

# Center for Embedded Systems

An NSF Industry/University Cooperative Research Center

## KEYNOTE – ABSTRACT

Magnetoresistive Random Access Memory (MRAM) combines magnetic data storage devices with CMOS technology to enable a high-performance RAM with nonvolatility. Everspin Technologies' Toggle MRAM, which uses magnetic field pulses generated by current-carrying lines to write the bits, is used in a variety of areas including: data storage, networking, industrial automation, transportation, and energy systems. Recent exciting scientific developments in two areas, magnetic tunnel junction materials with very high magnetoresistance and magnetic switching by spin-torque-transfer, have set off a global race to develop the next generation of MRAM. This spin-torque MRAM (ST-MRAM) is being intensively developed for a number of purposes: extending MRAM technology to densities beyond those achieved with field switching, enabling embedded nonvolatile memory with a small cell size, and as an eventual successor to high-density DRAM with the potential to solve extreme scaling problems. Technical challenges, key properties for fully-functional ST-MRAM, and first results from a new 64Mb ST-MRAM circuit are presented.

## SPEAKER - BACKGROUND

[Dr. Jon Slaughter, Vice President, Technology Research & Development, Everspin Technologies](#)

Jon directs R&D efforts for Everspin's Spin-Torque MRAM. Previously, he was manager of MRAM Process and Magnetic Materials for Freescale, where his team was responsible for developing the magnetic materials used to bring the first MRAM to volume production in 2006, including the magnetic tunnel junction (MTJ) bits that are at the heart of MRAM technology. Jon's numerous technical contributions have resulted in 40 issued patents. His honors include being named a Freescale distinguished member of the Technical Staff in 2007 and receiving the Motorola Distinguished Innovator Award in 2001.

Before joining Freescale, Jon was an associate research professor at the University of Arizona's Optical Sciences Center, specializing in the effects of film growth and microstructure on the properties of ultra-thin metallic films and multilayers. Jon earned a doctorate in physics from Michigan State University in 1988 where he was awarded the Sherwood K. Haynes Award for his research on the structure and electronic properties of magnetic multilayers. He has more than 90 publications in scientific/technical journals and is active in IEEE, technical conferences and select university collaborations.

[About Everspin Technologies Inc.](#)

Everspin Technologies is the leading developer and manufacturer of magnetic RAM (MRAM), offering stand-alone and embedded MRAM products. Everspin's MRAM is the industry's fastest non-volatile memory and provides unlimited endurance, unmatched reliability, 10-year-plus data retention and parallel and serial

interfaces. As the world's first volume MRAM supplier, Everspin has established an MRAM intellectual property portfolio of more than 600 active patents and applications, many of which are fundamental and essential for MRAM technologies.

Headquartered in Chandler, Ariz., Everspin is a fab-light semiconductor company that owns and operates a back-end manufacturing line for MRAM. Everspin leverages standard CMOS wafers from foundries adding its proprietary magnetic back-end-of-line processing. The Everspin MRAM team launched the first commercial MRAM product. This first MRAM device, based on Everspin's patented Toggle programming technology, has received numerous industry awards and is the first in a current portfolio of more than 100 MRAM products.

Today, Everspin provides MRAM products to more than 100 applications for tier one and global customers across multiple high growth markets. Leading data center and storage OEMs have chosen MRAM for applications such as RAID, NAS, SAN and DAS applications, as well as rack and blade servers and routers. A growing number of energy and infrastructure customers are using MRAM in smart grid, smart meter, solar and wind applications, industrial computing and automation, and casino gaming. In addition, automotive and transportation applications such as power train, brakes, safety, data logging, multimedia, navigation, camera and black box, are taking advantage of MRAM's unique characteristics.