Institut für
Angewandte Mathematik

Leibniz
Universität
Hannover

Vortragsankündigung
Oberseminare Analysis und Theoretische Physik und Numerik und Optimierung

"Learned Infinite Elements"

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We discuss the numerical solution of scalar time-harmonic wave equations on unbounded domains which can be split into a bounded interior domain of primary interest and an exterior domain with separable geometry. To compute the solution in the interior domain, approximations to the Dirichlet-to-Neumann (DtN) map of the exterior domain have to be imposed as transparent boundary conditions on the artificial coupling boundary. Although the DtN map can be computed by separation of variables, it is a nonlocal operator with dense matrix representations, and hence computationally inefficient. Therefore, approxima.tions of DtN maps by sparse matrices, usually involving additional degrees of freedom, have been studied intensively in the literature using a variety of approaches including different types of infinite elements, local nonreflecting boundary conditions, and perfectly matched layers. The entries of these sparse matrices are derived analytically, e.g., from transformations or asymptotic expansions of solutions to the differential equation in the exterior domain. In contrast, we propose to "learn" the matrix entries from the DtN map in its separated form by solving an optimization problem as a preprocessing step. We show that the approximation quality of learned infinite elements improves exponentially with increasing number of infinite element degrees of freedom, which is confirmed in numerical experiments. These numerical studies also show that learned infinite elements outperform state-of-the-art methods for the Helmholtz equation. At the same time, learned infinite elements are much more flexible than traditional methods as they, e.g., work similarly well for exterior domains involving strong reflections. As the main motivating example we study the atmosphere of the Sun, which is strongly inhomogeneous and exhibits reflections at the corona.

Dienstag 15.11.2022 16:00 Uhr Raum F142

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Alle Interessierten sind herzlich eingeladen.