

The aim of this thesis is to study hybrid methods for solving ill-posed linear inverse problems corrupted by white noise. These approaches are based on the combination of iterative Krylov subspace methods and the Tichonov regularization with a general regularization term. We explain the basic properties of ill-posed problems, the idea of regularization, the role of the regularization term to enforce desirable properties to the solution and the theoretical background of Standard and General Tichonov minimization. Then we explain shift invariance of Krylov subspaces. This allows us to describe a hybrid approach where the full size problem is first projected onto a Krylov subspace of a smaller dimension and then the Tichonov minimization is applied to the small projected problem. We focus on the regularization based on the finite difference approximation of derivatives of the solution. The well known regularization terms constructed from forward differences for the first and the second derivative are summarized, then we use the Taylor expansion to construct finite differences of higher orders of precision. We incorporate different variants of boundary conditions. Then the impact of the order of precision of the finite difference schemes on the quality of the solution is studied. In the experiments we use the hybrid method combining the LSQR with the General Tichonov regularization.