Computational Modeling of Driver Speed Control with its Applications in Developing Intelligent Transportation Systems to Prevent Speeding-Related Accidents
**University Transportation Research Center - Region 2**

The Region 2 University Transportation Research Center (UTRC) is one of ten original University Transportation Centers established in 1987 by the U.S. Congress. These Centers were established with the recognition that transportation plays a key role in the nation’s economy and the quality of life of its citizens. University faculty members provide a critical link in resolving our national and regional transportation problems while training the professionals who address our transportation systems and their customers on a daily basis.

The UTRC was established in order to support research, education and the transfer of technology in the field of transportation. The theme of the Center is “Planning and Managing Regional Transportation Systems in a Changing World.” Presently, under the direction of Dr. Camille Kang, the UTRC represents USDOT Region II, including New York, New Jersey, Puerto Rico and the U.S. Virgin Islands. Functioning as a consortium of twelve major Universities throughout the region, UTRC is located at the CUNY Institute for Transportation Systems at The City College of New York, the lead institution of the consortium. The Center, through its consortium, an Agency-Industry Council and its Director and Staff, supports research, education, and technology transfer under its theme. UTRC’s three main goals are:

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<th>Research</th>
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<td>The research program objectives are (1) to develop a theme based transportation research program that is responsive to the needs of regional transportation organizations and stakeholders, and (2) to conduct that program in cooperation with the partners. The program includes both studies that are identified with research partners of projects targeted to the theme, and targeted, short-term projects. The program develops competitive proposals, which are evaluated to insure the most responsive UTRC team conducts the work. The research program is responsive to the UTRC theme: “Planning and Managing Regional Transportation Systems in a Changing World.” The complex transportation system of transit and infrastructure, and the rapidly changing environment impacts the nation’s largest city and metropolitan area. The New York/New Jersey Metropolitan has over 19 million people, 600,000 businesses and 9 million workers. The Region’s intermodal and multimodal systems must serve all customers and stakeholders within the region and globally. Under the current grant, the new research projects and the ongoing research projects concentrate the program efforts on the categories of Transportation Systems Performance and Information Infrastructure to provide needed services to the New Jersey Department of Transportation, New York City Department of Transportation, New York Metropolitan Transportation Council, New York State Department of Transportation, and the New York State Energy and Research Development Authority and others, all while enhancing the center’s theme.</td>
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<th>Education and Workforce Development</th>
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<td>The modern professional must combine the technical skills of engineering and planning with knowledge of economics, environmental science, management, finance, and law as well as negotiation skills, psychology and sociology. And, she/he must be computer literate, wired to the web, and knowledgeable about advances in information technology. UTRC’s education and training efforts provide a multidisciplinary program of course work and experiential learning to train students and provide advanced training or retraining of practitioners to plan and manage regional transportation systems. UTRC must meet the need to educate the undergraduate and graduate student with a foundation of transportation fundamentals that allows for solving complex problems in a world much more dynamic than even a decade ago. Simultaneously, the demand for continuing education is growing—either because of professional license requirements or because the workplace demands it—and provides the opportunity to combine State of Practice education with tailored ways of delivering content.</td>
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<th>Technology Transfer</th>
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<td>UTRC’s Technology Transfer Program goes beyond what might be considered “traditional” technology transfer activities. Its main objectives are (1) to increase the awareness and level of information concerning transportation issues facing Region 2; (2) to improve the knowledge base and approach to problem solving of the region’s transportation workforce, from those operating the systems to those at the most senior level of managing the system; and by doing so, to improve the overall professional capability of the transportation workforce; (3) to stimulate discussion and debate concerning the integration of new technologies into our culture, our work and our transportation systems; (4) to provide the more traditional but extremely important job of disseminating research and project reports, studies, analysis and use of tools to the education, research and practicing community both nationally and internationally; and (5) to provide unbiased information and testimony to decision-makers concerning regional transportation issues consistent with the UTRC theme.</td>
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To request a hard copy of our final reports, please send us an email at utrc@utrc2.org

**Mailing Address:**

University Transportation Research Center  
The City College of New York  
Marshak Hall, Suite 910  
160 Convent Avenue  
New York, NY 10031  
Tel: 212-650-8051  
Fax: 212-650-8374  
Web: www.utrc2.org

**Project No:** 49111-18-23

**Project Date:** August 2013

**Project Title:** Computational Modeling of Driver Speed Control with its Applications in Developing Intelligent Transportation Systems to Prevent Speeding-Related Accidents

**Principal Investigator:**

Dr. Changxu (Sean) Wu  
Associate Professor, Department of Industrial & System Engineering  
State University of New York (SUNY)-Buffalo  
Email: seanwu@buffalo.edu

**Performing Organization:** University at Buffalo/SUNY

**Sponsor:**  
Research and Innovative Technology Administration / USDOT (RITA)
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The UTRC Board of Directors consists of one or two members from each Consortium school (each school receives two votes regardless of the number of representatives on the board). The Center Director is an ex-officio member of the Board and The Center management team serves as staff to the Board.

