



University of Cyprus

Department of Electrical and
Computer Engineering

Seminar series: Spring 2023/24

Real-Time Optimization of Fuel-Consumption and Travel-Time of CAVs for Cooperative Intersection Crossing

Andreas Hadjigeorgiou

Department of Electrical & Computer Engineering
School of Engineering
University of Cyprus

Wednesday 6th of March 2024, 17:00 - 18:00

Room: XΩΔ02-013

Abstract: Connected and Autonomous Vehicles (CAVs) have the potential to revolutionize road transportation in terms of safety and efficiency, offering important societal, economic, and environmental benefits. In this work, we harness CAV capabilities, such as seamless connectivity and fine-grained control to safely and efficiently coordinate a set of CAVs crossing an unsignalized intersection. Coordinated control is achieved by generating an acceleration profile for each CAV to simultaneously optimize fuel consumption and travel time. As the resulting problem is non-convex and challenging to solve, we design a novel centralized solution approach. First, we construct a relaxed reformulation of the problem by ignoring certain safety constraints to eliminate interdependence between the trajectories of CAVs traveling in the same lane. Because the relaxed problem is still non-convex, we develop a custom convex-concave procedure that yields the travel time of each CAV to traverse the intersection without lateral collisions. Finally, the derived travel times are utilized to construct collision-free trajectories for all CAVs using convex optimization. Elaborating on principles from the centralized approach, we also introduce a decentralized scheme that solves the problem on a vehicle-by-vehicle basis. Extensive simulation results substantiate the effectiveness of the proposed solution approaches in terms of solution quality and execution speed. Simulation results also highlight the importance of optimizing the trade-off between travel time and fuel consumption as small sacrifices in travel time lead to substantial fuel savings. Finally, simulation results indicate that the simultaneous coordination of a set of CAVs yields significant performance benefits compared to decentralized control.

Biography: Andreas Hadjigeorgiou received a B.Eng. degree in mechanical engineering from the University of Bath, Bath, U.K., in 2012, and a B.Sc. degree in applied mathematics in 2016 from the University of Cyprus, where he is currently working toward a Ph.D. degree with the Department of Electrical and Computer Engineering. He has been a Researcher with the KIOS Research and Innovation Center of Excellence from 2018 to 2021. His research interests include optimization techniques, intelligent transportation systems, and connected and autonomous vehicles.