

Towards a Fast-Converging PMCHWT Equation for Structures Containing Junctions

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There are a number of avenues available for the modelling of fields in composite systems. The PMCHWT can be generalised in a fairly straightforward manner to apply to general systems, even those including junctions lines. The disadvantage of this approach is that it leads to ill-conditioned systems that need to be inverted using expensive LU or QR decomposition based methods. Alternatively, global multi-trace methods provide another framework for the modelling of general systems. Their downside, however, is the introduction of twice the number of unknowns compared to the classic PMCHWT.

In this contribution, a modified PMCHWT equation which we refer to as the quasi-local PMCHWT is introduced that marries the benefits of the above two methods. The method is based on first building an all-floating global multi-trace formulation of the scattering problem and by then choosing a suitable test space that does not coincide exactly with the subspace of single-trace functions, i.e. fields whose tangential components are continuous at interfaces. It provides an approximate solution to the scattering problem that exactly fulfils the continuity requirements at interfaces, and results upon discretization in a linear system that can be solved by a Krylov iterative method in a small number of iterations that increases only slowly as the mesh size tends to zero.

We will review the construction of the classic PMCHWT in the language of multi-trace methods, explain how this procedure can be generalised, and introduce a specific version that leads to well-conditioned system matrices. The correctness and efficiency of the method will be corroborated by numerical results.

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