TEMPLE UNIVERSITY
Department of Mathematics

Applied Mathematics and Scientific Computing Seminar

Room 617 Wachman Hall

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A Decentralized Optimal Control Framework for Improving Energy Consumption of Connected and Automated Vehicles

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Abstract. Recognition of the necessity for connecting vehicles to their surroundings is gaining momentum. In this "new world" of massive amounts of data from vehicles and infrastructure, what we used to model as uncertainty (noise or disturbance) for traffic becomes extra state information in a much higher-dimensional vector. Connected and automated vehicles provide the most intriguing opportunity for enabling users to better monitor transportation network conditions and make better operating decisions to improve safety and reduce pollution, energy consumption, and travel delays. While progress has been made, especially in the area of safety and how accidents could potentially be prevented, one particular question that still remains unanswered is "how much can we improve energy consumption, if we assume that the vehicles are connected and can exchange information with each other and with infrastructure?" This talk will address the problem of coordinating vehicles that are wirelessly connected to each other at different transportation segments, e.g., intersections, merging roadways, to achieve a smooth traffic flow without stop-and-go driving. I will present a decentralized optimal control framework whose closed-form solution exists under certain conditions, and which, based on Hamiltonian analysis, yields for each vehicle the optimal acceleration/deceleration at any time in the sense of minimizing fuel consumption. The solution, when it exists, allows the vehicles to cross the intersections and merging roadways without the use of traffic lights, without creating congestion, and under the hard safety constraint of collision avoidance.