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Variance-based stochastic extragradient methods with linear search for stochastic variational inequalities

We propose stochastic extragradient methods for stochastic variational inequalities with a linear search requiring only pseudo-monotonicity of the operator and no knowledge of the Lipschitz constant L. We provide convergence and complexity analysis, allowing for an unbounded feasible set, unbounded operator, non-uniform variance of the oracle and we do not require any regularization. We also prove the generated sequence is bounded in L^p. Alongside the stochastic approximation procedure, we iteratively reduce the variance of the stochastic error. Our methods cope with stepsizes bounded away from zero and attain the near-optimal oracle complexity $O(\log_{1/\theta} L) \cdot \epsilon^{-2} \cdot [\ln(\epsilon^{-1})]^{1+b}$ and an accelerated rate $O(1/K)$ in terms of the mean (quadratic) natural residual and the mean D-gap function, where K is the number of iterations required for a given tolerance $\epsilon > 0$ for arbitrary $\theta \in (0, 1)$ and $b > 0$. Explicit estimates for the convergence rate, oracle complexity and the p-moments are given depending on problem parameters and the distance of initial iterates to the solution set.