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Distributed Optimization and Learning: Balancing Communication Overhead, Computational Complexity, and Convergence Rate

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Abstract

Nowadays, with the emergence of large-scale machine learning models such as deep neural networks, centralized deployment of optimization algorithms has become intractable in its memory and time requirements. As such, and accelerated with the recent advances in multi-core parallel processing technology, distributed optimization algorithms has become a trend, which train machine learning models on multiple computation nodes in parallel, to enhance the scalability of the training procedure. However, three major factors, namely, communication overhead, computational load, and convergence rate, can be identified as the primary obstacles towards scaling distributed optimization algorithms, which are in conflict with each other and have not been addressed carefully in the literature yet.

In this talk, we propose a distributed optimization method that strikes a great balance between communication efficiency, computation efficiency and accuracy. We show that the proposed method benefits from low communication overhead and computational complexity, and yet fast convergence. More precisely and through extensive analyses, we prove that for a general class of non-convex stochastic optimization problems, the proposed method guarantees the same orders of communication load and convergence rate as in the state-of-the-art communication-efficient methods, while having order-wisely less computational complexity. Furthermore, it benefits from order-wisely faster convergence than the state-of-the-art low computational complexity methods. Finally, we utilize the proposed method in different learning applications to justify our theoretical analyses and empirically demonstrate the accuracy and convergence properties of the proposed method compared to various baselines.

Biography

Naeimeh Omidvar is a Postdoctoral Researcher at the School of Computer Science, Institute for Research in Fundamental Sciences (IPM). She received the Ph.D. degree in Electronic and Computer Engineering from The Hong Kong University of Science and Technology, and the Ph.D., M.Sc. and B.Sc. degrees from Sharif University of Technology. Before joining IPM, she was with Sharif University of Technology as a Postdoctoral Fellow. Her research interests include theoretical computer science, stochastic optimization, distributed machine learning, next generation data networks, and IoT.

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