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Algebraic analysis of MG methods: the nonsymmetric case

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We develop an algebraic analysis of two-grid methods that does not require any symmetry property. Several equivalent expressions are provided that characterize *all* eigenvalues of the iteration matrix. In the symmetric positive definite case, these expressions reproduce the sharp two-grid convergence estimate obtained by Falgout, Vassilevski and Zikatanov [Numer. Lin. Alg. Appl., 12 (2005), pp. 471–494], and also previous algebraic bounds which can be seen as corollaries of this estimate.

These results allow to measure the convergence by checking "approximation properties". In this talk, proper extentions of the latter to the nonsymmetric case are presented. Sometimes approximation properties for the symmetric positive definite case are summarized in loose terms; e.g.: *Interpolation must be able to approximate an eigenvector with error bound proportional to the size of the eigenvalue* [SIAM J. Sci. Comput., 22 (2000), pp. 1570–1592]. It is shown that this can be applied to nonsymmetric problems too, understanding "size" as "modulus".

Eventually, an analysis is developed, for the nonsymmetric case, of the theoretical foundations of "compatible relaxation", according to which a Fine/Coarse partitioning may be checked and possibly improved.