A discontinuous-Galerkin-based immersed boundary method

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RESUMO

Immersed boundary methods allow for the numerical approximation of boundary value problems using meshes that do not conform to the boundary. This greatly simplifies the mesh generation burden, since any mesh that contains the simulation domain can be used. On the other hand, existing immersed boundary methods typically exhibit stability issues, sub-optimal convergence rates and/or high coding complexity.

In this work we discuss a DG-based immersed boundary method with optimal convergence properties for elliptic problems [2]. The essential idea is to switch the elements cut by the domain boundary to a DG interpolation, while keeping the rest of the mesh continuous. The Dirichlet conditions are then imposed strongly on the immersed boundary. The resulting formulation does not exhibit the phenomenon of *boundary locking*, which leads to poor convergence rates and numerical artifacts near the boundary. In our implementation, we adopted the Bassi-Rebay [1] numerical fluxes. No need of numerical stabilization was observed, so that the method is free of adjustable parameters.

We report extensive numerical tests with two and three dimensional geometries, both in heat conduction and in linear and nonlinear elasticity.

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Referências

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