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Spectral Galerkin Method for Solving Helmholtz and Laplace Dirichlet Problems on Multiple Open Arcs

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We present a spectral numerical scheme for solving Helmholtz and Laplace problems with Dirichlet boundary conditions on an unbounded non-Lipschitz domain $\mathbb{R}^2\backslash\overline{\Gamma}$, where Γ is a finite collection of open arcs. An indirect method is employed, giving rise to first kind formulations whose variational forms are discretized using weighted Chebyshev polynomials. Well-posedness of the continuous and discrete problems is established as well as spectral convergence under the existence of analytic maps to describe the arcs. In order to reduce computation times, a simple matrix compression technique based on sparse approximations of the kernel is developed. Numerical results are provided to validate our claims pointing out to new improvements and extensions.

REFERENCES

[1] C. Jerez-Hanckes and J.-C. Nédélec. Explicit variational forms for the inverses of integral logarithmic operators over an interval. *SIAM Journal on Mathematical Analysis*, 44(4):2666–2694, jan 2012.

[2] C. Jerez-Hanckes, S. Nicaise, and C. Urzúa-Torres. Fast spectral galerkin method for logarithmic singular equations on a segment. *Journal of Computational Mathematics*, 36(1):128–158, oct 2017.

[3] C. Jerez-Hanckes, J. Pinto and S. Tournier. Local multiple traces formulation for high-frequency scattering problems. *Journal of Computational and Applied Mathematics*, 289(Supplement C):306 – 321, 2015.

[4] K.M. Liew, Y. Cheng, and S. Kitipornchai. Analyzing the 2D fracture problems via the enriched boundary element-free method.*International Journal of Solids and Structures*, 44(11):4220 – 4233, 2007.

[5] Y. Wang, Fuming Ma, and Enxi Zheng. Galerkin method for the scattering problem of a slit. *Journal of Scientific Computing*, 70(1):192–209, jul 2016.

[6] J. Saranen and G. Vainikko. *Periodic Integral and Pseudodifferential Equations with Numerical Approximation*. Springer Monographs in Mathematics. Springer Berlin Heidelberg, 2013.