USC Viterbi School of Engineering
Ming Hsieh Department of Electrical and Computer Engineering

Ming Hsieh Institute **Seminar Series**

Center for Systems and Control – CommNetS

Data-Driven Approaches for Estimating Reachable Sets in Complex Dynamical Systems

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Abstract: The computation of reachable sets is essential for characterizing and verifying the behavior of safety-critical systems. However, many practical systems are high-dimensional and analytically intractable, making the exact computation of reachable sets difficult or impossible. We propose a data-driven approach that uses a finite ensemble of sample trajectories to estimate reachable sets with probabilistic accuracy guarantees. This method is broadly applicable and computationally advantageous, as the main cost comes from simulating a predetermined number of trajectories, which can be parallelized to reduce computation time. We first present a method that uses scenario optimization to construct reachable set estimates as approximate solutions to chance-constrained optimization problems. Next, we use a class of polynomials derived from empirical moment matrices, whose sublevel sets act as nonconvex estimates of the reachable set. These data-driven methods offer scalable solutions for estimating reachable sets in systems with complex dynamics.

Bio: **Murat Arcak** is a professor at the University of California, Berkeley, where he holds the Robert M. Saunders Endowed Chair. He has a primary appointment in Electrical Engineering and Computer Sciences, and a courtesy appointment in Mechanical Engineering. He earned his B.S. degree in Electrical Engineering from Boğaziçi University, Istanbul, Turkey, in 1996, and his M.S. and Ph.D. degrees from the University of California, Santa Barbara, in 1997 and 2000. His research focuses on dynamical systems and control theory, with applications in multi-agent systems and transportation. He received a CAREER Award from the National Science Foundation in 2003, the Donald P. Eckman Award from the American Automatic Control Council in 2006, the Control and Systems Theory Prize from the Society for Industrial and Applied Mathematics (SIAM) in 2007, and the Antonio Ruberti Young Researcher Prize from the IEEE Control Systems Society in 2014. He is a member of ACM and SIAM, and a fellow of both IEEE and the International Federation of Automatic Control (IFAC)

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