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## Ultraspherical spectral method for the Landau-Lifshitz-Gilbert (LLG) equation

### Communication Info

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### Abstract

The Landau–Lifshitz–Gilbert equation governs dissipative magnetization dynamics under a nonlinear, non-convex unit-length constraint [1], making accurate numerical approximation challenging. Existing spectral penalty formulations suffer from ill-conditioning and limited constraint enforcement for large penalty parameters [2]. We propose an ultraspherical spectral discretization of the Landau–Lifshitz–Gilbert equation that achieves spectral accuracy while sufficiently preserving the unit-length constraint without ill-conditioning. Numerical experiments demonstrate improved stability and precision compared to penalty-based approaches and other classic numerical methods [3]–[5].

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