Simulation of traffic safety in the era of advances in technologies

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Editorial

Special issue on simulation of traffic safety in the era of advances in technologies

1. Introduction

The rapid advancement in vehicle technologies and vehicle automation introduces new challenges into road traffic systems and raises questions regarding the interactions of humans with these technologies and the implications on traffic safety. Side by side, the advancement in technologies for innovative data collection and the increase in computing capabilities provide unprecedented opportunities to investigate those questions comprehensively. Today, more than ever the need to close the gap between human factors conceptual models and traffic engineering models is becoming a necessity to understand the new interactions and phenomena introduced by vehicle technologies and vehicle automation. This understanding has begun to increase the validity of the developed models to simulate individual road user behavior and assess the collective impact on traffic safety.

Originated within the activities of the *19th EURO Working Group on Transportation (EWGT2016) Meeting* held at the Technical University of Istanbul, Turkey the present Special Issue on ‘Simulation of Traffic Safety in the Era of Advances in Technologies’ provides a synthesis of high-quality papers with novel contributions and breaking results on the analysis of traffic safety given the need for an efficient modeling and simulation in today’s context.

The interaction of the human behavior with the road, environment, and traffic has been the underlying feature of each of the studies within the collage of articles that are concentrated mainly on: simulating the impact of vehicle automation on traffic safety; the methodological advances in micros-simulation modeling; incorporating human factors in road user behavioral modeling; and the use of surrogate measures for safety assessments.

2. Brief overview on articles

A brief overview on each of the articles included in the Special Issue is given in the following.

2.1. Modeling take-over performance in level 3 conditionally automated vehicles

The article by Gold et al. (2018) summarizes the take-over performance of automated vehicles in a system of Level 3 conditional automation using data obtained by driving simulators. Authors utilize two distinct sets of take-over situation data to calibrate and validate the model proposed to model a number of performances, including the take-over time and the minimum time-to collision, where the taking over vehicle control due to crashed vehicle type lane blocking incidents are simulated over a three-lane highway. The findings reveal that the density of the simulated traffic and the time to collision are the key factors influencing driver performance in take-over scenarios.

2.2. Effective cues for accelerating young drivers' time to transfer control following a period of conditional automation

Wright et al. (2018) focus their attention on the safety conditions in transitions between manual and automated driving. A 57-subject's driving simulation experiment is carried out to evaluate the impact of different context-based auditory take-over requests prompted before potentially hazardous events. The authors identifies associations between such requests, the driver characteristics, glances at potential hazards and speed choice, quantifying ultimately potential benefits of prompting context-based take-over requests.

2.3. Structural equations modelling of drivers' speed selection using environmental, driver, and risk factors

Sadia et al. (2018) develop a theoretical model for drivers’ speed selection, focusing on the influence of environmental and road characteristics, situational factors and individual characteristics. The model is based on the structural equation modeling framework. The authors estimate the model parameters using driving simulator data that they collected.

2.4. Driving behavior recognition from EEG data obtained from a simulated car following experiment

The paper by Yang et al. (2018) focuses on driver behavior recognition. Authors propose a two-layer learning method for driving behavior recognition using physiological signals such as electroencephalography (EEG) data. For collecting this data a simulated car-following driving experiment is designed and conducted. The results show that the average classification accuracy for all tested traffic states is 69.5% and the highest accuracy reached 83.5%, suggesting a significant correlation between EEG patterns and car-following behavior.

2.5. Effectiveness of visual warnings on young drivers hazard anticipation and hazard mitigation abilities

In a 48-young subject's driving simulator experiment, Hajiseyedjavadi et al. (2018) present evidence on the benefits of head-

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up displays for mitigating hazardous event occurrence. The visual alerts are displayed at different times before the potential hazard occurrence, resulting in different impacts on the glances at the potential threat and on driver's speed choice, thus setting new ground for young driver targeted advanced driver assistance systems.

2.6. A fundamental experimental approach for optimal design of speed bumps

Analyzing the effects of speed reduction of an approaching vehicle on the resulting vertical acceleration due to an obstacle using a scaled model to simulate the vehicle and road interaction Lav et al. (2018) summarize an experimental study conducted with the aim of the optimal design of a speed bump. Dependent on the shape of the speed bump, authors specify the dimension based optimal design characteristics to yield acceptable levels of vertical acceleration.

2.7. Comparison of proposed countermeasures for dilemma zone at signalized intersections based on cellular automata simulations

In the purpose of helping drivers' decision making by reducing the Type II dilemma zone and enhancing the traffic safety at signalized intersections, Wu et al. (2018) propose a new warning system called pavement marking with auxiliary countermeasure that integrates the pavement marking and traffic signal system. Authors employ a cellular automaton model to simulate a number of countermeasure scenarios comparatively and to evaluate the safety levels within, estimating the indicators of rear-end crash and potential red-light running violations based on field data.

2.8. Assessment of countermeasure effectiveness and informativeness in mitigating wrong-way entries onto limited access facilities

In the purpose of proposing solutions for mitigating the wrong-way driving analyzing the countermeasures, Lin et al. (2018) summarize the findings from a number of pilot projects conducted in Florida, US involving multiple countermeasures, including detection-triggered LED lights around warning signs and detection-triggered blank-out signs flashing 'wrong-way', using Intelligent Transportation Systems technologies. The overall recommendations on the efficiency of wrong-way driving countermeasures are provided following an extensive work composed of the analysis on existing data, field tests using focus groups, a survey on public opinion, and a driving simulator based human factors analysis.

2.9. Safety assessment of passing relief lanes using microsimulation-based conflicts analysis

Cafiso et al. (2018) explore the use of traffic microsimulation and surrogate safety measures to understand and assess safety on 2 + 1 roads. The authors first calibrate and validate both a microscopic traffic simulator, accounting for the representativeness of 2 + 1 road maneuvers, and a conflict frequency model. Then both models are used in the analysis of the safety impact of different configurations of passing and merging lanes for multiple traffic conditions. With this study, Cafiso et al. (2018) contributed to the field of knowledge in the design of 2 + 1 roads, overcoming the existing gap in field safety data and in limited design configurations from observational studies.

2.10. Development of a continuous motorcycle protection barrier system using computer simulation and full-scale crash testing

Atahan et al. (2018) present a protection barrier system aimed at improving the safety of motorcyclists. The authors present the motorcycle protection barrier system and assess its crash performance using both computer simulations and full-scale crash testing. The combination of the two types of safety analysis can be useful in driving future studies.

2.11. Crash probability estimation via quantifying driver hazard perception

Li et al. (2018) present a practical approach to estimate crash probability. The authors consider and quantify driver hazard perception by considering time-to-collision and driver braking response in response to a near-risk situation. Li et al. (2018) thus define a hazard perception measure, called driver risk response time. The proposed approach is validated using data from mixed traffic conditions in China using a vehicle equipped with a Collision Mitigation Braking System.

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