Artificial added mass instabilities in sequential staggered coupling of nonlinear structures and incompressible viscous flows

Abstract:
This note investigates the so-called artificial added mass effect which is responsible for devastating instabilities within sequentially staggered Fluid-Structure Interaction (FSI) simulations where incompressible fluids are considered. A discrete representation of the added mass operator $M_A$ is given and 'instability conditions' are evaluated for different temporal discretisation schemes. It is proven that for every sequentially staggered scheme and given spatial discretisation of a problem, a mass ratio between fluid and structural mass density can be found at which the coupled system becomes unstable. The analysis is quite general and does not depend upon the particular spatial discretisation schemes used. However here special attention is put on stabilised finite elements employed on the fluid partition. Numerical investigations further highlight the results.

Stichworte:
artificial added mass,
fluid-structure interaction,
partitioned procedure, stability

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