition, parallel solution of voltage(V) matrix using linear matrix reduction and solution
- MOSFETs solved by successive “guessing” until convergence (Newton-Raphson)
  - Serial iteration of parallel solver until converges within tolerance
- Capacitances in transient approximated using Backward Euler
  - Must serially iterate each time-step, as it is reliant on prev. step’s solution

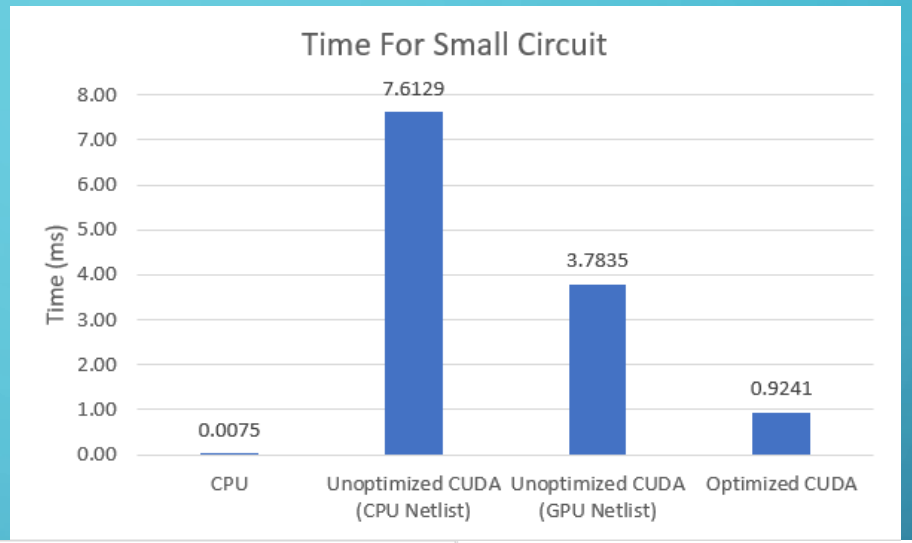
Voltage Source Transformation

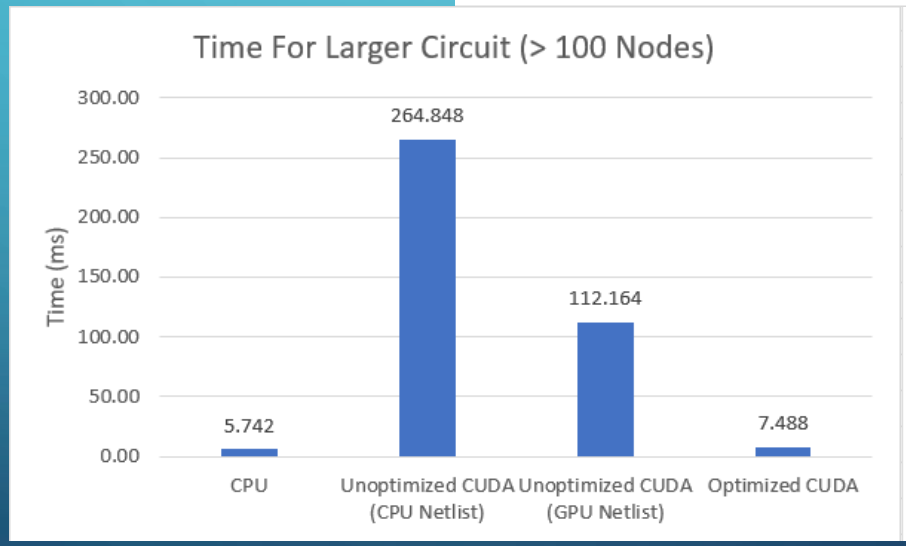


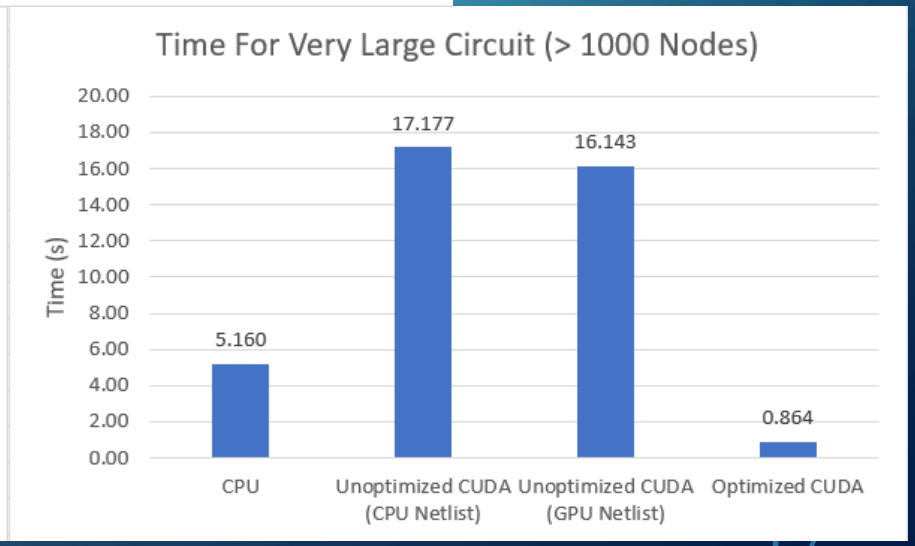


PERFORMANCE

- Testing the OP Simulation, CPU generally faster for small circuits
- For larger circuits (e.g. 1000 nodes) optimized CUDA has better performance







DEMO