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Review of a framework for simulation of magnetic soft robots using the material point method

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Abstract:

This abstract presents a framework for simulating Magnetic Soft Robots (MSRs) using the Material Point Method (MPM). The framework integrates hyper-elastic material models with the magnetic wrench induced under external fields, allowing for the accurate representation of MSR behavior. In contrast to Finite Element Methods (FEM), the MPM framework inherently models self-collision and captures the effect of forces in non-homogeneous magnetic fields. The document demonstrates the MPM framework's ability to model the influence of magnetic wrenches on MSRs, capture dynamic behavior under time-varying magnetic fields, and provide an accurate representation of deformation when colliding with obstacles. Additionally, the framework is validated through comparisons with real-world MSR designs from the literature, showcasing its capability to replicate complex behaviors seen in real robots in simulation.

Keyword:

Taichi, Magnetic beam Deformation, Finite Element Method (FEM).