

HIGHER-ORDER AND STRUCTURE-PRESERVING METHODS FOR MANIFOLD-VALUED PARTIAL DIFFERENTIAL EQUATIONS

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ABSTRACT

Many partial differential equations arising in geometry, continuum mechanics, and mathematical physics involve unknowns constrained to nonlinear manifolds. Examples include geometric evolution equations, nonlinear elasticity, shell and rod models, Landau–Lifshitz dynamics, harmonic and wave maps, and theories of liquid crystals and other constrained materials. Their numerical approximation poses significant challenges due to the interplay between geometric constraints, nonlinearity, and stability. This minisymposium focuses on the development and analysis of higher-order numerical methods for manifold-valued PDEs. Topics include high-order finite element and discontinuous Galerkin methods, geometric and structure-preserving time integrators, error analysis, adaptive algorithms, efficient nonlinear solvers, and applications to continuum mechanics, geometric evolution equations, and constrained physical models. The aim is to bring together researchers working on the mathematical foundations, algorithmic development, and practical implementation of advanced discretization techniques for manifold-valued problems, fostering interactions between numerical analysis, scientific computing, and applications.

SPEAKERS

1. Michael Feischl (TU Wien): Adaptivity for the Landau–Lifshitz–Gilbert equation.
2. Jan Giesselmann (TU Darmstadt): A posteriori error estimates for wave maps into spheres.

3. Zikang Gong (University of Freiburg): Unconstrained approximation of constrained problems.
4. Ricardo H. Nochetto (University of Maryland): Robust discretization of surface PDEs.
5. Robert Nürnberg (University of Trento): Second order in time discretizations for curve shortening flow and curve diffusion.
6. Dirk Praetorius (TU Wien): Weak and strong convergence of a BDF2-type integrator for the Landau–Lifshitz–Gilbert equation.
7. Michele Ruggeri (University of Bologna): Projection-free approximation of wave and Schrödinger maps into spheres.
8. Oliver Sander (TU Dresden): The discretization error of geometric finite elements for Cosserat materials.
9. Agus Soenjaya (University of New South Wales): Structure-preserving midpoint finite element method for chiral Landau–Lifshitz–Gilbert dynamics.
10. Rong Tang (The Hong Kong Polytechnic University): Optimal (L^2) convergence of tangent-plane FEM for the harmonic map heat flow.
11. Shuo Yang (Beijing Institute of Mathematical Sciences and Applications): High order projection-free iterative schemes for some non-convex pointwise constrained variational problems.
12. Jilu Wang (HIT Shenzhen): Projection-free Gauss methods for harmonic maps.