

A multigrid Immersed Boundary Method for the CFD Solver Horses3D

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One of the main bottleneck in high order simulations is the generation of high order meshes. The Immersed Boundary Method (IBM) [1] is a promising approach for overcoming such problem, indeed it allows to deal with complex geometries not requiring curved meshes. The IBM is handle through the volume penalization approach which consists in the application of a source term to the Navier-Stokes equations [2, 3]. The source term is applied on points lying inside the body that are identified thanks to a mask generated with a ray-tracing technique. The latter procedure can be easily automatized providing a fast and effective tool to get a solution starting from a CAD geometry. Moreover, IBM can be coupled with hp-refinement in the high order framework making it attractive for industrial applications.

In the present work we implement a volume penalization IBM for 3-dimensional simulation for the Horses3D solver [5]. Exploiting the capability of Horses3D, we have coupled the IBM with a multigrid method [4] in the Discontinuous Spectral Galerkin framework. Numerical experiments with different geometries are presented in order to validate the results obtained with Horses3D.

Keywords: *Immersed Boundary Method, Volume Penalization, Multigrid, Horses3D, Discontinuous Spectral Galerkin Methods*

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