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Modulus-based iterative methods for constrained ℓ_p-ℓ_q minimization

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The need to solve discrete ill-posed problems arises in many areas of science and engineering. Solutions of these problems, if they exist, are very sensitive to perturbations in available data. Regularization replaces the original problem by a nearby regularized problem, whose solution is less sensitive to the error in the data. The
regularized problem contains a fidelity term and a regularization term. Recently, the use of a p-norm to measure the fidelity term and a q-norm to measure the regularization term has received considerable attention. The balance between these terms is determined by a regularization parameter. In many applications, such as in image restoration, the desired solution is known to live in a convex set, such as the nonnegative orthant. It is natural to require the computed solution of the regularized problem to satisfy the same constraint(s). This paper shows that this procedure induces a regularization method and describes a modulus-based iterative method for computing a constrained approximate solution of a smoothed version of the regularized problem. Convergence of the iterative method is shown, and numerical examples that illustrate the performance of the proposed method are presented.

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