Title: Learning-based Control: A Theory based on Robust Adaptive Dynamic Programming

Abstract: This talk considers learning-based control design for continuous-time linear and nonlinear systems with unknown dynamics. It introduces a new design paradigm, called “Robust Adaptive Dynamic Programming (RADP)”, that is fundamentally different from traditional control theory. In the classical paradigm, controllers are often designed for a given class of dynamical control systems; it is a model-based design. In the RADP paradigm, controllers are learned online using real-time input-output data collected along the trajectories of the control system in question. An entanglement of techniques from reinforcement learning and model-based control theory is advocated to find a sequence of suboptimal controllers that will approximate the optimal solution as learning steps increase. On the one hand, this RADP paradigm overcomes the well-known “curse of dimensionality” and the “curse of modeling” associated with Bellman's Dynamic Programming. On the other hand, rigorous stability and robustness analysis can be derived for the closed-loop system with real-time learning-based controllers. The effectiveness of RADP as a new framework for data-driven nonlinear control design is demonstrated via its applications to power systems, autonomous vehicles, and biological motor control.

Biography: Zhong-Ping JIANG received the B.Sc. degree in mathematics from the University of Wuhan, Wuhan, China, in 1988, the M.Sc. degree in statistics from the University of Paris XI, France, in 1989, and the Ph.D. degree in automatic control and mathematics from the Ecole des Mines de Paris (now, called Paris Tech-Mines), France, in 1993, under the direction of Prof. Laurent Praly.

Currently, he is a Professor of Electrical and Computer Engineering at the Tandon School of Engineering, New York University. His main research interests include stability theory, robust/adaptive/distributed nonlinear control, adaptive dynamic programming and their applications to information, mechanical and biological systems. He is coauthor of four books Stability and Stabilization of Nonlinear Systems (with Dr. I. Karafyllis, Springer, 2011), Nonlinear Control of Dynamic Networks (with Drs. T. Liu

and D.J. Hill, Taylor & Francis, 2014), Robust Adaptive Dynamic Programming (with Y. Jiang, Wiley-IEEE Press, 2017) and Nonlinear Control Under Information Constraints (with T. Liu, Science Press, 2018). He also is the (co)author of 15 book chapters, over 200 published/accepted journal papers, and numerous conference papers. His work has received 19,800 citations with an h-index of 73, by Google Scholar.

Dr. Jiang is a Deputy Editor-in-Chief of the Journal of Control and Decision and of the IEEE/CAA Journal of Automatica Sinica, a Senior Editor for the IEEE Control Systems Letters, an Editor for the International Journal of Robust and Nonlinear Control and has served as an Associate Editor for several journals including Mathematics of Control, Signals and Systems (MCSS), Systems & Control Letters, IEEE Transactions on Automatic Control, European Journal of Control, and Science China: Information Sciences. Dr. Jiang is a recipient of the prestigious Queen Elizabeth II Fellowship Award from the Australian Research Council (1998), the CAREER Award from the U.S. National Science Foundation (2001), JSPS Invitation Fellowship from the Japan Society for the Promotion of Science (2005), the Distinguished Overseas Chinese Scholar Award from the NSF of China (2007), and the Chair Professorship by the Ministry of Education of China (2009). His recent awards include the Steve and Rosalind Hsia Best Biomedical Paper Award at the 2016 World Congress on Intelligent Control and Automation in Guilin, China, the Best Paper Award at the 2017 Asian Control Conference, Gold Coast, Australia, and the Best Paper Award on Control at the 2018 IEEE Conf. on Real-Time Computing and Robotics, Maldives.

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