A New Paradigm for Multiphysics Simulation: Its Initial Application to Fluid-Structure Interaction

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ABSTRACT

A new paradigm for simulating mulitipysics systems is presented with initial focus on Fluid-Structure Interaction (FSI). For each single-field governing equations adopting Lagrangian frame, a projection operator couples the coupled field without invoking interface Lagrange multipliers. For FSI problems where fluids are modeled by employing ALE kinematics, a physics-based interface equations are formulated as an independent set of third-field equations. This approach facilitates the connection of non-matching meshes and provides consistent dynamic equations of motion for the interface that can be integrated in parallel. The proposed simulation paradigm adopts stand-alone software modules for the fluid and the structure, which is coupled through a third interface system treating their interaction, which preserves the modularity of the single-discipline software modules. The new FSI simulation paradigm is demonstrated as applied to several FSI benchmark examples, demonstrating its efficiency and accuracy. Extension of the proposed new multiphysics simulation paradigm to treat other multiplhysics problems are suggested.

REFERENCES

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