Advances in Linear-Quadratic Stochastic Differential Games

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Abstract:

Since the seminal paper of Fleming and Souganidis, stochastic differential games have been playing a central role in mathematical control theory, as they can be applied to model the general decision-making process between interacting players under stochastic uncertainties. Two different types of stochastic differential games can be formulated depending on the role of the interacting players. Specifically, when the interaction of the players can be described in a symmetric way, it is called the Nash differential game. On the other hand, the Stackelberg differential game can be used to formulate the nonsymmetric leader-follower hierarchical decision-making process between the players.

This talk consists of two parts, studying various recent results on LQ stochastic Nash and Stackelberg differential games. In the first part, the rigorous mathematical formulation on LQ stochastic Nash and Stackelberg differential games will be covered within various different frameworks, including systems with random-coefficients, games of mean-field type, Markov-jump systems, and systems with delay, where we will also provide several different notions of Nash and Stackelberg equilibria depending on the underlying information structures. In the second part, we will address the detailed mathematical approaches to and analyses of the LQ stochastic differential games formulated in the first part, and present their explicit Nash/Stackelberg equilibrium solutions expressed by Riccati differential equations. Some examples including numerical solvability of the corresponding Riccati differential equations will also be discussed to illustrate the theoretical results of this talk.