Resource-Constrained Multi-Agent Control Systems: Dynamic Event-triggering, Input Saturation, and Connectivity Preservation

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Abstract

978-91-7729-579-2A multi-agent system consists of multiple agents cooperating to achieve a common objective through local interactions. An important problem is how to reduce the amount of information exchanged, since agents in practice only have limited energy and communication resources. In this thesis, we propose dynamic event-triggered control strategies to solve consensus and formation problems for multi-agent systems under such resource constraints.

In the first part, we propose dynamic event-triggered control strategies to solve the average consensus problem for first-order continuous-time multi-agent systems. It is proven that the state of each agent converges exponentially to the average of all agents' initial states under the proposed triggering laws if and only if the underlying undirected graph is connected. In the second part, we study the consensus problem with input saturation over directed graphs. It is shown that the underlying directed graph having a directed spanning tree is a necessary and sufficient condition for achieving consensus. Moreover, in order to reduce the overall need of communication and system updates, we propose an event-triggered control strategy to solve this problem. It is shown that consensus is achieved, again, if and only if the underlying directed graph has a directed spanning tree. In the third part, dynamic event-triggered formation control with connectivity preservation is investigated. Single and double integrator dynamics are considered. All agents are shown to converge to the formation exponentially with connectivity preservation. The effectiveness of the theoretical results in the thesis is verified by several numerical examples.

Key Words
Consensus; Connectivity; Dynamic event-triggered control; Formation control; Input saturation; Multi-agent systems; Self-triggered control