



Models for unravelling a future with Automated Vehicles: a multi-scale approach

First Research Seminar of the hEAT Lab (research on Electric and Automated Transport)

6 of December 2019

Room HG 2.62

Program

13:00-13:15 Introduction Meng Wang and Goncalo Correia

13:15-13:45 Bahman Madadi: **Multi-stage optimization of road networks for automated driving**

13:45-14:15 Xiao Liang: **An optimization model of automated taxis in trip assignment under elastic demand for the last mile problem**

14:15-14:45 Senlei Wang: **Modeling the Autonomous Mobility-on-Demand System**

14:45-15:15 Coffee Break

15:15-15:45 Lin Xiao: **Using the existing dedicated lane for automated driving vehicle sounds good?**

15:45-16:15 Meiqi Liu: **Vehicle trajectory planning considering traffic signals on urban roads**

16:15-16:30 Wrap-up Goncalo Correia and Meng Wang

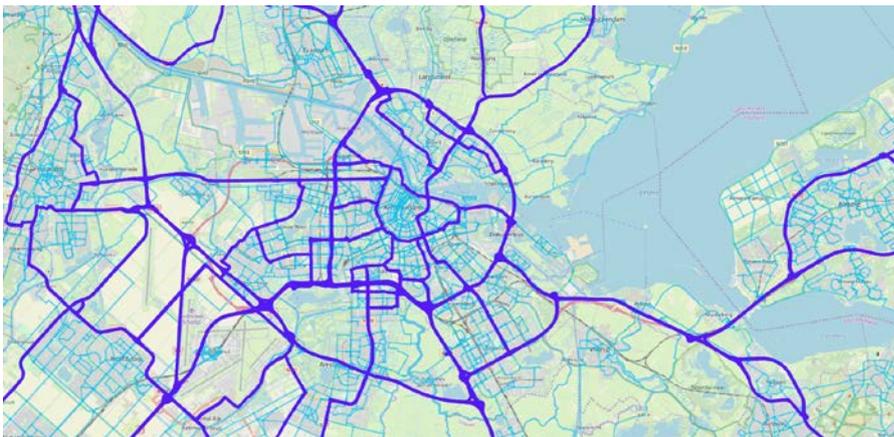
16:30 Drinks

Presentations

13:15-13:45 Bahman Madadi



Multi-stage optimization of road networks for automated driving



Automated driving has received extensive attention from the automobile industry as well as the scientific community in recent years. Various aspects of vehicle automation have been studied and the scientific literature in this field is rapidly growing. However, when it comes to designing road networks compatible with automated vehicles and developing policies for accommodating automated vehicles in urban regions, the scientific literature is still scarce. I have spent the past three years working on network design concepts for accommodating automated vehicles in road networks and developed models to investigate potential impacts of these concepts on transport systems. In my latest work, I have proposed multi-stage optimization of automated-vehicle-friendly subnetworks within road networks. In my presentation, first, I will provide a brief overview of what I have done during my PhD. Then, I will present the results of my latest work.

13:45 - 14:15 Xiao Liang



An optimization model of automated taxis in trip assignment under elastic demand for the last mile problem



An automated taxi (AT) system is designed to provide a seamless transport service for the last mile problem. In this research, we establish a shared-use vehicle routing model incorporating mode choice between ATs and bikes. It considers the impact of traffic congestion on mode split. The demand for ATs is elastic depending on its service level considering traffic congestion. We aim to achieve an equilibrium between these two modes when assigning all passengers to finish their trips. This research proposes a mixed-integer non-linear programming model to address the trip assignment problem of ATs with elastic travel demand and a customized gradient algorithm to solve such a problem.

14:15-14:45 Senlei Wang



Modeling the Autonomous Mobility-on-Demand System

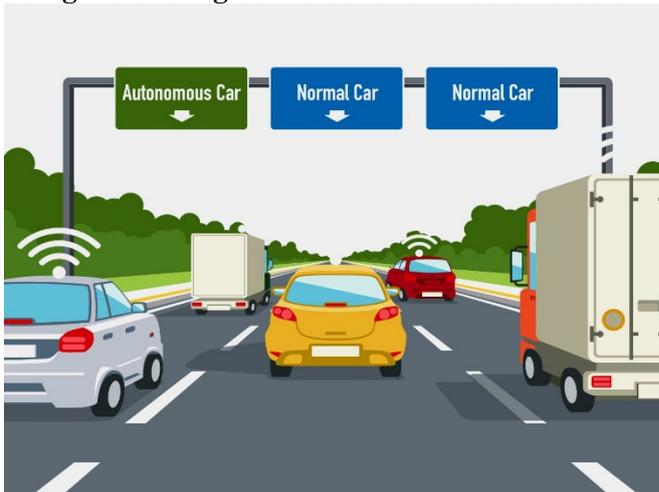


An agent-based model for the autonomous mobility on-demand (AMoD) system, which includes the dynamic generation of time-dependent travel requests, real-time vehicle assignment, and route assignment, is presented. The model can be used to look at the impact of different operations of shared automated vehicles in the AMoD system, such as providing different service schemes, operating in a platooning fashion, and transporting the travelers in the case of multiple fleet operators.

