

Heterogeneous Tolerance Strategies in H-LU Decomposition for Integral Equations

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This research examines the use of heterogeneous tolerance strategies within the H-matrix framework to optimize solver performance for integral equations. The H-matrix method, widely employed in computational electromagnetics, is valued for reducing memory and computational complexity. A key aspect of this technique is managing block-wise accuracy, which can be adjusted across the matrix structure. This study introduces distinct tolerances for different block types in the block cluster tree. Specifically, leaf admissible blocks are assigned looser tolerances compared to non-leaf admissible blocks, reflecting their differing contributions to the solution process. Leaf blocks, often representing finer matrix levels, can operate with lower accuracy, while non-leaf blocks require higher precision to maintain overall solution accuracy. The research highlights the impact of these heterogeneous tolerances on solver efficiency. By allocating computational resources more effectively, the approach accelerates the solution process while preserving accuracy. A case study demonstrates the advantages of applying separate tolerances to leaf and non-leaf blocks, showcasing improved computational speed and solution precision.

Figure 1 illustrates the optimal balance of tolerances for a PEC sphere, achieving accurate results with reduced wall time. The findings underscore the potential of heterogeneous tolerances to enhance H-LU decomposition in boundary element methods, enabling faster, cost-effective solutions without compromising quality.

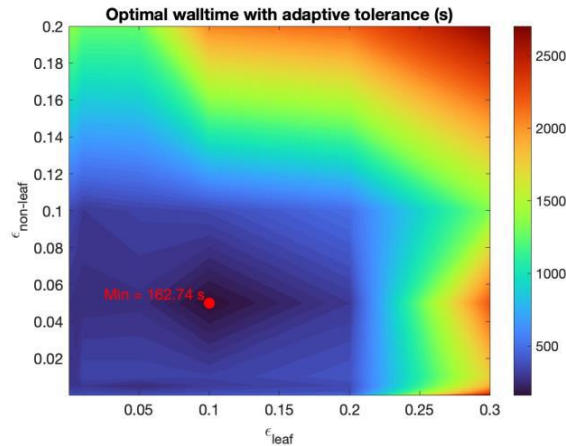


Fig. 1. Optimal wall-time for the sphere at 300 MHz