A Robust True Random Number Generator Using Voltage-Controlled MTJ in 65nm CMOS


Foundation Required for Novel Compute (FRANC)

Security and Access

Comparison to Prior State-of-the-Art

VC-MTJ based RNG

- VC-MTJ based RNG can be embedded in memory
- Lower hardware overhead compared to CMOS solutions
- VC-MTJ based RNG is insensitive to timing unlike Spin Transfer Torque (STT) based RNG

Approach

Voltage-Controlled Magnetic Tunneling Junction (VC-MTJ) as Entropy Source

- VC-MTJ’s magnetic (H) field exhibits damped precession upon voltage application
- After precession, thermal noise randomly switches the H field into a parallel (P) or anti-parallel (AP) state with equal probability
- Effectively, a 1 or 0 is randomly stored in the VC-MTJ
- H-field switching offers low energy, high density random number generation
- True RNG unlike pseudorandom number generators

Results and Impact

Comparison to Prior State-of-the-Art

VC-MTJ Random Number

- VC-MTJ Random Numbers
- VC-MTJ Random Number Buffer (8-bit)
- VC-MTJ Random Number Generator

VC-MTJ

- Voltage-Controlled MTJ
- Voltage-Controlled Magnetic Tunneling Junction

VC-MTJ Film Stack

- Hysteresis Loop
- Precessional Switching
- Metastable State

Approach

Voltage-Controlled Magnetic Tunneling Junction (VC-MTJ) as Entropy Source

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