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# Multi-trace Single Source Integral Equation for Scattering by Partially Coated Composite Structures

Kristof Cools(1)
(1) Dept. of Information Techn., Ghent University

## 1 Introduction

Multiple trace formulations are an appealing avenue for the modelling of scattering and transmission problems [1]. They reduce problems involving generic stackings of multiple homogeneous penetrable bodies to a problem involving only free floating bodies that conceptually do not touch. This removes the need for ad-hoc treatment of junctions (i.e. lines along which three or more regions meets) and renders the description compatible with highly effective Calderón preconditioning schemes.

The price one pays is the introduction of - as the name suggests - multiple traces. On the interface between two regions, two copies of both the electric and magnetic field values need to be kept track off. The multiple trace method can be thought of as additive in the same sense as the classic PMCHWT equation: it is built from adding the representation formulas valid in the exterior and interior domains.

Recently, a multiplicative multiple trace formulation has been introduced [2]: it is built, not by adding, but by multiplying (i.e. composing) the interior and exterior representation operators. It follows not the additive PMCHWT recipe, but the multiplicative single-source recipe [3]. The advantage of this multiple trace single source equation is that a single equation can be solved for a single trace. In summary: the unknowns are doubled by using ideas from multiple trace formulations, but are subsequently halved by using ideas from single source formulations. Moreover, these equations appear in an intrinsically regularised form. No additional regularisation is required to arrive at well-conditioned linear systems.

In this contribution, the domain of applicability of the multiple trace single source formulation from [2] is extended to composite scatterers that can comprise penetrable regions, perfectly conducting regions, and thin sheets and coatings. It is demonstrated that multiple-trace single source equations can be built that can be efficiently solver for the unknown field traces.

## References

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