

# Addressing Design and Human Factors Challenges in Cyber-Transportation Systems

## Abstract

This project has two closely related objectives. The first is to design and evaluate new Cyber Transportation System (CTS) architectures, protocols and applications for improved traffic safety and traffic operations. The second is to design and develop an integrated traffic-driving-networking simulator. The project takes a multi-disciplinary approach that combines cyber technologies, transportation engineering and human factors.

To improve traffic safety, the project will develop and evaluate novel algorithms and protocols for prioritization, delivery and fusion of various warning messages so as to reduce drivers' response time and workload, prevent conflicting warnings, and minimize false alarms. To improve traffic operations, the project will focus on the design of next generation traffic management and control algorithms for both normal and emergency operations (e.g. during inclement weather and evacuation scenarios). Both human performance modeling methods and human subject experimental methods will be used to address the human element in this research. As the design and evaluation of CTS applications requires an effective development and testing platform linking the human, transportation and cyber elements, the project will also design and develop a 3-in-1 simulator that combines the main features of a traffic simulator, a networking simulator and a driving simulator. The integrated simulator will allow a human driver to control a subject vehicle in a virtual environment with realistic background traffic, which is capable of communicating with the driver and other vehicles with CTS messages. Background traffic will be controlled by a realistic driver model based on our human factors research that accounts for CTS messages' impact on driver behavior.

**Intellectual Merits:** The project explicitly considers human factors in the design and evaluation of CTS protocols for safety and operations applications, a topic which has not received adequate attention. Moreover, the proposed integrated simulator represents a first-of-a-kind simulator with unique features that can reduce the design and evaluation costs of new CTS applications.

**Broader Impacts:** The proposed research can improve the safety, efficiency and environmental-friendliness of transportation systems, which serve as the very foundation of modern societies and directly affects the quality of life. The integrated simulator will be used as a tool for teenage and elderly driver education and training, and to inspire minority, middle and high school students to pursue careers in math, science, and computer-related fields.