Data based regularization for discrete ill-posed problems

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We focus on the solution of discrete ill-posed problems to recover the original information from blurred signals in the presence of Gaussian white noise more accurately. For a certain class of blur operators and signals we develop a diagonal preconditioner to improve the reconstruction quality, both for direct and iterative regularization methods. In this respect, we incorporate the variation of the signal data during the construction of the preconditioner. For general blur operators and signals we present the impact of a piecewise reconstruction using a partitioning approach to improve the quality. Embedding both methods in an outer iteration may yield further improvement of the solution. In connection with iterative regularization methods we modify the stopping criterion and investigate two approaches to estimate the optimal number of iterations. Reconstructions of discrete ill-posed model problems, arising both from realistic applications and examples generated on our own, demonstrate the effect of the presented approaches. Regarding the stopping criteria, we provide comparison to standard tools known from literature which we moderatly adjust for certain problems.