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EULER-RICHARDSON METHOD PRECONDITIONED BY WEAKLY STOCHASTIC MATRIX ALGEBRAS: A POTENTIAL CONTRIBUTION TO PAGERANK COMPUTATION*

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Abstract. Let S be a column stochastic matrix with at least one full row. Then S describes a Pagerank-like random walk since the computation of the Perron vector x of S can be tackled by solving a suitable M-matrix linear system $Mx = y$, where $M = I - \tau A$, A is a column stochastic matrix and τ is a positive coefficient smaller than one. The Pagerank centrality index on graphs is a relevant example where these two formulations appear. Previous investigations have shown that the Euler-Richardson (ER) method can be considered in order to approach the Pagerank computation problem by means of preconditioning strategies. In this work, it is observed indeed that the classical power method can be embedded into the ER scheme, through a suitable simple preconditioner. Therefore, a new preconditioner is proposed based on fast Householder transformations and the concept of low complexity weakly stochastic algebras, which gives rise to an effective alternative to the power method for large-scale sparse problems. Detailed mathematical reasonings for this choice are given and the convergence properties discussed. Numerical tests performed on real-world datasets are presented, showing the advantages given by the use of the proposed Householder-Richardson method.

Key words. Matrix algebras, Preconditioning, Nonnegative matrices, Pagerank.

AMS subject classifications. 15B48, 15B51, 65F08.

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