

On the Behavioral of Adaptive Cruise Control Vehicles: An Empirical Study

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About the Speaker

Dr. Danjue Chen is an Assistant Professor in the Dept. of Civil and Environmental Engineering at the University of Massachusetts Lowell. She is the recipient of the NSF CAREER award. Dr. Chen had her PhD from the Georgia Institute of Technology and her B.S. in environmental science from Peking University in China. Prior to UMass Lowell, she worked as a Researcher at the University of Wisconsin - Madison, and a postdoc at California PATH at University of California, Berkeley. Dr. Chen's research interests include modeling and control of connected and automated vehicles, traffic flow theory & simulation and cyber-physical-system of smart vehicles. Her research aims to better understand the fundamental nature of traffic flow, particularly with cutting-edge vehicle technologies such as connected vehicles and autonomous vehicles, (2) understand the cyber-physical-system of smart vehicles which includes sensing, computation, communication and control, and (3) understand the complex interaction between human and machines (like smart vehicles). Her research has been sponsored by NSF, USDOT, and state DOTs.

About the Talk

Emerging automated vehicle (AV) technologies are increasingly being deployed around the world and it is only a matter of time before the transportation landscape changes dramatically. Unfortunately, those changes cannot be well predicted due to the lack of empirical data. But adaptive cruise control (ACC) vehicles are common in the market and can be used to fill this gap. In this paper, we aim to characterize the empirical car-following behaviors of a commercial ACC system and understand how ACC behaves in different conditions and the underlying impact mechanism. It is found that for a single ACC: (i) the ACC response time is comparable to human drivers but much larger than the ACC controller time gap and it exhibits small variance, (ii) the ACC response can amplify or dampen an oscillation, (iii) after the oscillation, the stabilization process can exhibit overshooting or undershooting, and (iv) these CF behaviors depend largely on the ACC headway setting, speed level, and leader stimulus, which produce the impacts directly and/or indirectly through the mediation of earlier ACC behaviors. For a three-vehicle platoon, our main finding is that the change from one ACC vehicle to the next is progressive for oscillation growth, and regressive for deceleration, acceleration, and overshooting. This implies that in long platoons, oscillation amplitude tends to exacerbate very quickly, which forces ACC vehicles further upstream to apply very strong braking followed by a strong acceleration. This can cause significant overshooting and safety hazards.

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