

Subspace Correction Methods for a Class of Variational Problems in Image Processing

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The recovery of the original image from an observed image is an ill-posed inverse problem. In order to find a “good” approximation of the original (unknown) image we propose in this talk to minimize a functional composed of a non-smooth and non-additive regularization term and a combined L1 and L2 data-fidelity term. We show analytically and numerically that the new model has noticeable advantages over popular models in image processing tasks. For the numerical minimization of the new objective, subspace correction methods are introduced which guarantee the convergence and monotone decay of the associated energy along the iterates. Subspace correction methods are specifically important for performing medium and large-scale simulations, which usually cannot be solved in real-time by standard methods. Moreover, we derive an estimate of the distance between the outcome of the proposed subspace correction methods and the global minimizer of the non-smooth and non-additive objective.

We present numerical experiments for image denoising, inpainting, and deblurring and show with the help of the derived estimate that in practice the proposed subspace correction methods indeed converge to the global solution of the underlying minimization problem.