Modeling, Control and Estimation of Traffic Road Networks

Abstract: This talk discusses some of our recent advancements in management and estimation of traffic road networks. Traffic congestion is a major source of world-wide inefficiency. In the first part of the talk I will describe a set of modeling, analysis and simulation tools for traffic operations planning to provide quick and quantitative assessments of the benefits that transportation management center control policies can provide on freeway corridors. In addition to describing some basic controllability and observability properties of traffic dynamics, I will first present ramp metering and variable speed advisory techniques to ameliorate freeway congestion, followed by a framework for freeway ramp metering, using both a Model Predictive Control (PMPC) framework and a framework that maximizes the aggregate utility of onramp flows. In the second part of the talk, I will present recent results on the analysis of traffic networks with mixed autonomous and non-autonomous vehicles. Autonomous and connected vehicles can potentially travel using shorter headways via platooning and therefore their deployment can potentially increase flow capacity in the roadways. I will present the conditions under which the replacement of regular vehicles by smart vehicles is guaranteed to improve network mobility. However, when these conditions do not hold, counterintuitive behavior might occur such that increasing the proportion of autonomous vehicles in a network leads to decreases in overall network throughput.

Biography: Roberto Horowitz is a Professor in the Department of Mechanical Engineering at UC Berkeley and holds the James Fife Endowed Chair in the College of Engineering. He received a B.S. degree with highest honors in 1978 and a Ph.D. degree in 1983 in mechanical engineering from the University of California at Berkeley and became a faculty member of the Mechanical Engineering Department in 1982. Dr. Horowitz teaches and conducts research in the areas of adaptive, learning, nonlinear and optimal control, with applications to Micro-Electromechanical Systems (MEMS), computer disk file systems, robotics, mechatronics and Intelligent Vehicle and Highway Systems (IVHS). He is currently the Chair of the Department of Mechanical Engineering Department and a former co-director of the Partners for Advanced Transportation Technology (PATH) research center at U.C. Berkeley. Dr. Horowitz is a member of IEEE and ASME. He is the recipient of the 2010 ASME Dynamic Systems and Control Division (DSCD) Henry M. Paynter Outstanding Investigator Award and the SME 2018 Rufus Oldenburger Medal in recognition of his pioneering and impactful contributions to control applications in mechatronics, magnetic data storage and traffic systems.