

# Micromagnetic and atomistic simulations

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Micromagnetics is the standard tool for understanding complex magnetization processes of magnetic materials at the nanoscale. We will introduce the micromagnetic formulation and continuum model of a magnetic material and important interactions including exchange, anisotropy and magnetostatic fields. Finite differences and finite element simulations define the two types of micromagnetic models and we will explore the differences and advantages of each in detail. We will cover numerical solution of the Landau-Lifshitz-Gilbert equation for magnetization dynamics and energy minimization techniques including conjugate gradient and nudged elastic band methods to find ground state magnetic structures and energy barriers. Finally, we will explore the limitations of micromagnetics and the development of Landau-Lifshitz-Bloch micromagnetics and atomistic Spin Dynamics to address these shortcomings.