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A fluid-structure interaction model of soft robotics using an active strain approach ANDREW HESS, ZHAOWU LIN, TONG GAO, Michigan State University — Soft robotic swimmers exhibit rich dynamics that stem from the non-linear interplay of the fluid and immersed soft elastic body. Due to the difficulty of handling the nonlinear two-way coupling of hydrodynamic flow and deforming elastic body, studies of flexible swimmers often employ either one-way coupling strategies with imposed motions of the solid body or some simplified elasticity models. To explore the nonlinear dynamics of soft robots powered by smart soft materials, we develop a computational model to deal with the two-way fluid/elastic structure interactions using the fictitious domain method. To mimic the dynamic response of the functional soft material under external actuations, we assume the solid phase to be neo-Hookean, and employ an active strain approach to incorporate actuation, which is based on the multiplicative decomposition of the deformation gradient tensor. We demonstrate the capability of our algorithm by performing a series of numerical explorations that manipulate an elastic structure with finite thickness, starting from simple rectangular or circular plates to soft robot prototypes such as stingrays and jellyfish.

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