Abstract Submitted
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Global Model Reduction for the Aerodynamics of Coupled Fluid-Structure Systems[1] HAOTIAN GAO, MINGJUN WEI, New Mexico State University — We have recently developed a global approach for model order reduction of dynamic problems involving coupled fluid-structure systems. The approach is based on but different from traditional POD-Galerkin projection method, which is usually applied on fluid flow with fixed solid boundaries (or infinite domain). To consider moving boundaries/structures, instead, we work on a modified Navier-Stokes equation for the combined fluid-solid domain where body forcing terms are added for the description of solid motion. Then, POD modes can be easily computed in the combined fluid-solid domain, and so is the Galerkin projection. However, our earlier model required time-consuming integration at every time steps to count for the contribution from solid motion. In the current work, we decompose the solid motion to base functions and reduce the integration time from the number of time steps to a much lower number of representative modes of solid motion. A separate dynamic equation is developed to describe the evolution of these modes of solid motion to further simplify the process and allow fully-coupled fluid-structure interaction to be considered. The accuracy and efficiency of the new approach are demonstrated in both canonical cases (e.g. oscillatory cylinder) and practical applications.

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