Parameter selection strategies for the Arnoldi-Tikhonov method

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In this work we describe some strategies for setting the regularization parameter when performing the Arnoldi-Tikhonov method.

Often, when dealing with linear discrete ill-posed problems of huge dimensions, just a purely iterative or a hybrid approach to regularization can be adopted. The class of the Arnoldi-Tikhonov methods [1] is based on the projection of the original Tikhonov-regularized problem onto Krylov subspaces of small but increasing dimensions; in particular, we are concerned with formulations that can deal with an arbitrary initial guess for the solution and a generic regularization matrix.

In this setting, a suitable value for the Tikhonov regularization parameter should be set at each iteration, as well as a stopping criterion for the underlying Arnoldi algorithm. We present two reformulations of the classical discrepancy principle, including a new scheme that can be applied without any initial estimate on the noise level, which is recovered during the iterations. An efficient reformulation of the Generalized Cross Validation method is presented, too. We briefly address some theoretical estimates, in order to justify our approach [2].

References

[1] D. Calvetti, S. Morigi, L. Reichel, F. Sgallari, *Tikhonov regularization and the L-curve for large discrete ill-posed problems*, J. Comput. Appl. Math. 123 (2000), pp. 423–446.

[2] S. Gazzola, P. Novati, and M. R. Russo, *Embedded techniques for choosing the parameter in Tikhonov regularization*, submitted (2013).