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Convergence Theory for Nonsymmetric Smoothed Aggregation Multigrid

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Applying smoothed aggregation multigrid (SA) to solve nonsymmetric linear systems, $A\mathbf{x} = \mathbf{b}$, can be problematic due to a lack of minimization principle in the coarse-grid corrections. We propose an approach that is based on approximately applying SA to the symmetric positive definite matrices $\sqrt{A^*A}$ or $\sqrt{AA^*}$. These matrices, however, are typically full and difficult to compute, and it is therefore not computationally efficient to use these matrices directly to form a coarse-grid correction. Our proposed approach approximates these coarse-grid corrections by using smoothed aggregation to accurately approximate the right and left singular vectors of A that correspond to the lowest singular value. These are used to construct the interpolation and restriction operators, respectively. We present some preliminary two-level convergence theory and numerical results.