Adaptive Time-Step Control for Nonlinear Fluid-Structure Interaction

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In this talk we consider time step control for variational-monolithic fluid-structure interaction. The fluid-structure interaction system couples the incompressible Navier-Stokes equations with geometrically nonlinear elasticity resulting in a nonlinear PDE system using the arbitrary Lagrangian-Eulerian approach. As the Navier-Stokes equations are of parabolic type and the solid equations of hyperbolic nature, they ask for different conservation properties that should be reflected in their temporal discretization. To circumvent this difficulty we use a dual-weighted residual error estimator for a Fractional-Step-θ timestepping scheme. The algorithm for temporal adaptivity is based on a Gelerkin interpretation of the Fractional-step theta time-stepping scheme and a rigorous derivation of dual-weighted sensitivity measures. All developments are substantiated with several numerical tests that include FSI-benchmarks with appropriate extensions and a flapping membrane example.