Analysis of Domain Embedding Method for Elliptic Problems Defined Over Curved Complex Domains

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ABSTRACT

Solving Partial differential equations over curved complex domains is a very challenging job due to the meshing intricacy of the domain. In particular, for time-dependent problems, meshing is needed at each time step if the domain has a moving interface, which increases the computational cost intensely. So, we insert the given domain into a more extensive rectangular domain and use the structured triangular grid and linear finite element method to solve the extended penalized version of the given partial differential equation over a rectangular domain. Penalty parameters are used to utilize the original boundary conditions. The a priori estimates and stability results are derived for the proposed idea with the error estimates in H^1 and L^2 norms. Error analysis ensures the practical applications of the method, and several numerical experiments demonstrate the theoretical results.

Keywords: finite element method; curved domains; uniform mesh; error estimates.

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