Spintronic and Magneto-Resistive Logic for Beyond-CMOS Computing

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Abstract

Dennard scaling of the MOSFET transistors used in CMOS logic and its contribution to the Moore's law increase in transistor count has taken us through four decades of faster, smaller and lower-power VLSI but is now encountering fundamental physical limits. This is an opportunity for engineers to step back and consider new logic structures and computing paradigms which will take us into the future. The MOSFET uses electric field effects to modulate conduction through a channel but magnetic fields may also be used to control conduction in semiconductor devices. In this talk I will discuss some of our work in novel logic circuit topologies and device structures which use magnetic field effects to gain logical efficiency and speed, and to realize other unconventional computing properties such as non-volatility. This is joint work with my Ph.D. student Joseph Friedman (now an Assistant Professor at the University of Texas - Dallas) and collaborators Professors Bruce Wessels and Gokhan Memik of Northwestern University.

Short Biography

Alan V. Sahakian is the John A. Dever Professor and Chair of Electrical Engineering and Computer Science, and Professor of Biomedical Engineering at Northwestern University. He received the Ph.D. in ECE with a minor in CS, and the MSEE from the University of Wisconsin - Madison, working in the Willis Tompkins/John Webster group. During his graduate study he was also a Senior Electrical Engineer at Medtronic, Inc. His BS was in Applied Science and Physics from the University of Wisconsin-Parkside. He is also on the academic affiliate staff at NorthShore University HealthSystem (Evanston Hospital). He is a Fellow of AIMBE and of the IEEE "for contributions to electrophysiology of atrial cardiac arrhythmias." In addition to cardiac electrophysiology, his lab studies microwave and millimeter wave methods for medical imaging and non-contact patient monitoring, irreversible electroporation for tumor ablation, and spintronic and other beyond-CMOS logic circuits. His recent research is funded by the NIH, the NSF, the Department of Defense Breast Cancer Research Program, the Defense Intelligence Agency, Intel and Medtronic.