Stochastic and accelerated primal dual fixed point methods

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Abstract: Many problems in data and imaging sciences can be formulated as composite optimization problems, for example, graph-guided Lasso, Computed Tomography (CT) reconstruction, etc. The primal dual fixed point (PDFP) method is one of the most popular algorithms for solving this class of problems. The paper is devoted to extending the PDFP from two perspectives. Firstly, to solve large-scale problems, by combining the stochastic gradient and stochastic variance reduced gradient (SVRG) with PDFP, we propose stochastic PDFP (SPDFP) and SVRG-PDFP. Secondly, to accelerate the convergence speed of solving medium-size problems, we import the inertial term into the update of PDFP and propose inertial PDFP (iPDFP). The convergence and convergence rate of the algorithms are provided under some standard assumption. The effectiveness of the algorithms is validated by several examples, such as graph-guided logistic regression, 2D and 3D CT reconstruction. Furthermore, the proposed three algorithms can be seen as generalizations of Proximal Stochastic Gradient Descent (Prox-SGD), Proximal Stochastic Variance Reduced Gradient (Prox-SVRG), and Fast Iterative Shrinkage-Thresholding Algorithm (FISTA).