

Title: Synthesizing Distributed Algorithms for Combinatorial Network Optimization

Abstract: Many important network design problems are fundamentally combinatorial optimization problems. A large number of such problems, however, cannot readily be tackled by distributed algorithms. We develop a Markov approximation technique for synthesizing distributed algorithms for network combinatorial problems with near-optimal performance. We show that when using the log-sum-exp function to approximate the optimal value of any combinatorial problem, we end up with a solution that can be interpreted as the stationary probability distribution of a class of time-reversible Markov chains. Selected Markov chains among this class, or their carefully-perturbed versions, yield distributed algorithms that solve the log-sum-exp approximated problem. The Markov Approximation technique allows one to leverage the rich theories of Markov chains to design distributed schemes with performance guarantees. It not only can provide fresh perspective to existing distributed solutions, but also can help us generate new distributed algorithms in other problem domains with provable performance, including cloud computing, edge computing, and IoT scheduling.

Biography: Minghua received his B.Eng. and M.S. degrees from the Department of Electronic Engineering at Tsinghua University. He received his Ph.D. degree from the Department of Electrical Engineering and Computer Sciences at University of California Berkeley. He is now a Professor at School of Data Science, City University of Hong Kong. Minghua received the Eli Jury award from UC Berkeley in 2007 (presented to a graduate student or recent alumnus for outstanding achievement in the area of Systems, Communications, Control, or Signal Processing) and The Chinese University of Hong Kong Young Researcher Award in 2013. He also received several best paper awards, including IEEE ICME Best Paper Award in 2009, IEEE Transactions on Multimedia Prize Paper Award in 2009, ACM Multimedia Best Paper Award in 2012, and IEEE INFOCOM Best Poster Award in 2021. He serves as Associate Editor of IEEE/ACM Transactions on Networking in 2014 - 2018. He is currently a Senior Editor for IEEE Systems Journal (2021- present), an Area Editor of ACM SIGEnergy Energy Informatics Review (2021 - present), and an Award Chair and Executive Committee member of ACM SIGEnergy (2018 - present). Minghua's recent research interests include online optimization and algorithms, machine learning in power system operation, intelligent transportation systems, distributed optimization, delay-constrained network coding, and capitalizing the benefit of data-driven prediction in algorithm/system design. He is an ACM Distinguished Scientist and an IEEE Fellow.