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Flow-Structure Interaction Simulation of Parachute using Immersed Boundary Method with Implicit Aerodynamical Load[1] HANG YU, CARLOS PANTANO, University of Southern California, FEHMI CIRAK, University of Cambridge — A method of flow-structure interaction simulation of the thin structure is presented. The immersed boundary method is used to incorporate the dynamics of the fluid and thin structure. A Cartesian background grid is used for compressible flow simulation and the thin structure is represented by Lagrangian markers immersed in the fluid. Linear operators based on the delta function is used for the interpolation and spreading. The boundary condition is enforced with a singular force f that is supported on the thin shell S which serves as boundary representation. Analog to the projection method for incompressible flow, the singular force is regarded as a Lagrangian multiplier to enforce boundary condition. A splitting method is used. The singular force is calculated implicitly by solving a symmetric system, which scales as number of Lagrangian markers. Furthermore, with the interpolation operator acting on the momentum equation, the implicit singular force can be subsequently translated as the aerodynamical load for the thin shell. Therefore, separate calculation of pressure and viscosity load is no longer needed. Lagrangian markers are dynamically removed or added to prevent leakage, unphysical oscillation, or the implicit force equation being underdetermined.

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