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Effects of Island Shape on Magnetostatic Interactions in Bit Patterned Media for Data Storage

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Bit patterned media is one of the promising approaches to extend magnetic recording densities in hard-disk drives beyond recording densities of one Terabit (10^{12}) per square inch. In this approach, the magnetic medium is patterned into nanometer-sized magnetic islands where each island can be considered to represent a binary digit. The islands are magnetically isolated but experience magnetostatic interactions between them. This study investigates magnetostatic interactions between islands of various shapes for various island separations using micromagnetic simulations. The shapes range from truncated elliptic cones to cylinders. The computation of magnetostatic interactions is a major time-consuming task in a micromagnetic simulation. These interactions scale with O(N^{2}) operations, where N is the number of interacting mesh elements in discretized islands. To carry out simulations, an open-source finite element micromagnetics package called magpar was used. The island mesh was generated using netgen, a tetrahedral mesh generator. An open source visualization tool called paraview was used view the outputs of simulations. Open MPI was used in the simulations. Twelve cores on one node were used in this work. The interactions between islands have been compared against dipole-dipole interactions where each island is assumed to be a dipole. The study has shown that for islands considered, the effect of island shape is important for island separations less than twice the island width, centre to centre. The dipole approximation is only sufficient for island separations beyond twice the island width. This result further suggests an improvement in the computation of time-consuming magnetostatic interactions between large numbers of islands by treating distant islands as dipoles.

Presenter Biography

Dr Josephat Kalezhi completed his undergraduate studies at the University of Zambia where he graduated with a BSc in Physics in 2001. From there on he completed his postgraduate diploma studies in Condensed Matter Physics at the Abdus Salam International Centre (ICTP), Italy in 2003. Following that he undertook postgraduate studies at the University of Leeds in England where he graduated with an MSc in Information Systems in 2004. Following MSc Studies, he undertook PhD research in Computer Science at the University of Manchester in 2007. The research involved modelling data storage in nano-island magnetic materials. He completed PhD research in 2010. In 2011, he enrolled in a PhD Plus programme at the University of Manchester. The research involved modelling data storage in exchange-coupled composite nano-island magnetic materials. He has been lecturing at CBU for 13 years now and is the Head of Department - Computer Engineering.

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