Driving Simulation Research at Morgan State University, Baltimore, USA

1) Driver Behavior Analysis under Simulated Animal Crossing Scene

ABSTRACT
Animal-vehicle collisions (AVC) have an increasing impact on U.S. roadway safety; this trend necessitates comprehensive analysis of the variety of factors involved in such hazardous events. Human factor as a complicated component in this context has yet to be thoroughly studied. This study utilizes synthetic driving simulator data to better identify heterogeneity of driving behavior with AVC. More than 100 subjects were recruited to drive on a large-size realistic road network in four different animal related scenarios. In two scenarios, the animal passing occurred unexpectedly on a freeway and a highway, with or without a warning system. Using the driving simulator method, the study results revealed interesting facts regarding animal-driver interactions. The effect of driver-specific and road-related factors on the risk of AVC was determined using statistical analysis, such as Pearson's chi-square and a logistic regression model. Drivers' speeding behavior and collision probability were found to be associated with their socio-economic characteristics.

2) Speed Pattern Analysis in the Proximity of Dynamic Message Signs Using a Driving Simulator

ABSTRACT
This study aims to find whether dynamic message signs (DMS) have an adverse effect on traffic flow and safety due to traffic slowdown to read the message. Drivers' speed fluctuations in the proximity of two dynamic message signs with qualitative and quantitative contents on a highway and a freeway are analyzed. Over 100 subjects are recruited to drive on a fairly large and realistic road network developed in a driving simulator. No statistically significant reduction in the speed of the subjects to read the quantitative message in a highway with 55 mph (88.5 km/hr) speed limit was found. In correlation with our speed analysis, majority of the subjects believed their speed reduction was insignificant. However, the average speed decreased by 2.6 mph (4.3 km/hr) to read the quantitative message on a sign mounted on the 65 mph (105 km/hr) freeway. Although DMS accounted to likely impact the speed of fast drivers, they were found to safely operate as traffic management tools.

3) Exploring Travelers' Behavior in Response to Dynamic Message Signs (DMS) Using a Driving Simulator

ABSTRACT
This research studies the effectiveness of a dynamic message sign (DMS) using a driving simulator. Over 100 subjects from different socio-economic and age groups were recruited to drive the simulator under different traffic and driving conditions and various travel-related DMS messages. The subjects drove between a specified pair of origin and destination while choosing their own route in a fairly realistic 12×12 mi^2 (20×20 km^2) network that included road signs,

traffic signals, three-dimensional buildings and trees, and other roadside objects. Their driving behavior, including changes in driving speed, route choice and diversion, and travel time perception in the presence of DMS were studied. In addition to the driving simulator experiment, a stated preference analysis was conducted through three sequential survey questionnaires. The questionnaire data was utilized to better understand drivers' perceptions of the efficiency-related attributes. The study concluded that DMS is a safe device, since drivers did not reduce their speed significantly to read the DMS contents. Furthermore, quantitative information provided by DMS affected drivers' route choice significantly and drivers were quite sensitive to travel time change. However, the diversion rate due to a second DMS with qualitative information was much less than what the subjects stated in the survey.

4) **INTEGRATION OF DRIVING SIMULATOR AND TRAFFIC SIMULATOR**

CASE STUDY:
EXPLORING DRIVERS' BEHAVIOR IN RESPONSE TO VARIABLE MESSAGE SIGNS

IN THIS STUDY, A DRIVING SIMULATOR IS INTEGRATED WITH A TRAFFIC SIMULATOR IN THE NETWORK-LEVEL FOR THE FIRST TIME TO ALLOW SUBJECTS TO DRIVE IN A FAIRLY REALISTIC ENVIRONMENT AND A REALISTIC TRAFFIC FLOW AND DENSITY. A 3.1 × 3.1 MI^2 (5 × 5 KM^2) NETWORK WAS DEVELOPED IN A DRIVING SIMULATOR AND THEN EXPORTED TO A TRAFFIC SIMULATOR. ABOUT 30 SUBJECTS DROVE THE SIMULATOR UNDER DIFFERENT TRAFFIC AND DRIVING CONDITIONS AND VARIABLE MESSAGE SIGN (VMS) INFORMATION WITH AND WITHOUT INTEGRATION. ROUTE GUIDANCE WAS AVAILABLE FOR THE SUBJECTS. THE STUDY CONCLUDED THAT TRAFFIC DENSITY AND VMS RELIABILITY IS HIGHER WHEN INTEGRATE DRIVING AND TRAFFIC SIMULATORS, HOWEVER, SUBJECTS' ROUTE CHOICE AND ROUTE DIVERSION BEHAVIOR WAS SIMILAR.

A BINARY LOGISTIC REGRESSION MODEL WAS UTILIZED TO FIND FACTORS AFFECTING ROUTE DIVERSION. THE RESULTS INDICATED THAT THE ORIGINAL CHOSEN ROUTE, DISPLAYED VMS INFORMATION, SUBJECTS' ATTITUDE TOWARD VMS INFORMATION HELPFULNESS, AND THEIR LEVEL OF EXPOSURE TO VMS AFFECTS ROUTE DIVERSION.