



復旦大學
FUDAN UNIVERSITY

Applied Math
Ph.D. Seminar

Multiscale Computational Method for the Landau-Lifshitz Equation

Speaker: Zetao Ma (Shanghai Jiao Tong University)

Time: 2026-05-21, 16:10 to 17:00

Location: Rm 1801, Guanghai East Tower

Advisor: Lei Zhang (Shanghai Jiao Tong University)

Abstract: In this work, we develop a numerical homogenization approach for the fully nonlinear Landau-Lifshitz equation with rough coefficients, including non-periodicity and nonseparable scales. Direct fine-mesh resolution of such multiscale problems incurs prohibitive computational costs. To address this, we propose an efficient coarse-scale approximation using localized basis functions derived from energy minimization within the GRPS/LOD framework. These basis functions preserve critical multiscale features on a tractable coarse mesh. The nonlinear, vectorial, non-symmetric nature of the Landau-Lifshitz equation necessitates careful design of variational formulations for basis construction. We introduce several such formulations, each tailored to specific structural aspects. Systematic numerical experiments demonstrate that our approach achieves significant computational savings without compromising accuracy, offering a robust framework for simulating multiscale magnetic systems with complex microstructures. The theoretical foundation is established via systematic error analysis, decomposing the total error into temporal and spatial components. The spatial error analysis is conducted by formulating the LL equation within the LOD framework.