COLLEGE OF ENGINEERING

Control Seminar

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Learning and Control of Linear Dynamical Systems in High-Dimensional Settings

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Event will take place via Zoom

ABSTRACT: Most of today's real-world systems are characterized by being large-scale, complex, and safety-critical. For instance, the nation-wide power grid consists of millions of active devices that interact according to uncertain dynamics. A common feature of these systems is that they are comprised of a hierarchy of interconnected subsystems with complex and uncertain dynamics, strongly motivating the use of data-driven approaches in their operation. However, most of the contemporary data-driven control techniques for dynamical systems are focused on either the richness of their learned models using machine learning tools (culminating in reinforcement learning), or the guaranteed robustness of the control schemes (e.g., the classical H-infinity control methods), with one coming at the expense of the other. The ultimate goal of this presentation is to bring the best of both worlds into practice for the control of large-scale, distributed, and safety-critical systems.

First, we will present a class of structure-aware inference methods for learning accurate models of linear dynamical dynamics, while avoiding "long interactions" with the system to ensure its safety. In particular, we will explain how to systematically exploit side information from the unknown system—such as sparsity, locality, and stability—to provide certifiable estimates of the system model in the high-dimensional settings, where the system dimension is significantly larger than the number of available input-output samples. Once a reliable model of the system is learned, our second goal is to design a robust and distributed controller for the unknown system, while taking into account the uncertainties of the learned model. Although the literature on the centralized control of unknown systems is vast and mature, there is paucity of research in the learning-based control of interconnected systems with unknown dynamics that are subject to more sophisticated structural constraints.

BIO: Salar Fattahi is an Assistant Professor in the Department of Industrial and Operations Engineering at the University of Michigan. He received his M.S. and Ph.D. degrees in Industrial Engineering and Operations Research from UC Berkeley. He received a M.S. degree from Columbia University, and a B.S. degree from Sharif University of Technology, Iran, both in Electrical Engineering. Salar's research lies at the intersection of optimization, statistics, and control. He was the recipient of several awards, including 2020 INFORMS ENRE Best Student Paper Award (as a co-author), 2020 Power & Energy Society General Meeting Best-of-the-Best Paper Award, and 2018 INFORMS Data Mining Best Paper Award. He was also a finalist for the *2018 American Control Conference* Best Paper Award.

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