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A discontinuous-Galerkin-based immersed boundary method for simulation of elastic solids

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ABSTRACT

We propose a discontinuous-Galerkin-based immersed boundary method (DG–IBM) for the simulation of elastic solids. The highlight of the method is its ability to handle complex domains without requiring a mesh the conforms to the geometry. Dirichlet boundary conditions are imposed strongly and numerical solutions are found to converge with optimal convergence rate.

There are three main ingredients to the proposed DG–IBM, namely, a way to approximate the domain of the problem, the construction of the finite element space adopted to approximate solutions, and a prescription to imposes boundary conditions on the approximate domain in a way that preserves the right order of convergence. The approximate domain is constructed by embedding an approximate boundary on a simple discretization of *any* set containing the exact geometry. This is accomplished by adopting an implicit representation of the domain, although this is not essential. The finite element space is constructed by enriching the conforming space of elementwise polynomials on elements intersected by the approximate domain. The enrichment consists of adopting a discontinuous Galerkin approximation on those elements intersected by the approximate boundary. Allowing for such discontinuities is important to avoid the so–called boundary locking, which manifests itself as a loss of order of convergence when strongly imposing Dirichlet boundary conditions on standard conforming spaces.

In the talk, we will discuss our method of imposing Dirichlet and Neumann boundary conditions on the approximate domain for two- and three-dimensional problems, and demonstrate their performance using numerical examples in linear and non-linear elasticity. We will discuss our choice of basis functions and quadrature rules in cut elements for linear triangles and tetrahedral elements. The examples confirm the expected optimal convergence properties of the method.

REFERENCES

[1] Adrián J. Lew and Gustavo C. Buscaglia. “A discontinuous Galerkin based immersed boundary method”. *International Journal for Numerical Methods in Engineering.*, In press.

[2] R.Ramsharan, Adrián J. Lew and Gustavo C. Buscaglia. “A discontinuous Galerkin based immersed boundary method for simulation of elastic solids”. *Under preparation*.