Exact complex scalings based on Hardy space infinite elements

M. Wess[1,*], **L. Nannen**[2]

[1]*Institute for Analysis and Scientific Computing, TU Wien, Austria*
[2]*Institute for Analysis and Scientific Computing, TU Wien, Austria*
[*]Email: `markus.wess@tuwien.ac.at`

Helmholtz scattering and resonance problems in open domains can be treated using the Hardy space infinite element method. This method is based on the pole condition which characterizes outgoing waves by the poles of their Laplace transforms. Outgoing solutions are approximated in the Laplace domain.

We present an interpretation of Hardy space infinite elements as a truncation-free complex scaling method in space. The discretization matrices can be computed numerically using suitable Gauss-Laguerre quadrature rules. This allows us to deal with non-homogeneous exterior domains.

Similarly to the application of perfectly matched layers in [1] we employ our method to discretize complex scaled Helmholtz resonance problems with frequency dependent scaling functions. The frequency dependency of the scaling function optimizes the complex scaling for all frequencies and reduces the dependency of the approximation on the specific choice of scaling parameter.

References

[1] L. Nannen and M. Wess, Computing scattering resonances using perfectly matched layers with frequency dependent scaling functions, *BIT Numerical Mathematics* (2018)