Memristor Simulation Report

ECE 410/510 - Week 10 Challenge #28

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Objective

Model and simulate a memristor using Python to generate the characteristic pinched hysteresis I-V curve.

Methodology

- The Biolek model was used to simulate a memristor.
- A sinusoidal voltage input (5 Hz) was applied to observe dynamic resistance changes.
- The doped region width (w) was updated using a window function to ensure it remained bounded.

Constants Used

- R_on = 100 Ohms
- R_off = 16,000 Ohms
- Memristor thickness D = 10 nm
- Ion mobility mu_v = 1e-14 m^2/s/V

Key Observations

- The I-V curve exhibits the classic pinched hysteresis loop centered at the origin.
- This validates the memristor's memory-dependent resistance behavior.
- The simulation shows increased conductance when the internal state variable favors the R_on region.

Conclusion

The Biolek model successfully simulates memristive behavior under time-varying input. This model can be extended to emulate synaptic weight updates in neuromorphic systems.

Simulated I-V Curve