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On ADI Method for Sylvester Equations


**Abstract.** This paper is concerned with numerical solutions of large scale Sylvester equations $AX - XB = C$, Lyapunov equations as a special case in particular included, with $C$ having very small rank. For stable Lyapunov equations, Penzl (2000) and Li and White (2002) demonstrated that the so called Cholesky factored ADI method with decent shift parameters can be very effective. In this paper we present a generalization of Cholesky factored ADI for Sylvester equations. We also demonstrate that often much more accurate solutions than ADI solutions can be gotten by performing Galerkin projection via the column space and row space of the computed approximate solutions.