OPTIMAL ADDITIVE SCHWARZ PRECONDITIONING FOR THE
$hp$-BEM: THE HYPERSINGULAR INTEGRAL OPERATOR IN 3D

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Abstract. We consider the discretization of the hypersingular integral operator by the $hp$-version of the Galerkin boundary element method ($hp$-BEM) in $\mathbb{R}^3$ and propose a preconditioner based on the overlapping additive Schwarz framework. The preconditioner is based on a space decomposition into the space of piecewise linears and spaces of high order polynomials supported by the vertex patches. This decomposition results in uniformly bounded (w.r.t. mesh size $h$ and polynomial degree $p$) condition number for the preconditioned system. It is possible to further decompose the space of piecewise linears in a multilevel fashion and retain the uniformly bounded condition number. The preconditioner is suitable for locally refined meshes but assumes shape regularity of the mesh. For a mesh with $N$ elements, the preconditioner can be applied in $O(Np^4)$ operations; the setup of the preconditioner takes $O(N + p^6)$ operations.

Keywords: $hp$-BEM, hypersingular integral equation, additive Schwarz preconditioning

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References


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