Semi-Convergence and Relaxation Parameters for Projected SIRT Algorithms

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Large-scale problems in tomography call for the use of iterative methods, and there is an interest in regularizing iterations where the iteration vector can be considered as a regularized solution, with the iteration index playing the role of the regularizing parameter. The underlying mechanism is known as semi-convergence: initially the iteration vector approaches a regularized solution, while continuing the iteration often leads to iteration vectors corrupted by noise.

This work focuses on a class of non-stationary iteration methods, often referred to as Simultaneous Iterative Reconstruction Techniques (SIRT), with a projection step in each iteration, e.g., to ensure non-negativity or box constraints. These methods incorporate a relaxation parameter, and the convergence rate of the initial iterations depends on the choice of this parameter. In principle, one can use a fixed parameter, but usually a good value is not known a priori. An attractive alternative is to choose the relaxation parameter automatically in each iteration, in such a way that fast semi-convergence is obtained.

We study the semi-convergence for projected SIRT methods, and we use our insight to propose a new method for adaptively choosing the relaxation parameter so as to control the propagated noise component of the error. The advantage of using this strategy for noisy tomography problems is demonstrated numericxally.

This is joint work with Tommy Elfving, Linköping University and Touraj Nikazad, Iran University of Science and Technology.