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From Cognitive-Based Decision Making To Car-Following Modeling: Beyond an Accident-Free Environment

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ABSTRACT

In the year 2005, the monetary cost of injuries related to traffic accidents reached 625 billion USD (U. S. Dollars) in the U.S.A. only. Based on the National Highway Traffic Safety Agency (NHSTA) studies, 5 accident types of interest can be identified: 1) rear impacts (29.6% of US accidents), 2) angle or side impacts (28.6 % of US accidents), 3) fixed object crashes (16.1 % of US accidents), rollovers (2.3% of US accidents), head-on collisions (2 % of US accidents) and collision with pedestrians/bicyclists (1. 8 % of US accidents). In car-following, the focus is on the tailgating behavior that may lead to rear-end collisions. However, existing car-following models are built in an accident-free environment with a structure unsuited to capture driver behavior during incident scenarios; relaxing the safety constraints in these models causes breakdowns with an unrealistic number of chain-type accidents.

In 2008, an acceleration model was formulated by Hamdar et al., so that it incorporates the risk-taking attitudes of drivers; while using prospect theory to evaluate the perceived consequences of applying different acceleration rates, a probability of collision and a crash penalty term are explicitly introduced in the formulation. The objective is to explore the characteristics of this formulated car-following model in terms of its ability to capture congestion dynamics and the collective accident-prone behaviors on a freeway section. After being calibrated against real-life trajectory data, different incident scenarios are modeled including rear-end collision and fixed object crashes (Type 1 and Type 3 above). The effect of both psychological factors and execution/perception errors on the accidents number and their distribution along a freeway length is studied. Through sensitivity analysis, correlations between the crash-penalty, the negative coefficient associated with

losses in speed, the positive coefficient associated with gains in speed, the driver's uncertainty, the anticipation time and the reaction time are retrieved. The formulated model offers a better understanding of driver's behavior under extreme/incident conditions with a better insight into the psychological/cognitive reasoning adopted. Accidents are created as an inherent result of the utility function without imposing unnecessary safety constraints to prevent them

Biography

Samer Hani Hamdar is an assistant professor at the George Washington University where he is the director of the traffic and networks research laboratory. He is an affiliate faculty at the Center of Intelligent System Research (CISR) and the National Crash Analysis Center (NCAC). He holds a M.S. Degree from the University of Maryland, College Park and a Ph.D. Degree from Northwestern University – both in Civil and Environmental Engineering - Transportation. Dr. Hamdar worked on different projects covering different transportation areas. These projects include two National Science Foundation (NSF) Projects titled "Modeling Driver Behavior from a Cognitive Perspective" and "New Methods for Measuring, Evaluating and Predicting the Safety Impact of Road Infrastructure Systems on Driver Behavior"; and a Federal Highway (FHWA) Project titled "Incorporating Weather Effect in Traffic Estimation and Prediction". His primary research interests include Driver Behavior Modeling, Traffic Flow Theory, Intelligent Transportation Systems, Transportation Planning and Evaluation, Transportation Safety, Evacuation Modeling and Disaster Management. He has an international research background having participated in projects in Germany, Saudi Arabia and the USA.

Location: Bldg 222, 2d Floor Conference Room, Argonne National Laboratory