Geoffrey D. Sanders

RECURSIVELY ACCELERATED MULTILEVEL AGGREGATION FOR MARKOV CHAINS

University of Colorado
Applied Math
526 UCB
Boulder
CO 80309
sandersg@colorado.edu
Hans De Sterck
Killian Miller
Manda Winlaw

A recursive acceleration method is proposed for multiplicative multilevel aggregation algorithms that calculate the stationary probability vector of large, sparse and irreducible Markov chains. Pairs of consecutive iterates at all branches and levels of a multigrid W-cycle with simple, non-overlapping aggregation are recombined to produce improved iterates at those levels, in an approach that is inspired by so-called k-cycle (Krylov-cycle) methods. The acceleration is achieved by solving quadratic programming problems with inequality constraints: the linear combination of the two iterates is sought that has minimal two-norm residual, under the constraint that all vector components are nonnegative. It is shown how the two-dimensional quadratic programming problems can be solved explicitly in an efficient way. The method is further enhanced by windowed top-level acceleration of the W cycles using the same constrained quadratic programming approach. Recursive acceleration is an attractive alternative to smoothing the restriction and interpolation operators, since the operator complexity is better controlled and the probabilistic interpretation of coarse-level operators is maintained on all levels. Numerical results are presented showing that the resulting recursively accelerated multilevel aggregation cycles for Markov chains, combined with top-level acceleration, converge signifficantly faster than W cycles, and lead to close-to-linear computational complexity for challenging test problems.