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H-matrix Acceleration of Locally Corrected Nystrom Method

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In this work, H-Matrix acceleration of the Locally Corrected Nystrom (LCN) solution is represented. Generally, H-Matrix is used to approximate a dense matrix using a data-sparse representation. To do this, the matrix should be partitioned into blocks and for those blocks satisfying the admissibility criteria, low-rank decomposition is implemented. In this new computational framework, H-LU decomposition and H-back-substitution are employed to accelerate direct solution of the pertinent. Also, Adaptive Cross Approximation (ACA) and error-controlled H-matrix arithmetic provides error-controlled fast direct solution to the matrix equations by compressing the H-matrix blocks. Using the proposed approach, it is demonstrated that smooth objects of electrically moderate size (up to approximately 100 wavelengths) can be solved with O(NlogN) CPU time and memory consumption.

The key factor of H-Matrix is in subdividing of the matrix using the recursive blocks. It means, the area needs to be partitioned into similar sub-areas and it is based on geometry of the set of row and column indices of the matrix. This is a vital step in physical distances and interaction between degrees of freedom.

Despite the fact that the matrix conditioning deteriorates due to sharp edges in the scatterer, oversampling, or presence of multi-scale features, the fast-direct nature of the solution enables robust solution, as long as the LCN and H-matrix tolerances are set in a manner that resolves the relevant dynamic range of the interactions in the solution (for example, the dynamic range of the vector and scalar contributions of the EFIE). The conference will present numerical results demonstrating O(hp) error behavior as well as CPU and memory complexity scaling for the H-Matrix acceleration of the LCN method.

References

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