Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Ultra-low-energy analog straintronics using multiferroic composites[1] KUNTAL ROY, Purdue University — Multiferroic devices, i.e., a magnetostrictive nanomagnet strain-coupled with a piezoelectric layer, are promising as binary switches for ultra-low-energy digital computing in beyond Moore's law era [Roy, K. Appl. Phys. Lett. 103, 173110 (2013), Roy, K. et al. Appl. Phys. Lett. 99, 063108 (2011), Phys. Rev. B 83, 224412 (2011), Scientific Reports (Nature Publishing Group) 3, 3038 (2013), J. Appl. Phys. 112, 023914 (2012)]. We show here that such multiferroic devices, apart from performing digital computation, can be also utilized for analog computing purposes, e.g., voltage amplification, filter etc. The analog computing capability is conceived by considering that magnetization's mean orientation shifts gradually although nanomagnet's potential minima changes abruptly. Using tunneling magnetoresistance (TMR) measurement, a continuous output voltage while varying the input voltage can be produced. Stochastic Landau-Lifshitz-Gilbert (LLG) equation in the presence of room-temperature (300 K) thermal fluctuations is solved to demonstrate the analog computing capability of such multiferroic devices.

[1]This work was supported in part by FAME, one of six centers of STARnet, a Semiconductor Research Corporation program sponsored by MARCO and DARPA

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Date submitted: 15 Nov 2013 Electronic form version 1.4