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Magneto-elastic artificial neurons with extremely low energy dissipation[1] AYAN K. BISWAS, MD MAMUN AL-RASHID, JAYASIMHA ATULASIMHA, SUPRIYO BANDYOPADHYAY, Virginia Commonwealth University — We present a detailed analysis of artificial step transfer function neurons and binary weight synapses implemented with magneto-tunneling junctions whose soft layers are magnetostrictive nanomagnets switched with voltage generated mechanical strain. These devices are more energy-efficient than CMOS-based neurons or so-called spin neurons that are based on magnets switched with spin-polarized current [1]. We studied their switching dynamics using stochastic Landau-Lifshitz-Gilbert simulations for two different geometries (elliptical and cylindrical) of the magnetostrictive nanomagnet. Our study revealed that while the step transition (firing) of the magnetic neuron is always very sharp at 0 K, the threshold is significantly broadened at room temperature, regardless of geometry and regardless of whether the magnet is switched with strain or spin-polarized current. While this could preclude some applications, the extreme energy-efficiency of these neurons makes them nearly ideal for use in certain types of neuromorphic computation. [1] M. Sharad, et al., IEEE Trans. Nanotechnol., 11, 843 (2012).

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