MSc Project Description

Project Title: Multi-agent Traffic Simulation for Analyzing the Effects of Autonomous Vehicles on Traffic Safety and Flowrate in Work-zone Scenarios

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Background / Problem Definition

As the technological developments indicate, the autonomous cars will be a part of the traffic flow in near future. This exciting transition requires a well-planned and gradual introduction. Before such systems are deployed in real-traffic, their impact on traffic safety and traffic flow is of tremendous importance for companies and transport regulation authorities. In this MSc project, the aim is to take the first step in exploring the effects of having autonomous vehicles (AV) together with human-operated vehicles (HOV) in the traffic.

The student(s) will explore the effects of the autonomous cars in traffic safety and traffic flow using quantitative measures such as number of predicted accidents, delay times, number of conflicts. The exploration will take place in open-source software-based platforms such as SUMO and MATLAB.

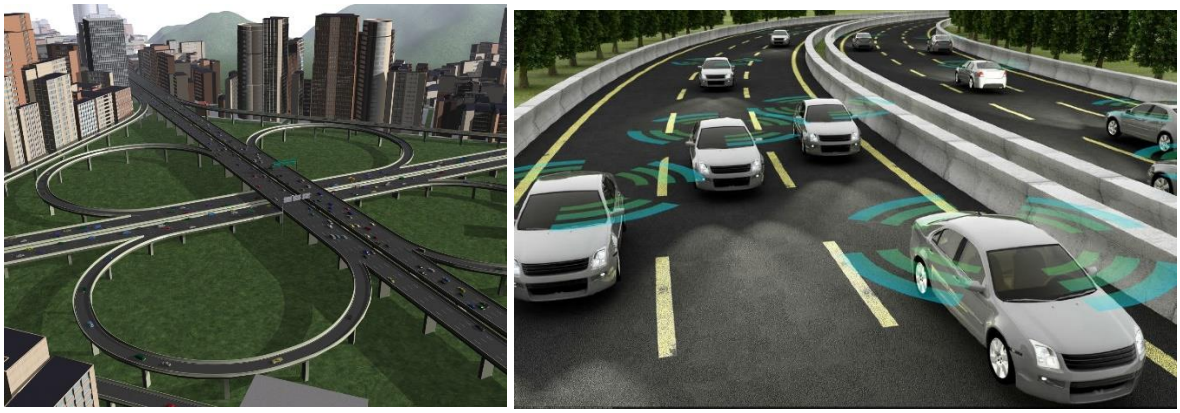

Photo: Courtesy of UNC and Phys.org

Research Tasks

Traffic Scenario Construction: The target scenarios to be constructed are work zone scenarios (e.g., lane reduction). Basic scenarios that are needed to study work zone scenarios should also be constructed. These include straight highway road segment that only need car-following behaviour and straight highway road segment with multiple lanes allowing lane-change and overtaking manoeuvres.

Agent Definition and Implementation: This task involves definition of at least 1 AV and up to 10 HOV behaviour profiles. (Optional: When software structure allows, addition of pedestrians and cyclists are encouraged to obtain more challenging situations). The definition of these agents will involve speeding, acceleration, and deceleration and lateral-control models. These models will be constructed in a parametric framework to define the full-range of realistic behaviour.

Simulations: This step will involve running simulations with different number of AV and HOV agents using the scenarios defined earlier. In order to observe the effect of AV in the traffic-flow and safety measures, the simulations will be defined with different rates of AV-penetration. For example: fully AV, fully HOV and mixed-fleet variations (1-10, 2-9, 3-8, etc.) In order to represent the diversity of driving styles in HOV, at least 10 different profiles will be described to represent aggressive, cautious and elderly drivers.

Data-logging and Analysis: This task involves measuring and logging relevant data from simulations such as number of conflict situations, lags/delays, number of accidents, the average and peak velocities of vehicles. During analysis, the logged data will be examined using statistical and probabilistic techniques.

Expected Outputs:

1. A running platform for (may include codes) for the defined problem and scenarios
2. Definition of agents in the simulation and implementation of definitions in the software
3. Logged data from the simulation.
4. In-depth analysis on the logged data taking the parametric definition and probabilistic envelopes of the behaviour from different agents.