Fluid structure interaction using a second order embedded strategy

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Keywords: fluid-solid interaction, numerical simulation, experimental validation, GPU implementation

Abstract: A Navier-Stokes solver based on Cartesian structured finite volume discretization with embedded bodies is presented. Fluid structure interaction with solid bodies is performed with an explicit partitioned strategy. The Navier-Stokes equations are solved in the whole domain via a fractional step method using a staggered finite volume discretization. The well known QUICK advection scheme is used at predictor stage. While, to enforce the velocity field in the solid region, the Poisson system is solved with Iterated Orthogonal Projection (IOP). A explicit integration in time is applied. As uniform cartesian grids are used, the solid interface is staircase defined. This fact affects the computation of fluid forces on the solid wall and, accordingly the results in fluid-structure analysis. In the present formulation, first and second order approximation for computing the fluid forces at the interface are studied and compared. The solver is specially oriented to General Purpose Graphic Processing Units (GPGPU) hardware. The code is validated with an experiment that involves a fully submerged spherical buoy confined in a cubic box, attached to the bottom of the box by a string. A harmonic displacement is imposed to the box with a shake table. Position of the buoy is determined from video records with a Motion Capture algorithm. The numerical results are compared with the experiments, and allows the validation of the numerically predicted drag and added mass of the body.