

AN ARNOLDI-BASED PRECONDITIONER FOR ITERATED TIKHONOV REGULARIZATION

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Many problems in science and engineering give rise to linear systems of equations that are commonly referred to as large-scale linear discrete ill-posed problems. These problems arise for instance, from the discretization of Fredholm integral equations of the first kind. The matrices that define these problems are typically severely ill-conditioned and may be rank deficient. Because of this, the solution of linear discrete ill-posed problems may not exist or be extremely sensitive to perturbations caused by error in the available data. These difficulties can be reduced by applying Tikhonov regularization. We describe a novel "approximate Tikhonov regularization method" based on constructing a low-rank approximation to the matrix in the linear discrete ill-posed problem by carrying out a few steps of the Arnoldi process. The iterative method so defined is transpose-free. Our work is inspired by Donatelli and Hanke whose approximate Tikhonov regularization method seeks to approximate a severely ill-conditioned block-Toeplitz matrix with Toeplitz-blocks by a block-circulant matrix with circulant-blocks.