Recursive self preconditioning method based on Schur complement for Toeplitz matrices

N. Akhoundi and F. Toutounian
Department of Mathematics, Ferdowsi University of Mashhad,
P.O. Box 1159-91775, Mashhad, Iran
nasserakhoundi@gmail.com

In this paper, we propose to solve the Toeplitz linear systems $T_n x = b$ by a recursive-based method. The method is based on repeatedly dividing the original problem into two subproblems with leading principal submatrix and related schur complement. The idea is to solve the linear systems $S_m y = d$, where S_m is the schur complement of T_{2m} (the principal submatrix of T_n), by using a self preconditioned iterative methods. The preconditioners, which are the approximate inverses of S_m, are constructed based on famous Gohberg-Semencul formula. All occurring matrices are represented by proper generating vectors of their displacement rank characterization. We show that, for well conditioned problems, the proposed method is efficient and robust. For ill-conditioned problems, by using some iterative refinement method, the new method would be efficient and robust. Numerical experiments are presented to show the effectiveness of our new method.