

On adaptive stochastic heavy ball momentum for solving linear systems

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The stochastic heavy ball momentum (SHBM) method has gained considerable popularity as a scalable approach for solving large-scale optimization problems. However, one limitation of this method is its reliance on prior knowledge of certain problem parameters, such as singular values of a matrix. In this talk, we propose an adaptive variant of the SHBM method for solving stochastic problems that are reformulated from linear systems using user-defined distributions. Our adaptive SHBM (ASHBM) method utilizes iterative information to update the parameters, addressing an open problem in the literature regarding the adaptive learning of momentum parameters. We prove that our method converges linearly in expectation, with a better convergence bound compared to the basic method. Notably, we demonstrate that the deterministic version of our ASHBM algorithm can be reformulated as a variant of the conjugate gradient (CG) method, inheriting many of its appealing properties, such as finite-time convergence. Consequently, the ASHBM method can be further generalized to develop a brand-new framework of the stochastic CG (SCG) method for solving linear systems. Our theoretical results are supported by numerical experiments. This is a joint work with Prof. Deren Han, Yun Zeng, and Yansheng Su. The arXiv link: <https://arxiv.org/abs/2305.05482>.

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