Asociación Argentina
de Mecánica Computacional

Mecánica Computacional Vol XXXIX, págs. 3-3 (resumen)
F.E. Dotti, M. Febbo, S.P. Machado, M. Saravia, M.A. Storti (Eds.)
Bahía Blanca, 1-4 Noviembre 2022

AN ADAPTIVE, SCALABLE, AND ROBUST APPROACH FOR COMPUTING EXTERNAL FLOWS VIA THE IMMERSED BOUNDARY METHOD

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Keywords: Immersed Boundary Method; Flows; Complex Geometry.

Abstract. The immersed boundary (IB) method enables computation of flows in a wide array of complex geometries with far easier meshing compared to traditional body-fitted discretization, particularly for moving/deforming bodies. Retaining an underlying Cartesian mesh is likewise very favorable for developing robust (conservative, stable), efficient, and scalable algorithms that can preserve many of the important symmetries and invariants of the continuous equations of motion. On the other hand, a grid with fixed resolution is inefficient for resolving multi scale features such as thin boundary layers. We describe recent efforts to equip an IB method with two features that alleviate these constraints while maintaining the benefits of the Cartesian mesh. These are the use of a lattice Green's function solver (implemented with a scalable, linear-complexity fast multipole method) and block-wise adaptive mesh refinement. We highlight the capabilities of the solver by computing flows over bluff and streamlined bodies at high Reynolds number.