Parallel-friendly non local Optimized Schwarz Method (OSM) for electromagnetism

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Abstract

We consider the propagation of harmonic electromagnetic waves and we are aiming at an efficient domain decomposition strategy without overlap. In (1), it has been proved for general case of substructuring domain decomposition for harmonic wave problems that a non-local treatment on the transmission conditions accross interfaces allows to deal with cross points while maintaining a convergence speed that is robust with respect to the discretization parameter. In this non-local OSM method, the transmission conditions are implemented with a non-local exchange operator defined on the skeleton of the partition which is the union of the interfaces between subdomains. However, introducing non-local operations may affect the parallelism of the domain decomposition. That is why in this presentation, we will talk about different ways of reaching scalability and parallel efficiency despite the possible non-locality of the exchange operator in particular recycling and preconditionning techniques.

References

(1) X. Claeys. Non-Local Variant of the Optimised Schwarz Method for Arbitrary Non-Overlapping Subdomain Partitions. *ESAIM: Mathematical Modelling and Numerical Analysis* 55, no 2 (1st March 2021): 429-48.

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Two-level domain decomposition methods on perforated domains

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Abstract

We propose a new coarse space for the two-level Restricted Additive Schwarz (RAS) preconditioner to efficiently solve elliptic equations on perforated domains. The numerous polygonal perforations in the model domain represent realistic structures (buildings, walls, etc.) in given areas of Nice, France. With the eventual goal of modeling urban floods via the nonlinear Diffusive Wave equation, we focus on the solution of linear problems on these domains. Similar to other multi-scale numerical methods, this coarse space is spanned by basis functions that are locally discrete harmonic inside of each subdomain. It is based on nodal degrees of freedom that occur at the intersection between the perforations and the subdomain boundaries. Numerical experiments are shown using the two-level RAS method as both a multiplicative iterative method and a Krylov preconditioner. These numerical results show that the new coarse space is very robust and accelerates iteration counts in both methods, independent of the complexity of the data. Additionally, we see that the coarse space has approximation properties that make it a strong coarse approximation in its own right.

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