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Incompressible Flow with Elastic Filaments Using Moving Overset Grids

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We consider elastic filaments with mass that are coupled to a viscous incompressible flow using a new pressure velocity formulation. The key idea is to use thin, body-fitted grids that move and deform with moving boundaries, while using fixed Cartesian grids to cover most of the computational domain. Since the elastic boundary is always aligned with a grid line we can guarantee there is no leakage across immersed elastic boundaries: This is a major improvement over the immersed boundary and immersed interface methods. Our approach combines the strengths of earlier moving overset grid methods for rigid body motion, and unstructured grid methods for flow-structure interactions. Large scale deformation of the flow boundaries can be handled with only locally regenerated grids that adapt to moving boundaries in a computationally efficient way. Numerical experiments are used to demonstrate the improved accuracy of the method over prior work.

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