Spring 2015 Seminar Series
Presented by the ECE Division

BRAIN INSPIRED AND NON-BOOLEAN COMPUTING WITH SPIN-TRANSFER TORQUE DEVICES

THURSDAY FEBRUARY 19, 2015
1:30 PM – HEC 101

As Complementary Metal-Oxide-Semiconductor (CMOS) transistors begin to face significant scaling challenges, work has started in earnest to explore new devices that can potentially replace CMOS. Spintronic devices, utilizing the spin of electrons as state variable for computation, have recently emerged as one of the leading candidates for post-CMOS technology. Recent experiments on spin-transfer torque devices have demonstrated high speed magnetization switching of nanoscale magnets with small current densities. Coupled with other properties, such as non-volatility, zero current leakage, high integration density, the spin-transfer torque devices can be inherently suitable in some unconventional computing models for information processing. In this talk, I will present brain-inspired and Non-Boolean computing with spin-transfer torque devices. In brain-inspired computing, the proposed 'spin-neuron' can provide direct mapping to the operation of biological neuron, leading to ultra-low power neuromorphic computation hardware. I will also introduce work that employs the dynamics of coupled spin-torque oscillators for low-power non-Boolean computing. Finally, I will discuss future research in brain-inspired, Non-Boolean and Boolean computing with emerging nanoscale devices and techniques in the device/ circuit/ architecture levels suitable for low-power, high performance computing system design.

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Deliang Fan received his B.S. degree in Electronic Information Engineering from Zhejiang University, Hangzhou, China, in 2010 and M.S. degree in Electrical and Computer Engineering from Purdue University, West Lafayette, USA, in 2012. Currently he is a graduate research assistant of Professor Kaushik Roy and pursuing Ph.D. degree in Electrical and Computer Engineering at Purdue University, West Lafayette, USA.

His primary research interest lies in brain inspired (neuromorphic) computing using spin-transfer torque devices, nanoelectronic device and circuit co-design, low power digital and mixed signal circuit design. His work contributed to multiple collaborative projects funded by SRC, DARPA, NSF, CSPIN, DoD and Intel. His past research interests include cross-layer digital system optimization and imperfection-resilient scalable digital signal processing algorithms and architectures using significance driven computation.