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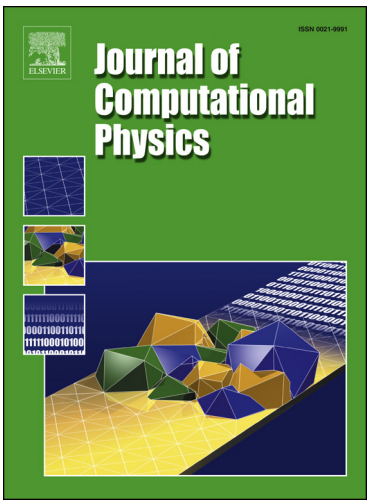

Compatible-Strain Mixed Finite Element Methods for Incompressible Nonlinear Elasticity

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Highlights

- We introduce a new family of mixed finite elements (CSFEM) for incompressible nonlinear elasticity. The displacement, the displacement gradient, the first Piola-Kirchhoff stress, and a pressure-like field are the four independent unknowns.
- Using the Hilbert complexes of nonlinear elasticity we identify the solution spaces of the independent unknown fields: The displacement in H^1, the displacement gradient in $H(\mathrm{curl})$, the stress in $H(\mathrm{div})$, and the pressure field in L^2.
- This approach results in compatible-strain mixed finite element methods that satisfy both the Hadamard compatibility condition and the continuity of traction at the discrete level independently of the refinement level of the mesh.
- We demonstrate that CSFEMs have a good performance for bending problems and for bodies with complex geometries. CSFEMs are capable of capturing very large strains and accurately approximating stress and pressure fields. Using CSFEMs, we do not observe any numerical artifacts, e.g., checkerboarding of pressure, hourglass instability, or locking in our numerical examples.