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Interacting intelligent computers in a complex cyber-physical system

We focus on the decision-making aspect of artificial intelligence in cyber-physical systems. According to NSF, cyber-physical systems are engineered systems that are built from and depend upon, the seamless integration of computational algorithms and physical components. Generally, there are multiple decision-making entities (multi-agents) in such systems. We highlight the presence of multi-agents with different objectives by defining these as complex cyber-physical systems (CCPS). Multi-agents are implemented as intelligent computers. There is relatively less attention on multiple decision-making entities in the cyber-physical systems and in the artificial intelligence literatures. In this presentation we attempt to stimulate the artificial intelligence community to broaden the scope of their research to include work on CCPS. Much of the underlying basis of CCPS is nonzero-sum dynamic game theory. With very few exceptions, the theory involves simplifying assumptions that result in problems that are mathematically tractable. In the first part of the presentation, we provide an overview of these results. In the second part of the presentation we explore trends on how some of the simplifications might be relaxed to increase the scope of applications. One simplifying assumption is that the CCPS has a single mathematical model that is known to all decision-making entities. In realistic applications, each decision-making entity constructs its own mathematical model, known only to itself, of the same CCPS. Another simplifying assumption is that each decision-making entity knows the objective function of each decision-making entity. We consider a parameterization concept to relax these assumptions. We illustrate parameterization in an electric power network.

Biography

Jose B Cruz is an Academician, National Academy of Science and Technology, Philippines and a Member of the US National Academy of Engineering. He is also a Fellow of the International Federation on Automatic Control and Fellow of IEEE. He has received the Richard E. Bellman Control Heritage Award, AACC and the IEEE James H Mulligan and Jr Education Medal. He has worked as an Associate Head of ECE, University of Illinois, Urbana-Champaign, Chair of ECE, University of California, Irvine and Dean of Engineering, the Ohio State University.

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