Higher Order Cut-Elements for the Wave Equation

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Abstract

We consider solving the scalar wave equation on second order form using immersed finite elements, also known as cut-elements. Such a method might be useful in scattering problems where the domain geometry is not known a priori. For wave propagation problems the computational work per dispersion error is typically lower for higher order methods. This serves as motivation for using a higher order immersed method. Here, boundary conditions are enforced using Nitsche's method, which leads to a symmetric weak formulation. This ensures that a discrete energy is preserved in the semi-discrete setting, which guarantees stability. In immersed methods, small intersections between the immersed domain and the elements of the background mesh make the system ill-conditioned. Here, we consider solving this issue by adding stabilizing penalty terms to the weak formulation. These terms ensure that the condition numbers of the matrices are independent of how the boundary cuts the background mesh.