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Trefftz-DG solution to the Helmholtz equation using integral equations

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Numerical solutions of the Helmholtz equation, over large distances of propagation, face a serious drawback known as the dispersion error or the pollution effect. It is necessary to augment the density of the degrees of freedom (dof) to maintain a given level of accuracy [2]. This rapidly exceeds the capabilities in CPU time and even storage of massively parallel platforms. Discontinuous Galerkin (DG) methods have demonstrated a good resistance to the pollution effect [3] but they also require to apply mesh refinement when the computational domain is several hundred of wavelengths long. Trefftz-DG methods are specific DG methods using basis functions which are local solutions of the problem of interest and requiring less dofs. In [1], we have elaborated a Trefftz-DG method using a representation of the fluxes at the boundary of each element from an accurate computation of the Dirichlet-to-Neumann (DtN) map obtained by solving an integral equation. We have shown that when the order of approximation is high, it performs better than an Interior Penalty DG method regarding the tolerance to the pollution effect. The objective of this talk is to compare different approximations of the DtN map involving finite elements, spectral method, DG methods by quantifying their resistance to the pollution effect in large domains.

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