

Traffic Flow Control: Calming “Stop-and-Go” in Congested Traffic

Thursday, April 12th, 11:00 am
EQUAD Rm J223



Miroslav Krstic
University of California, San Diego

“Stop-and-go” traffic oscillations are akin to thermoacoustic instabilities in combustion and laser chambers, as well as to slugging flows in oil production risers. The models of all these problems are quite similar - coupled nonlinear hyperbolic PDEs for density and velocity. The key difference is that the Aw-Rascle-Zhang model of traffic includes elements of human behavior (“forward-oriented” attention, collision avoidance, etc.). Actuation by ramp metering (the durations of red and green lights) propagates, through human action, upstream, i.e., against the direction of the cars’ motion. This makes it possible to calm stop-and-go at large distances from the ramp. I will show how PDE backstepping controllers, which have been implemented in oil drilling and production applications, can also stabilize stop-and-go, even in the absence of distributed measurements of vehicle speed and density, and when driver reaction times are unknown.

At UC San Diego, Miroslav Krstic is Distinguished Professor of MAE, holds the Alspach chair, founded the Center for Control Systems and Dynamics, and serves as Senior Associate Vice Chancellor for Research. He earned his PhD and the campuswide Lancaster dissertation prize at UC Santa Barbara in 1995. Krstic is Fellow of seven scientific societies - IEEE, IFAC, ASME, SIAM, AAAS, IET (UK), AIAA - and foreign member of the Academy of Engineering of Serbia. He has received the ASME Oldenburger Medal, Nyquist Lecture Prize, Paynter Outstanding Investigator Award, Ragazzini Education Award, Chestnut textbook prize, the PECASE, NSF Career, and ONR Young Investigator awards. Krstic has been awarded several best paper awards (Axelby, Schuck, CDC, ACC) and the first UCSD Research Award given to an engineer. He has also been Springer Professor at UC Berkeley, Distinguished Visiting Fellow of the Royal Academy of Engineering, and Invitation Fellow of the Japan Society for the Promotion of Science. Krstic works on adaptive, nonlinear, and stochastic control, extremum seeking, control of PDE systems including turbulent flows, and control of delay systems. He has coauthored thirteen books and over 300 journal papers.