Title: Decentralised Multi-Agent Natural Actor-Critic Reinforcement Learning Algorithms

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Area: POM

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Abstract:

Multi-agent actor-critic algorithms are an important part of the Reinforcement Learning (RL) paradigm. We propose three fully decentralized multi-agent natural actor-critic (MAN) algorithms in this work. The objective is to collectively find a joint policy that maximizes the average long-term return of these agents. In the absence of a central controller and to preserve privacy, agents communicate some information to their neighbors via a time varying communication network. We prove convergence of all the three MAN algorithms to a globally asymptotically stable set of the ODE corresponding to actor update; these use linear function approximations. We show that the Kullback-Leibler divergence between policies of successive iterates is proportional to the objective function's gradient. We observe that the minimum singular value of the Fisher information matrix is well within the reciprocal of the policy parameter dimension. Using this, we theoretically show that the optimal value of the deterministic variant of the MAN algorithm at each iterate dominates that of the standard gradient-based multi-agent actor-critic (MAAC) algorithm. To our knowledge, it is the first such result in multi-agent reinforcement learning (MARL). To illustrate the usefulness of our proposed algorithms, we implement them on a bilane traffic network to reduce the average network congestion. We observe an almost 25% reduction in the average congestion in 2 MAN algorithms; the average congestion in another MAN algorithm is on par with the MAAC algorithm.

Speaker Profile:

N. Hemachandra is a Professor at Industrial Engineering and Operations Research, IIT Bombay. His academic interests include Operations Research and Machine Learning, including RL and Bandit problems and their applications to problems arising from Supply chains, Communication Networks, Logistics and Financial Engineering. He is currently on a Sabbatical leave with IIM Bangalore

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