

Mechanical & Aerospace Engineering

seminar

Traffic Congestion Control:
A PDE Backstepping Perspective

February 23rd 10:45 AM Schwada Classroom and Office Building (SCOB) Room 150

abstract

Control of freeway traffic using ramp metering is a "boundary control" problem when modeling is approached using widely adopted coupled hyperbolic PDE models of the Aw-Rascle-Zhang type, which include the velocity and density states, and which incorporate a model of driver reaction time. Unlike the "free traffic" regime, in which ramp metering can affect only the dynamics downstream of the ramp, in the "congested traffic" regime ramp metering can be used to suppress stop-and-go oscillations both downstream and upstream of the ramp – though not both simultaneously. Controlling the traffic upstream of a ramp is harder – and more interesting – because, unlike in free traffic, the control input doesn't propagate at the speed of the vehicles but at a slower speed, which depends on a weighted difference between the vehicle speed and the traffic density. I will show how PDE backstepping controllers, which have been effective recently in oil drilling and production applications (similarly modeled by coupled hyperbolic PDEs), can help stabilize traffic, even in the absence of distributed measurements of vehicle speed and density, and when driver reaction times are unknown.

biosketch

Miroslav Krstic is Distinguished Professor of Mechanical and Aerospace Engineering, holds the Alspach endowed chair, and is the founding director of the Cymer Center for Control Systems

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biosketch (cont'd) and Dynamics at UC San Diego. He also serves as Associate Vice Chancellor for Research at UCSD. As a graduate student, Krstic won the UC Santa Barbara best dissertation award and student best paper awards at CDC and ACC. Krstic has been elected Fellow of seven scientific societies - IEEE, IFAC, ASME, SIAM, AAAS, IET (UK), and AIAA (Assoc. Fellow) - and as a 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, the Axelby and Schuck paper prizes, and the first UCSD Research Award given to an engineer. Krstic has also been awarded the Springer Visiting Professorship at UC Berkeley, the Distinguished Visiting Fellowship of the Royal Academy of Engineering, the Invitation Fellowship of the Japan Society for the Promotion of Science, and honorary professorships from four universities in China. He serves as Senior Editor in IEEE Transactions on Automatic Control and Automatica, as editor of two Springer book series, and has served as Vice President for Technical Activities of the IEEE Control Systems Society and as chair of the IEEE CSS Fellow Committee. Krstic has coauthored twelve books on adaptive, nonlinear, and stochastic control, extremum seeking, control of PDE systems including turbulent flows, and control of delay systems.

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