Resonance-free single-current inverse source formulations based on Steklov-Poincaré mappings

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The inverse source problem has seen an extensive study in the last few decades, with the introduction in the literature of several alternative solution approaches based on the boundary element method (BEM) and on the definition of equivalent currents. Among them, schemes enforcing the Love condition are well appreciated because of the relationship among the currents and the external fields. Another relevant aspect in the comparison of the different solution strategies is the size of the BEM linear system that needs to be inverted to compute the solution, which sees in the single-source schemes a clear advantage. Nevertheless, these approaches require additional care unless further physical constraints are imposed.

One of the single-source formulations presented in the literature enforces the Love condition by means of a Steklov-Poincaré mapping between the currents. However, this scheme is affected by interior resonances which limit its applicability in a real-case scenario.

This work defines a cure for the internal resonances of that formulation. This is done by solving the same issue for the Steklov-Poincaré operator via an approach based on the combined-field integral operator (CFIO). Additional similar equations are also derived, forming a family of resonance-free single-source Love formulations.

The new formulations are first analyzed using vector spherical harmonics to clearly identify the interior resonances of the operators involved and to verify that the new formulations are not affected by this issue. Finally, each of the proposed equations is effectively discretized on a triangular mesh and the new approach is tested in a more practical scenario.

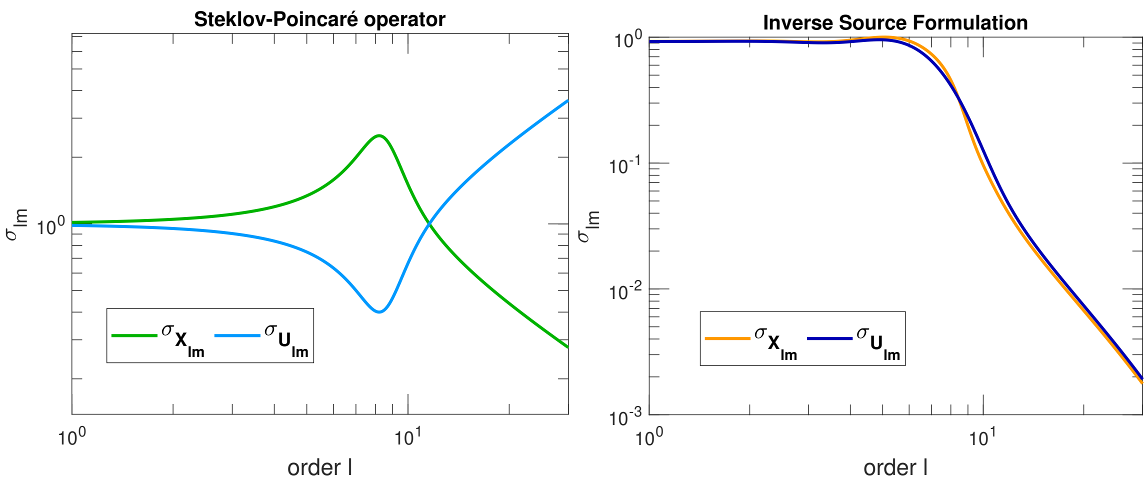

Figure 1. Singular values in function of the order of the vector spherical harmonics l. *On the left:* resonance-free Steklov-Poincaré operator. *On the right:* resonance-free single-source formulation for the inverse source problem.

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