Università di Brescia

Dipartimento di Ingegneria Civile, Architettura,
Territorio, Ambiente e di Matematica

Structure-preserving approximation of evolutionary, geometrically constrained partial differential equations

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Alma Mater Studiorum - Università di Bologna

Mercoledì 15 aprile 2026, ore 11:00

in Aula Seminari della Sezione di Matematica

Abstract: We consider the numerical approximation of evolutionary geometrically constrained partial differential equations. As prototypical examples, we focus on two problems with sphere-valued solutions: the (parabolic) heat flow of harmonic maps and the (hyperbolic) wave map equation. Similar models arise in several applications in materials science, including continuum descriptions of ferromagnetic materials (micromagnetics), nematic liquid crystals, and nonlinear bending theory.

For this class of problems, we discuss fully discrete numerical schemes based on finite element spatial discretizations. Our goal is the construction of structure-preserving methods that reflect the key properties of the underlying continuous models. In particular, we address the accurate realization of the unit-length constraint, the preservation of discrete energy laws (dissipative or conservative), and the design of schemes that are unconditionally stable and provably converge to weak solutions. The resulting framework yields robust approximations while preserving the intrinsic geometric and energetic structure of the problem.

<u>Part of the talk will be based on joint work with G. Akrivis (U Ioannina), S. Bartels (U Freiburg), and J. Wang (HIT Shenzhen).</u>

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