DRIVER BEHAVIOR IN TRAFFIC

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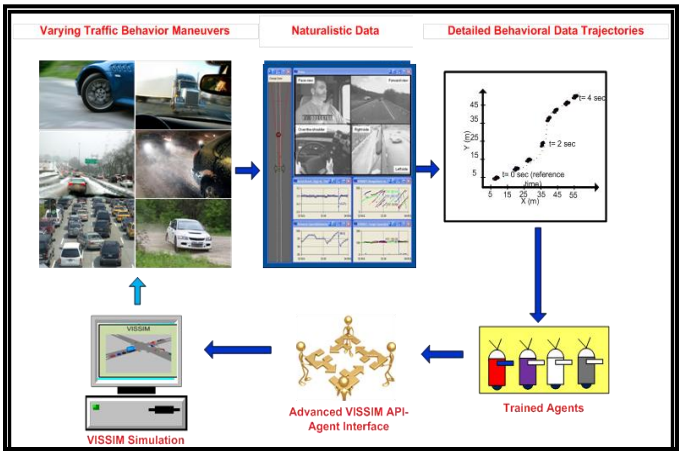
Existing traffic analysis and management tools do not model the ability of drivers to recognize their environment and respond to it with behaviors that vary according to the encountered driving situation and is typically limited to specific locations (i.e., by collecting data on specific intersections or freeway sections) and is very narrow in scope.

The goal of this research was to characterize driver behaviors under naturalistic driving experiences with respect to critical parameters related to driving. Of special interest to this research was the modeling of both normal and safety-critical driving beyond existing models' capabilities. The poster will summarize the research performed to model driver behavior in traffic based on naturalistic driving data. The data was analyzed and used as the basis to train and validate driver agents, each of which encapsulated an individual driver's decisions in response to varying traffic situations. The developed agents were designed and trained to learn individual drivers' actions for any given traffic state based on neuro-fuzzy reinforcement learning, an agent-based artificial intelligence machine-learning technique. As an additional product of this research, several car-following models were calibrated and compared using the naturalistic data and a new hybrid car-following model was developed.



The proposed methodology simulated events from different drivers and proved behavior heterogeneities. Robust agent activation techniques were also developed using discriminant analysis. The developed agents were implemented in the VISSIM simulation platform and were evaluated by comparing the behavior of vehicles with and without agent activation. The results showed very close resemblance of the behavior of agents to driver data. Prototype agents were also developed. One of the major contributions of this research is the developed integrated framework for safety and operation analysis.

The research has contributed the following:

1. Improvement of car-following models during normal driving episodes; namely, the development of the hybrid Wiedemann-GHR model and the addition of the new pass and hook thresholds.
2. Development of agent-based models for safety-critical events, and training agents to mimic different drivers extracted from the naturalistic database.
3. Development of agent-based simulation components integrated with the VISSIM simulation package through its driver model.
4. Development of a robust activation mechanism for agent-based simulation based on discriminant analysis and implementing the activation mechanism in a GUI.

Future research recommendations include training agents using more data to cover a wider region in the Wiedemann regime space, and sensitivity analysis of agent training parameters. The research conducted in this project can be considered as a foundation for agent-based modeling and simulation based on naturalistic data. The goal of the effort was to provide the industry with methods for developing more accurate and more sensitive traffic simulation models. This could also enable future research to develop new generations of traffic simulation models that accurately model driver behavior during incidents and other complex traffic situations.

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