A Unified Primal-Dual Algorithm Framework for Inequality Constrained Problems

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Abstract: In this talk, we discuss a unified primal-dual algorithm framework based on the augmented Lagrangian function for composite convex problems with conic inequality constraints. The new framework is highly versatile. First, it not only covers many existing algorithms such as PDHG, Chambolle–Pock (CP), GDA, OGDA and linearized ALM, but also guides us to design a new efficient algorithm called Simi-OGDA (SOGDA). Second, it enables us to study the role of the augmented penalty term in the convergence analysis. Interestingly, a properly selected penalty not only improves the numerical performance of the above methods, but also theoretically enables the convergence of algorithms like PDHG and SOGDA. Under properly designed step sizes and penalty term, our unified framework preserves the $O(1/N)$ ergodic convergence while not requiring any prior knowledge about the magnitude of the optimal Lagrangian multiplier. Linear convergence rate for affine equality constrained problem is also obtained given appropriate conditions. Finally, numerical experiments on linear programming, ℓ_1 minimization problem, and multi-block basis pursuit problem demonstrate the efficiency of our methods.