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Operator preconditioning for two-dimensional screen and fracture problems using boundary elements

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Abstract

Calderón preconditioning has been successfully used in the past for solving boundary integrals over surfaces without boundaries [2, 1]. The situation changes drastically when considering open boundaries as when modeling screens or cracks. Indeed, Calderón identities break down due to the disappearance of the double layer boundary operator (and its adjoint). The associated weakly singular and hypersingular operators no longer map fractional Sobolev spaces in a dual fashion but degenerate into different subspaces depending on their extensibility by zero.

Recently, Jerez-Hanckes and Nédélec [3], showed that a jump and average decomposition of the volume solution leads to precise coercivity results in fractional Sobolev spaces and characterize the mismatch occurring between associated functional spaces in the aforementioned limiting cases. Moreover, they present explicit and exact variational formulations when considering an open interval as well as for their corresponding inverses and naturally define Calderón-type identities in each case with potential use as preconditioners. In this presentation, we show first numerical implementations of these preconditioners and discuss future extensions.

Key words: operator preconditioning, boundary element methods, screen problems

Mathematics subject classifications (1991): 45P05, 65N38, 31A10, 46E35

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