Announcing the Final Examination of Wei Lin for the degree of Doctor of Philosophy

Title: Differential Games for Multi-Agent Systems under Distributed Information

In this dissertation, we consider differential games for multi-agent systems under distributed information where every agent is only able to acquire information about the others according to a directed information graph of local communication/sensor networks. Such games arise naturally from many applications including mobile robot coordination, power system optimization, multi-player pursuit-evasion games, etc. Since the admissible strategy of each agent has to conform to the information graph constraint, the conventional game strategy design approaches based upon Riccati equation(s) are not applicable because all the agents are required to have the information of the entire system. Accordingly, the distributed game strategy design problem is commonly known to be challenging. Toward this end, we propose novel open-loop and feedback game strategy design approaches for Nash equilibrium and noninferior solutions with a focus on linear quadratic differential games. For the open-loop design, epsilon-Nash game strategies are proposed by integrating distributed state estimation into the open-loop global-information Nash/noninferior strategies such that, without global information, performance of the distributed game strategies can be made arbitrarily close to and asymptotically converge over time to that under the global-information Nash/noninferior strategies. For the feedback design, we propose the best achievable performance indices based approach under which the distributed strategies form a Nash equilibrium or noninferior solution with respect to a set of performance indices that are the closest to the original indices. This approach overcomes two issues in the classical optimal output feedback approach: the simultaneous optimization and initial state dependence. The proposed design approaches are applied to an unmanned aerial vehicle formation control problem and a multi-pursuer single-evader differential game problem with limited observations. Simulation results of several scenarios are presented to illustrate the proposed approaches.

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Approved for distribution by Zhihua Qu, Committee Chair, on September 30, 2013.

The public is welcome to attend.