A High-order Extended Discontinuous Galerkin Method to Treat Hydrodynamics Problems

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Key words: Sharp immersed interface, High-order, Discontinuous Galerkin, Hydrodynamics.

ABSTRACT

The use of immersed discretization methods to treat complex geometries or moving boundary problems has gathered the attention of the CFD community leading to various embedded techniques. The phenomena in the vicinity of this boundary/interface usually drive the physics of the problem hence the need to treat the immersed interface with high accuracy. Therefore, the development of an immersed Discontinuous Galerkin (DG) discretization able to keep high-order convergence near the interface makes this method very attractive. Furthermore, the locality of data and operations for DG schemes leads to an efficient local enrichment of the solution space to treat the embedded discontinuity. In this work, we integrated a sharp interface method in a three dimensional high-order DG code Argo. The extended solver can treat single or multi-phase problems over an immersed domain with explicit or implicit time integration schemes. In order to achieve high-order convergence, the spatial integration over cut cells is handled using the hierarchical moment fitting technique proposed in [2] and small cut cells are agglomerated to ensure the stability of the scheme [1]. This work will present the implementation of this sharp immersed method to discretize the Navier-Stokes equations and to simulate the flow around complex geometries. Preliminary results are shown in Fig. 1, which shows the incompressible flow at low Reynolds past an immersed cylinder compared with a body fitted mesh solution. The extension of this methodology to treat moving boundary problems (e.g. free surface flow) will be discussed.

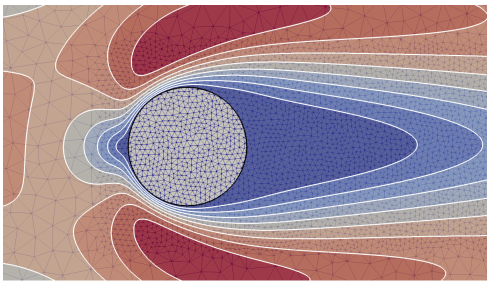

Figure 1: Close-up view of the steady state flow past an embedded cylinder at $Re = 20$. The white iso-countours are the results of the conformal simulation and the filled iso-countours are the results of the immersed DG method.

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