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Improved Adaptive Smoothed Aggregation

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Smoothed Aggregation (SA) multigrid has proved to be a useful AMG method for solving discretizations of elliptic problems. However, SA requires knowledge of slow to converge near-nullspace vectors in order to achieve good performance. Previous work in adaptively finding near-nullspace vectors relied on heuristics and had trouble when near-nullspace vectors were too similar. Our improved version of Adaptive Smoothed Aggregation (aSA) uses a more principled approach to find near-nullspace vectors. By leveraging the Weak Approximation Property and global and local orthogonalization processes, we ensure that our candidates better match the near-nullspace vectors. We extend this method to find candidates on all multigrid levels. Our technique can be used as a tool to find near-nullspace vectors for developing new multigrid methods or as a stand alone solver for difficult problems.