

On Landau-Lifshitz Equations for Micromagnetics

Xiao-Ping Wang

Department of Mathematics

Hong Kong University of Science and Technology

E-mail: mawang@ust.hk

One of the main difficulties in micromagnetics simulations is the severe time step constraint introduced by the exchange field. Using standard explicit integrators leads to a physical time step of sub-pico seconds, which is often two orders of magnitude smaller than the fastest physical time scales. Direct implicit integrators require solving complicated, coupled systems. In this paper, we introduce an implicit method whose complexity is comparable to solving the scalar heat equation implicitly. This method is based on a combination of a Gauss-Seidel implementation of a fractional-step implicit solver for the gyromagnetic term, and the projection method for the heat flow of harmonic maps. This method allows us to carry out fully resolved calculations for the switching of the magnetization in micron-sized elements.