Systems and Control Seminar
Fujita Laboratory
Tokyo Institute of Technology

Average Consensus over Strongly Connected Digraphs

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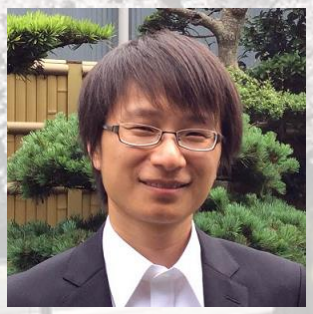

Abstract

This talk is about average consensus in multi-agent networks: namely individual agents reach agreement on the average value of their initial states, through only local communications with neighbors. The communication topology is represented by a directed graph (or digraph), where information flow is generally unidirectional. It is well known that average consensus is achieved by the standard consensus algorithm given that the communication digraph is strongly connected and balanced. The question of special interest is: Can average consensus be achieved given any strongly connected digraph, including those not balanced? And if so, how to design a solution algorithm?

This talk gives an affirmative answer to the above question, and supply solution algorithms. The key idea is to augment "surplus" variables, one for each agent, that locally keep track of individual state changes. In effect, the overall state sum shift, due to unbalanced topology, is recorded collectively by these surplus variables. Each agent then uses its surplus in its own state update, as well as communicates surplus to its neighbors: This results in a distributed algorithm, called "surplus-based" algorithm. Variations of the surplus-based algorithm will be introduced effective for a set of different scenarios: static digraphs, time-varying digraphs, random networks, and asynchronous communications. In each case, it is proved that the surplus-based algorithm achieves average consensus over arbitrary strongly connected digraphs.