学术报告会

报告题目：Data-driven Control and Optimization for Industrial Processes: Reinforcement Learning and Supervisory Control

报告人：Prof. F. L. Lewis (University of Texas at Arlington, USA)

时间：2016 年 8 月 5 日（周五） 10：00

地点： 电信学院 2-410

邀请： 李柠 杨博

Prof. F. L. Lewis

National Academy of Inventors

Fellow IEEE, Fellow IFAC, Professional Engineer Texas USA

Moncrief-O'Donnell Endowed Chair, Head, Advanced Controls & Sensors Group

UTA Research Institute (UTARI), University of Texas at Arlington, USA

Abstract:

This talk will present methods for data-driven control (DDC) and data-driven optimization (DDO) using data measured from industrial processes online in real time. Modern industrial processes are complex and new imperatives in sustainable manufacturing and energy efficient systems require improved decision and control methods. More emphasis is being placed on optimal design of automatic decision and control systems, including minimum fuel, minimum energy, minimum time, minimum pollutant concentration, and others. Operational control loops are responsible for stable plant operation, and they must ensure following of setpoints from higher-level supervisory loops that include optimization-based design criteria. Optimal feedback control design has been responsible for much of the successful performance of engineered systems in aerospace, manufacturing, industrial processes, vehicles, ships, robotics, and elsewhere since the 1960s. Optimal feedback control design is performed offline by solving optimal design equations including the algebraic Riccati equation. It is difficult to perform optimal designs for nonlinear process systems since they rely on solutions to complicated Hamilton-Jacobi-Bellman equations. Finally, optimal design generally requires that the full system dynamics be known, which is seldom the case in manufacturing systems. Dynamics modeling identification of systems is complicated, expensive, and inaccurate. Moreover, practical manufacturing systems may have no tractable closed-form system model. Nevertheless, the availability of large amounts of measured data in today's industry has the potential to allow good process controller design with optimization of performance if data are properly and efficiently used. This talk will present methods for online DDC and DDO for processes with unknown dynamical models using process data measured online. We will present several methods for efficient online tuning of process controllers based on measurements of real-time data for unmodeled or partially modeled processes. Techniques from Reinforcement Learning are used to design a novel class of adaptive control algorithms that converge to optimal control solutions by online learning in real time. The result is a two-loop supervisory control scheme, with inner control loops that guarantee operational plant control stability, and outer loops that provide controller tuning on a longer time horizon for optimal performance. Comparisons with other supervisory process control methods are given. Auto-tuning is a method of tuning PD and PID control parameters online using process input test signals. Run-to-Run Iterative Learning Control improves the controller design at each iteration of a process run by measuring errors incurred during the previous run.