Title: A fully coupled nonlinear magnetoelastic thin shell formulation

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Abstract: A geometrically exact dimensionally reduced order model for the nonlinear deformation of thin magnetoelastic shells is presented. The Kirchhoff–Love assumptions for the mechanical fields are generalised to the magnetic variables to derive a consistent two-dimensional theory based on a rigorous variational approach. The general deformation map, as opposed to the mid-surface deformation, is considered as the primary variable resulting in a more accurate description of the nonlinear deformation. The commonly used plane stress assumption is discarded due to the Maxwell stress in the surrounding free space requiring careful treatment on the upper and lower shell surfaces. The complexity arising from the boundary terms when deriving the Euler–Lagrange governing equations is addressed via a unique application of Green's theorem. The governing equations are solved analytically for the problem of an infinite cylindrical magnetoelastic shell. This clearly demonstrates the model's capabilities and provides a physical interpretation of the new variables in the modified variational approach. This novel formulation for magnetoelastic shells serves as a valuable tool for the accurate design of thin magneto-mechanically coupled devices.

Reference

[1] Ghosh et al, "A fully-coupled nonlinear magnetoelastic thin shell formulation", arXiv:2308.12300