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Editorial

Advances in Traffic Safety Methodologies and Technologies

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Traffic safety represents a significant challenge for current, transitional, and future transportation systems, where the advanced communication and automation systems within vehicles and in the road infrastructure might interfere with the driving behavior of individual vehicles and raise concerns regarding the implications on safety. Developing better traffic safety methodologies, strategies, and policies is of practical importance to reduce traffic crashes and improve transportation system operations and might lead to a mitigation of congestion, together with a reduction of traffic-related air pollution. Enabled by emerging vehicle, sensing, and control technologies, Smart City research initiatives, big data analytics, and recent advances in driving experiments, traffic safety research will greatly enhance our scientific understanding of the new interactions and phenomena between conventional, connected, and automated vehicles. In addition, the innovative data sources and increasing computing capabilities provide a great potential to extend the application of advanced methodologies in traffic safety research. Advances in traffic safety modeling, simulation, and management will play a critical role in addressing the competitiveness, sustainability, and mobility issues of current, transitional, and future transportation systems. This special issue is focused on the crucial aspects of current, transitional, and future traffic safety issues, with particular emphasis on the implications of advanced vehicle communication and automation technologies. Scientific research that develops and refines methodologies and technologies using new sources of data, such as data from naturalistic driving, connected vehicles, social media, and smart phones, is also incorporated. In total, 36 papers were submitted to this special issue, 11 of which were accepted for publication. As the guest editors of this special issue, we would like to summarize the 11 accepted papers below.

One study is chosen under the topic of safety implications and evaluation of advanced driving assistance systems. In "Influences of Waiting Time on Driver Behaviors While Implementing In-Vehicle Traffic Light for Priority-Controlled Unsignalized Intersections" by B. Yang et al., the authors investigated the effects of the waiting time on driver behaviors to improve the in-vehicle traffic light for the priority-controlled unsignalized intersections. Gap acceptance theory that considers the waiting time was employed in the implementation of the in-vehicle traffic light to assist minor-road drivers in passing through the intersections by selecting appropriate major-road gaps. The results show that the maximum acceleration strokes of minor-road vehicles were significantly reduced, which indicate a lower possibility of aggressive driving when the in-vehicle traffic light was applied with the consideration of waiting time. In addition, an improved steering stability was observed from the driver behaviors at the intersections, as the maximum lateral acceleration of minor-road vehicles significantly decreased.

Three studies examined the impacts of influencing factors on traffic crashes. In "Analyzing Traffic Crash Severity in Work Zones under Different Light Conditions" by X.

Wei et al., the authors examined the contributing factors to crash severity in highway work zones under different light conditions. The results show that an increase in the number of lanes increases the crash severity level in work zones during the daytime while decreasing the severity at nighttime. Drugs and alcohol are found to increase the severity level significantly under the dark-not-lighted conditions while it has a limited influence under daylight and dark-lighted conditions. In "Effects of Human-Centered Factors on Crash Injury Severities" by E. K. Adanu and S. Jones, the authors analyzed the effects of human-centered crash contributing factors on crash outcomes using the latent class (LC) logit model and random parameters logit (RPL) model. The results show that serious injury crashes were more likely to involve unemployed drivers, no seatbelt use, elderly drivers, fatigued driving, and drivers without a valid license. Comparison of model fit statistics shows that the LC logit model outperformed the RPL model, as an alternative to the traditional multinomial logit (MNL) model. In "Investigating the Differences of Single-Vehicle and Multivehicle Accident Probability Using Mixed Logit Model" by B. Dong et al., the authors investigated the different contributing factors on single-vehicle (SV) and multivehicle (MV) crashes. A mixed logit model is employed using disaggregated data with the response variable categorized as no crashes, SV crashes, and MV crashes. The results indicate that the speed gap, length of segment, and wet road surfaces have significant effects on both SV and MV crashes. Hourly traffic volume, inside shoulder width, and wet road surface are found to produce statistically significant random parameters.

Two papers addressed the topic of data-driven traffic safety monitoring, assessment, and improvement. In "Microscopic Simulation-Based High Occupancy Vehicle Lane Safety and Operation Assessment: A Case Study" by C. Li et al., the authors proposed two general alternative designs to enhance the operation and safety of High Occupancy Vehicle (HOV) lanes at junctions with bus terminals or parking lots. The microscopic simulation, video-based vehicle tracking technique, and Surrogate Safety Assessment Model (SSAM) are employed to assess the safety and operational efficiency of an HOV road segment near a bus terminal. The results show that the proposed alternative geometry design efficiently ameliorates the traffic conflict issues. In addition, the alternative control design scheme significantly reduces the public transit delay. In "Modeling Lane-Changing Behavior in Freeway Off-Ramp Areas from the Shanghai Naturalistic Driving Study" by L. Zhang et al., the authors investigated lane-changing characteristics in freeway off-ramp areas using Shanghai Naturalistic Driving Study (SH-NDS) data. A logit model was developed to analyze the choice of target lanes and estimate the parameters. The results suggested that the lane-changing behavior of exiting vehicles is the consequence of the balance between route plan (mandatory incentive) and expectation to improve driving conditions (discretionary incentive).

From the perspective of methodological advancement in traffic safety modeling, two studies investigated the advanced methodologies for crash frequency and severity analyses. In "Developing a Clustering-Based Empirical Bayes Analysis Method for Hotspot Identification" by Y. Zou et al., the authors proposed three clustering-based Empirical Bayer (EB) methods for hotspot identification. The considered clustering methods include the GFMNB-g model, K-means clustering, and hierarchical clustering with complete linkage. The results indicated that all three clustering-based EB analysis methods are preferred over the conventional statistical methods. Additionally, it seems that the accuracy of hotspot identification can be enhanced by appropriately classifying roadway segments according to the heterogeneity of the crash data (i.e., clustering the data before developing SPFs for use in EB estimates). In "A Novel Surrogate Safety Indicator Based on Constant Initial Acceleration and Reaction Time Assumption" by A. Fazekas et al., the authors presented the derivation of a novel surrogate safety indicator based on a constant initial acceleration and reaction time assumption. The evaluation is based on video-based microscopic traffic data collection. The results showed that the new indicator is more sensitive in detecting critical situations than the other indicators and can describe the conflict situations more realistically.

The remaining three articles focus on the topic of innovative traffic safety data collection, analysis, and molding using advanced technologies. In "A Novel Approach for Operating Speed Continuous Predication Based on Alignment Space Comprehensive Index" by Y. Yan et al., the authors proposed a novel method to estimate the operating speed for multilane highways in China from the aspect of the three-dimensional alignment combination. The results indicate that the proposed models have a superior performance. In "Road Surface State Recognition Based on SVM Optimization and Image Segmentation Processing" by J. Zhao et al., the authors proposed a method of video image processing technology for road surface state recognition. The results show that the method based on SVM and video image segmentation is feasible. The accuracy of particle swarm optimization algorithm is more than 90%, which effectively solves the problem of road surface state recognition under the condition of hybrid or different video scenes. In "Turnout Fault Diagnosis through Dynamic Time Warping and Signal Normalization" by S. Huang et al., the authors developed an intelligent diagnosis method for railway turnout through Dynamic Time Warping. The results indicate that the analyzed five turnout fault types can be diagnosed automatically with 100% accuracy.

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