Gradient Flows for Regularized Stochastic Control Problems

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Abstract

This talk is on stochastic control problems regularized by the relative entropy, where the action space is the space of measures. This setting includes relaxed control problems, problems of finding Markovian controls with the control function replaced by an idealized infinitely wide neural network and can be extended to the search for causal optimal transport maps. By exploiting the Pontryagin optimality principle, we identify suitable metric space on which we construct gradient flow for the measure-valued control process along which the cost functional is guaranteed to decrease. It is shown that under appropriate conditions, this gradient flow has an invariant measure which is the optimal control for the regularized stochastic control problem. If the problem we work with is sufficiently convex, the gradient flow converges exponentially fast. Furthermore, the optimal measure valued control admits Bayesian interpretation which means that one can incorporate prior knowledge when solving stochastic control problem. This work is motivated by a desire to extend the theoretical underpinning for the convergence of stochastic gradient type algorithms widely used in the reinforcement learning community to solve control problems.

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