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UTRC Consortium Universities

The following universities/colleges are members of the UTRC consortium.

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Columbia University (Columbia)
Cornell University (Cornell)
Hofstra University (Hofstra)
Manhattan College
New Jersey Institute of Technology (NJIT)
New York Institute of Technology (NYIT)
New York University (NYU)
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Rensselaer Polytechnic Institute (RPI)
Rochester Institute of Technology (RIT)
Rowan University (Rowan)
Rutgers University (Rutgers)
State University of New York (SUNY)
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UTRC Key Staff

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Assistant Professor of Civil Engineering, CCNY

Dr. Robert E. Paaswell: Director Emeritus of UTRC and Distinguished Professor of Civil Engineering, The City College of New York

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Penny Eickemeyer: Associate Director for Research, UTRC

Dr. Alison Conway: Associate Director for New Initiatives and Assistant Professor of Civil Engineering

Nadia Aslam: Assistant Director for Technology Transfer

Dr. Anil Yazici: Post-doc/ Senior Researcher

Nathalie Martinez: Research Associate/Budget Analyst

Membership as of December 2013
Computational Modeling of Driver Speed Control with its Applications in Developing Intelligent Transportation System to Prevent Speeding-related Accidents in Region II

August, 2013

Dr. Changxu Wu, Assistant Professor, University at Buffalo/SUNY

University at Buffalo
State University of New York (SUNY)
319 Bell Hall
North Campus, SUNY-Buffalo

University Transportation Research Center (UTRC)
Marshak Hall - Science Building, Suite 910
The City College of New York
138th Street & Convent Avenue
New York, NY 10031

Final Report - Jan 01 2012 to July 31 2013

Speed prediction, modeling driver behavior, intelligent speeding warning system

Unclassified
Speeding is commonly recognized as exceeding the posted speed limits or driving too fast for conditions. National Center for Statistics and Analysis (NCSA) reported that speeding is a contributing factor in about one-third of all fatal traffic crashes in the United States and costs society an estimated $40 billion annually in 2004. In the U.S. DOT’s Region II, speeding is the leading contributing factor in fatal motor vehicle accidents in NY State and more than 34 percent of all fatal accidents were due to unsafe speed in 2009 (Summary of Motor Vehicle Accidents, NY State Department of Motor Vehicles, 2009).

In theory, speed control is a complex behavior of longitudinal vehicle control consisting of speed perception, decision making, motor control, vehicle dynamics modeling, and individual driver differences. However, there are few existing models that can integrate all of these aspects, in a cohesive manner. To address this problem, this work introduces a mathematical model for a driver’s speed control with analytical solutions based on a rigorous understanding of the human cognitive mechanisms involved in driving (See Figure 1).

This model includes an integrated queuing network-model human processor structure, and the rule-based decision field theory. This new model consequently provides new predictions with regards to several components involved in driving: driving speed, throttle/brake pedal angle, acceleration, and the frequency of speedometer inspection.

A laboratory session involving a driving simulator was conducted to validate the current model. The model accounted for over 99% of the experimental speed of the average driver, and over 95% of the experimental speed for the majority of individual drivers (See Figure 2).

Based on the model, we designed an intelligent speeding prediction system (ISPS) to prevent the occurrence of speeding in advance before it occurs (See Figure 3).

An experimental study is conducted to compare no speed assistance system, pre-warning system developed based on the ISPS, post-warning system ISA, and combined pre-warning and ISPS system. Both pre-warning and combined systems led to greater minimum time-to-collision. The combined system resulted in slower driving speed, fewer speeding exceedances, shorter speeding duration, and smaller speeding magnitude.

"A Mathematical Model for the Prediction of Speeding with its Validation,” IEEE Transactions on Intelligent Transportation Systems http://dx.doi.org/10.1109/TITS.2013.2257757

"Effectiveness and acceptance of the intelligent speeding prediction system (ISPS),” Accident Analysis and Prevention http://www.acsu.buffalo.edu/~seanwu/IEEE_SMCA_Speed%20control_final2.pdf
