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Distributed time-varying optimization in multi-agent systems: algorithms and experiments

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ABSTRACT: This talk focuses on the distributed time-varying optimization algorithms for continuous-time multi-agent systems. The objective is for multiple agents to cooperatively optimize a team time-varying objective function formed by a sum of local objective functions with only local interaction and information while ex-plicitly taking into account unbalanced communication topologies, more general objective functions, and time-varying constraints. Different from most studied distributed optimization problems with time-invariant objective functions and constraints, the optimal solutions here are time varying and form a trajectory. First, in order to design methodology under possibly weight-unbalanced directed networks, we propose a distributed algorithm based on a chain of two integrators which are coupled with a distributed estimator. Second, a distributed nonsmooth algorithm coupled with a state-dependent gain is proposed. The algorithm can solve the time-varying optimization problem without imposing a bound on any information about the local objective functions. Therefore, it is applicable to more general objective functions. Third, for the case where there exist time-varying nonlinear inequality constraints, we present a distributed control algorithm that consists of a sliding-mode consensus part and a Hessian-based optimization part coupled with the log-barrier penalty functions. The algorithm can guarantee the asymptotical tracking of the optimal solution with a zero tracking error. Moreover, we extend the previous result to the case where there exist not only time-varying nonlinear inequality constraints but also linear equality constraints. An extended algorithm is presented, where quadratic penalty functions are introduced to account for the equality constraints and an adaptive control gain is designed to remove the restriction on knowing the upper bounds on certain information. Numerical simulations are presented to illustrate the theoretical results. In addition, two proposed algorithms are experimentally implemented and validated on a multi-Crazyie platform.

BIOGRAPHY: Shan Sun is currently working towards the Ph.D. degree in Electrical and Computer Engineering at University of California, Riverside, CA, USA. She received the B.S. and the M.Sc. degrees in School of Astronautics from Beihang University, Beijing, China, in 2014 and 2017, respectively. Her research focuses on distributed optimization, multi-agent system and reinforcement learning.

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