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Exploring Overset Meshes for Moving Body Problems Using OpenFOAM

Bhadri Srivatshan K. R.[1], Chandan Bose[2] Parees Palkar[3],

[1]Department of Aerospace Engineering, Amrita Vishwa Vidyapeetham
[2]Department of Aerospace Engineering, The University of Birmingham
[3]FOSSEE, Indian Institute of Technology Bombay

ABSTRACT

The free fall of rigid bodies in a fluid exhibits a wide range of unsteady motion regimes due to strong coupling between rigid-body dynamics and wake-induced flow structures. In the present work, an overset-mesh-based numerical framework is developed in OpenFOAM to simulate freely falling rigid bodies undergoing large translational and rotational motion. Independent background and body-fitted meshes are generated and coupled through overset interpolation, enabling stable mesh motion without deformation. A circular cylinder is first considered to verify the numerical setup, followed by detailed simulations of a flat plate with finite thickness over a range of density ratios. The resulting descent dynamics, including steady fall, flutter, and strongly inertial oscillatory regimes, are shown to be in qualitative agreement with established experimental and numerical studies.