EE DEPARTMENT

PhD Thesis Presentation

Convergence Rate Analysis and Optimization of Distributed Consensus Algorithms

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Abstract:

The problem of achieving a common value in a distributed information sharing context, referred to as distributed consensus or agreement, is an important topic that has drawn significant research attention of late. Consensus algorithms find applications in many areas including network clock synchronization, sensor fusion and load balancing where achieving consensus as fast as possible is important. In this dissertation, we study the analysis and optimization of convergence rate of averaging based distributed consensus algorithms evolving on graphs. By relating the convergence speed of the algorithm to the mixing rate of a Markov chain, we propose two semi–definite programming (SDP) methods of assigning transition probabilities to a Markov chain in order to optimize its mixing rate. In the first SDP formulation, there is a single transition probability parameter to be optimized (the holding probability of vertices) which leads to easier and faster computation as opposed to the more general reversible Markov chain formulation corresponding to a stationary distribution that is proportional to the degree of vertices. By deriving exact analytical results, it is shown that both the single parameter and the degree proportional reversible fastest mixing Markov chain formulations yield better results than the symmetric SDP formulation for a path and some well–known edge-transitive and orbit graphs. The convergence rate of the averaging based distributed consensus algorithm is also analyzed for networks where delay exists in data receptions, which is unavoidable in practice. After introducing the delayed version of the consensus algorithm, it is analytically shown that bounded non–uniform delay does not adversely affect its convergence rate for directed acyclic graphs.