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Vesicle shape deformation using a discontinuous Galerkin method

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This work concerns the development of a finite-element algorithm for discretizing the phase-field model for the shape deformation of vesicle based on the idea of discontinuous Galerkin method [1, 2]. The phase-field model originated from minimization of Canham-Helfrich elastic bending energy involves fourth-order gradients and thus C^1-basis functions are required for standard conforming Galerkin formulation. Here, we introduce a relatively inexpensive, nonconforming method based on C^0-basis functions. We derive the variational form of the method and establish consistency. The variational form includes additional terms to weakly enforce continuity of the derivatives across interelement boundaries and its stabilization is achieved via Nitsche's method. Numerical tests for the equilibrium shapes of single component vesicles are performed to demonstrate the accuracy and robustness of the proposed variational formulation.

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