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Proximal Policy Optimization with Adaptive Generalized Advantage Estimate

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Abstract

Proximal Policy Optimization (PPO) is one of the leading algorithms in reinforcement learning, designed to optimize policy updates while maintaining stability. However, in complex environments a critical trade-off between bias and variance emerges. Parameter λ in Generalized Advantage Estimate (GAE) plays a crucial role in managing this trade-off, controlling the balance between future and immediate rewards. In this paper, we propose a dynamic adjustment method for parameter λ, based on changes in value loss during training. This adaptive approach enables the model to adjust with respect to variations in the learning process and achieve a better balance between bias and variance. Besides, a policy update delay is introduced to enhance the control of updates in PPO, helping to mitigate large fluctuations in the policy and increase the algorithm's stability. Our experiments show that dynamic λ adjustment significantly improves performance, particularly in complex environments. These results suggest that adaptive λ adjustment is a flexible and effective way to enhance the performance of PPO in various reinforcement learning tasks, especially in challenging and high-dimensional environments, in our case OpenAI Gym Environment Ant-v4 and in DeepMind Control Environment quadrupped walk.

Keywords: Proximal Policy Optimization, Generalized Advantage Estimate, and Bias-Variance Trade-Off

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