Second-kind Single Trace BEM for Acoustic Scattering at Composite Objects

X. Claeys[1], R. Hiptmair[2] and E. Spindler[3]
[1] Laboratoire Jacques-Louis Lions, Paris VI, xavier.claeys@upmc.fr,
[2] Seminar for Applied Mathematics, ETH Zürich, hiptmair@sam.math.ethz.ch,
[3] Seminar for Applied Mathematics, ETH Zürich, elke.spindler@sam.math.ethz.ch

We consider acoustic scattering at composite objects with Lipschitz boundary. The widely used classical first-kind approach leads to ill-conditioned linear systems on fine meshes and no preconditioner is available. Consequently, one observes slow convergence of iterative solvers, which are inevitable when solving large linear systems.
In contrast to this, a new intrinsically well-conditioned second-kind boundary element formulation has been discovered by one of the authors [**?**]. We adopt this idea and extend it by lifting the formulation from the trace spaces $H^{\frac{1}{2}}(\Gamma) \times H^{-\frac{1}{2}}(\Gamma)$ into the space $L^2(\Gamma) \times L^2(\Gamma)$. This enables us to solely work with discontinuous ansatz functions in order to approximate the unknown boundary data.

In the talk we are going to focus on recent computational results obtained for the 3D acoustic scattering. These results were generated by an implementation based on the C++ Boundary Element Template Library (BETL) by Lars Kielhorn (SAM, ETH Zürich). They show competitive accuracy of the new second-kind approach compared to the classical first-kind approach, and confirm the excellent conditioning of the Galerkin matrices and superior convergence of GMRES.

Publications:

[1] X. Claeys, *A single trace integral formulation of the second-kind for multiple subdomain scattering*, Tech. Rep. 2011-14, Seminar for Applied Mathematics, ETH Zürich, Zürich, Switzerland, 2011.

[2] X. Claeys, R. Hiptmair, and E. Spindler, *A second-kind galerkin boundary element method for scattering at composite objects*, Tech. Rep. 2013-13, Seminar for Applied Mathematics, ETH Zürich, Switzerland, 2013.