15:15-15:45 Lin Xiao



Using the existing dedicated lane for automated driving vehicle sounds good?

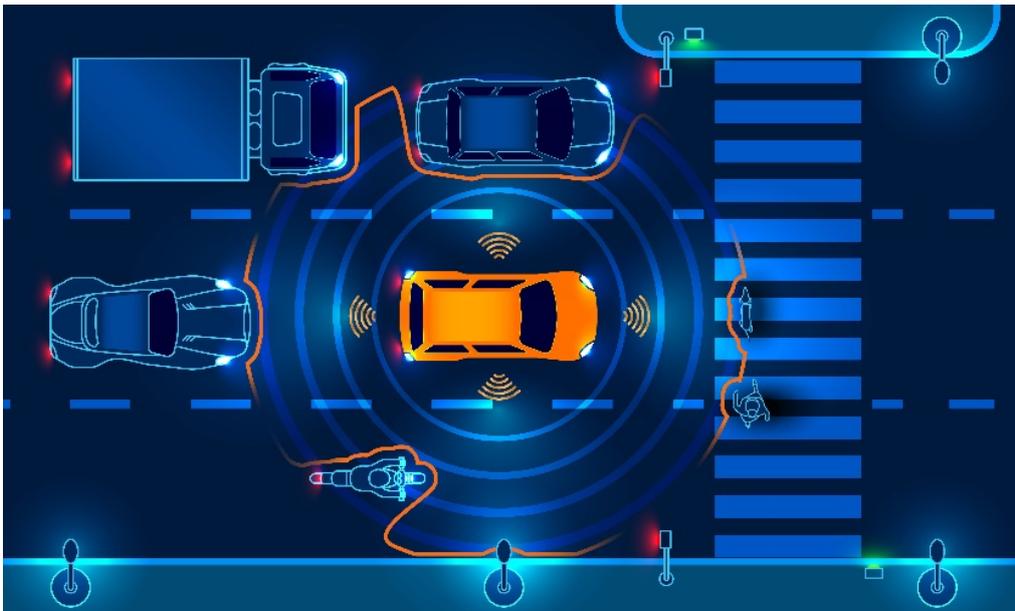


Cooperative Adaptive Cruise Control (CACC) systems can increase roadway capacity, but the benefits are marginal at low market penetration rates (MPRs). Thus, a CACC dedicated lane is considered to group CACC vehicles for efficient traffic stream. Concepts of converting existing High Occupancy Vehicle (HOV) lanes into CACC lanes emerge, which leverages the infrastructural facilities and experience with HOV lanes. However, it is unclear to which extent changing HOV lanes to CACC lanes can influence freeway operations. This study examines the traffic flow impacts of converting HOV lanes into CACC lanes regarding CACC MPRs on a complex freeway corridor with multiple interacting bottlenecks in California. A simulation model capable of reproducing flow characteristics with HOV lane and CACC systems is employed for the assessment. Special attention is paid to macroscopic congestion patterns, CACC lane utilization, travel time reliability and CACC operation characteristics. The results show that converting to CACC lanes at low MPRs (<30%) can exacerbate congestion in general purpose lanes, whereas at mediate CACC MPRs (40%–50%) the congestion is drastically alleviated due to a large share of traffic carried by CACC lanes.

15:45 -16:15 Meiqi Liu



Vehicle trajectory planning considering traffic signals on urban roads



The platoon trajectory planning of cooperative vehicles on urban roads is beneficial with respect to fuel consumption and travel time. The traffic signal control approaches play an important role when optimizing vehicle trajectories at signalized intersections. We present how to optimize the trajectories of cooperative and automated vehicles under fixed-timing, actuated and adaptive signal control approaches. This control approach optimizes accelerations of the controlled CAV platoon along a corridor with signalized intersections. The objectives of the proposed approach are to optimize the throughput, comfort, travel delay and fuel consumption. The proposed approach is flexible in dealing with platoon merging, splitting, stopping, and queue discharging characteristics at signalized intersections. Finally, the simulation results of the proposed control approach are presented.