

Trefftz Discontinuous Galerkin Approximation of the T-Matrix for Scattering by Periodic Layered Structures

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Abstract

We study the scattering of time-harmonic electromagnetic waves by periodic layered gratings [1], modelled by the two-dimensional Helmholtz equation with piecewise-constant relative permittivity ε . The periodic obstacle may include penetrable and impenetrable regions, and consists of a finite number of stacked layers. The problem is formulated on a single periodic cell using quasi-periodic boundary conditions. Radiation condition in the vertical directions is imposed through Dirichlet-to-Neumann (DtN) operators.

To efficiently treat multilayer configurations, we adopt a formulation based on the T-matrix method [3]. The global scattering problem is decomposed into boundary value problems posed on individual layers, where the field is expressed in terms of quasi-periodic modal expansions, and the T-matrix describes the mapping between incoming and outgoing wave modes on the layer boundaries. The T-matrix is approximated numerically using a Trefftz Discontinuous Galerkin (TDG) method [2], providing an efficient discretization for the computation of the layer scattering response. The resulting framework combines a mathematically consistent formulation of quasi-periodic scattering with a flexible high-frequency numerical method for wave propagation in periodic layered media.

References

- [1] A.-S. Bonnet-Bendhia and F. Starling, Guided waves by electromagnetic gratings and nonuniqueness examples for the diffraction problem. *Math. Methods Appl. Sci.* **17**, 305-338 (1994)
- [2] A. Moiola and A. M. Monforte, Trefftz Discontinuous Galerkin methods for scattering by periodic structures. *ArXiv: 2505.23216*. (2025)
- [3] P. Waterman, Matrix formulation of electromagnetic scattering. *Proceedings Of The IEEE*. **53**, 805-812 (1965)