MSc Project Description

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

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 SUMO and MATLAB.

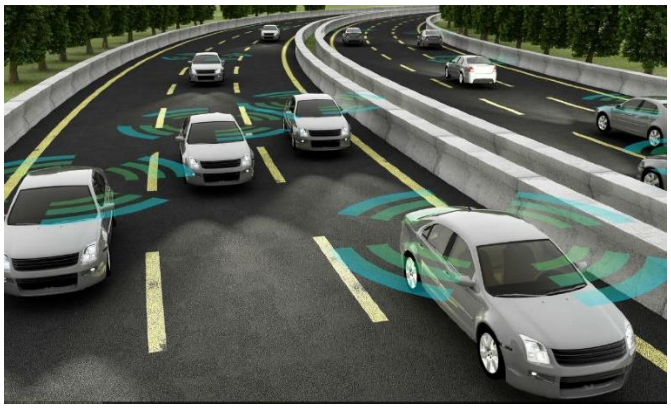

Photo: Courtesy of UNC and Phys.org

Research Tasks

Traffic Scenario Construction: This step involves creation of at least two traffic scenarios that allows quantitative analysis of the effects of AV in traffic.

The suggested base scenarios may include:

(i) simple scenario (i.e. straight highway road segment) with only car-following allowance

(ii) simple scenario with lateral dynamics (i.e. straight highway road segment with multiple lanes, allowing lateral control and lane-change maneuver which may be a part of overtaking actions)

(iii) artillery-road and highway junction with merging

Agent Definition and Implementation: This task involves definition of at least 1 AV and up to 10 HOV behavior 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, deceleration and lateral-control models. These models will be constructed in a parametric framework to define the full-range of realistic behavior.

Simulations: This step will involve running simulations with different number of AV and HOV agents using the scenarios defined in Task 1. 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. Integration of SUMO-MATLAB soft-ware for the defined problem and construction of traffic scenarios
2. Definition of agents in the simulation and implementation of definitions in the software
3. Running the simulations and logging the data.
4. In-depth analysis on the logged data taking the parametric definition and probabilistic envelopes of the behavior from different agents.