Computational mechanics of coupled flow-structure interaction with applications to biological and bio-inspired systems

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Over the last decade, there have been dramatic advances in mathematical modeling, analysis and simulation techniques to understand fundamental mechanics underlying fluid-structure interaction (FSI). To model a strong FSI interaction one must efficiently couple mathematical models with proper kinematics and dynamic coupling conditions. This work will present results from multidisciplinary applications for FSI problems in biological and bio-inspired systems. Specifically, finite element methods for efficient computation of the nonlinear interaction of the coupled differential equation models that arise from multi-physics applications including aneurysm-blood flow interaction, flexible wing of micro-air vehicles etc. will be presented. Some theoretical results that validate the reliability and robustness of the proposed computational methodology will also be discussed. Numerical experiments on benchmark problems will be presented to demonstrate the stability and convergence of the method.

Keywords: fluid-structure interaction, finite-element methods, nonlinear