Keynote Speaker

John S. Baras

University of Maryland College Park

Biography

John S. Baras received the B.S. in Electrical Eng. from the Nat. Techn. Univ. of Athens, Greece, in 1970, and the M.S. and Ph.D. in Applied Math. from Harvard Univ. in 1971 and 1973.
Professor Baras was the founding Director of the Institute for Systems Research (one of the first six NSF Engineering Research Centers) from 1985 to 1991. Since August 1973 he has been with the Electrical and Computer Engineering Department, and the Applied Mathematics Faculty, at the University of Maryland, College Park, where he is currently a Professor holding a permanent joint appointment with the ISR. In February 1990 he was appointed to the Lockheed Martin Chair in Systems Engineering. Since 1991 Dr. Baras has been the Director of the Maryland Center for Hybrid Networks (HYNET) (a NASA Research Partnership Center).
Among his awards are: the 1980 Outstanding Paper Award of the IEEE Control Systems Society; 1978, 1983 and 1993 Alan Berman Research Publication Awards from NRL; 1991 , 1994, Outstanding Invention of the Year Awards from the University of Maryland; 1998, the Mancur Olson Research Achievement Award, from the Univ. of Maryland College Park (award recognizes faculty whose research achievements have been extraordinary); 2002, Best paper Award at the 23rd Army Science Conference, Orlando, Florida; Best paper Award 2004 Wireless Security conference.
Dr. Baras is a Fellow of the IEEE. He was elected a Foreign Member of the Royal Swedish Academy of Engineering Sciences in 2006. Professor Baras' research interests include control, communication and computing systems.
Professor Baras was the initial principal architect of the ISR M.S. program in Systems Engineering. More recently Dr. Baras has been heavily involved in the development of new core courses for systems engineering. His efforts address the often emphasized need for a new integrative approach to engineering (holistic rather than in parts) which in turn addresses the needs for modular design, systems thinking and team work

Abstract

Robust Feedback Control vs Uncertainty Model Complexity: from Information Theory to Networked Control

We develop a framework for designing controllers for general, partially observed nonlinear systems which are robust with respect to uncertainties. Most significantly we include both parametric as well as structural model uncertainties. A general deterministic model for uncertainties is introduced, leading to a dynamic game formulation of the robust control problem. This problem is solved using an appropriate information state. We then develop a stochastic framework for decision making under such uncertainties, by employing maximum entropy stochastic models for the nonlinear system. This leads naturally to a risk-sensitive stochastic control problem, which we formulate and solve. The most

significant contribution of the paper is the subsequent linkage of the two approaches to designing controllers under model uncertainty via the Lagrange multipliers involved in the maximum entropy model construction. On the one hand they provide for the first time a rigorous justification for the 'randomization' involved. On the other hand, and again for the first time, they provide sensitivities of controller performance vs modeling uncertainty bounds (or the cost of uncertainty) - that is what is the relative value of a model for a particular control objective. This relationship is further established via duality theory. The result is a unified treatment of system performance robustness against uncertainty models of various complexities. We show how this framework captures several essential results from classical information theory, to modern robust control. We then proceed to develop a similar framework in the multi-agent case, which leads us to a new framework for understanding the fundamental tradeoffs in any networked system - between the benefits from collaboration vs the cost for collaboration. These constrained coalitional games are shown to capture the essentials in network design, network optimization and network control. They also capture the fundamentals of network formation in many areas including economics, sociology, biology and engineering. We describe how network architecture and connectivity pattern can emerge as a result from this framework - in particular we explain small world architectures from this perspective. We close with a result on networked control systems, which attempts to quantify the duality between information pattern and multi-agent control performance.