# FLORIDA ATLANTIC UNIVERSITY

## The Institute for Sensing and Embedded Network Systems Engineering

### Proudly Presents

## Autonomous Control of Multi-agent Cyber-Physical Systems Using Reinforcement Learning

A common feature of multi-agent cyber-physical systems is the presence of significant uncertain dynamics and uncertain signals (i.e., disturbances and cyber-physical attacks). This talk will discuss some adaptive control structures for learning online the solutions to optimal synchronization problem of multi-agent cyber-physical systems in the presence of uncertain dynamics and cyber-physical attacks. Techniques from reinforcement learning will be used to design a family of adaptive controllers based on actor-critic mechanisms that solves in real time the synchronization and consensus problem for multi-agent systems with uncertain dynamics and disturbances. The talk will start with the design of adaptive optimal controllers for single-agent continues-time (CT) systems. Using integral reinforcement learning and off-policy reinforcement learning, new methods will be developed that do not require any knowledge of the system dynamics to find the solution for the optimal tracking problem. In the linear quadratic case, the new reinforcement learning adaptive control algorithms learn the solution to the Riccati equation by adaptation along the system motion trajectories. Off-policy reinforcement learning algorithms will be presented for solving online the zero-sum games for optimal tracking of CT systems in the presence of disturbances. Extension to control of multi-agent cyber-physical system will be considered next. New distributed control protocols will be discussed that are resilient to attacks on sensors and actuators and prevent corrupted data from propagating across the network.

## Speaker

Hamidreza Modares received the B.Sc. degree from Tehran University, Iran, and the M.Sc. degree from Shahrood University of Technology, Iran. Between 2006 and 2009, he was with the Shahrood University of Technology as a senior lecturer. From 2012 to 2016, he was a researcher/teaching assistant at the University of Texas at Arlington Research Institute. He is currently an Assistant Professor with the Missouri University of Science and Technology. His work on the design of optimal controllers using reinforcement learning resulted in several journal and conference papers. His main research interests include cyber-physical systems, machine learning, distributed control, robotics, and renewable energy microgrids. He is an Associate Editor for IEEE Transactions on Neural Networks and Learning Systems. He has received best paper award from 2015 IEEE International Symposium on Resilient Control Systems, Stelmakh outstanding student research award from department of electrical engineering, UTA, 2015, and Summer Dissertation Fellowship, UTA, 2015.


**Hamidreza Modares, Ph.D.**

***Assistant Professor***

***Missouri University of Science and Technology***

***Electrical & Computer Engineering***


**May 18th, 2017**

**11:00 a.m. – 12:00 p.m.**

FAU Engineering East

777 Glades Rd, EE 303

Boca Raton, FL


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