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Reliability of Signal Propagation in Magnetostatically Coupled Arrays of Magnetic Nanoelements REINIER VAN MOURIK[1], IBM Almaden Research Center; Eindhoven University of Technology; Materials Science in Mainz Graduate School of Excellence, LI GAO, BRIAN HUGHES, CHARLES RETTNER, IBM Almaden Research Center, San Jose, CA, BERT KOOPMANS, Eindhoven University of Technology, Eindhoven, the Netherlands, STUART PARKIN, IBM Almaden Research Center, San Jose, CA — Nanomagnetic logic (NML) has promise as a low-power, non-volatile, and radiation resistant alternative to CMOS-based computational devices. Lines of magnetostatically coupled magnetic nano-elements (NEs) propagate information, and the intersections between lines form logic gates. We present simulations and experiments exploring the reliability of signal propagation in NML devices composed of lines of nominally rectangular permalloy NEs, typically 90×60 nm^2 in size. An external magnetic field sets the magnetic state of an input bit and also resets each of the NEs' magnetizations along their hard axis direction. As the field is reduced to zero the input state propagates along the line of NEs as they successively relax into one of two equilibrium states. The state of the NEs is probed by (i) a magnetic tunnel junction sensing device integrated with the output NE and (ii) magnetic force microscopy imaging. We conclude that signal propagation is inherently unreliable both through variations in fabrication of the NEs and due to the innate lack of directionality of the flow of information. We demonstrate an alternative clocking method where a domain wall passing underneath an NML device clocks each NE sequentially, thereby increasing the success of signal propagation.

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