### Appendix

#### ITS Institute Research Projects

Projects are listed under their corresponding research category and alphabetically by principal investigator. Project summaries and additional information for each research project listed in this section are online on the ITS Institute’s website at [www.its.umn.edu/Research](http://www.its.umn.edu/Research).

<table>
<thead>
<tr>
<th>Human Performance and Behavior</th>
<th>John Hourdos and Gary Davis, Department of Civil Engineering</th>
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<tr>
<td></td>
<td>Investigation of Pedestrian/Bicyclist Risk in Minnesota Roundabout Crossings</td>
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<tr>
<td>Max Donath, Alec Gorjestani,</td>
<td>Chen-Fu Liao, Department of Civil Engineering</td>
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<tr>
<td>Janet Creaser, and Michael Manser, Department of Mechanical Engineering</td>
<td>Spatial Cognition of the Blind and Visually Impaired while Using a Mobile Accessible Pedestrian System (MAPS) at Intersection Crossings</td>
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<td>Caroline Hayes, Department of Mechanical Engineering</td>
<td>John Evans, Department of Chemistry and Biochemistry (Duluth)</td>
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<td></td>
<td>Detection of Water and Ice on Bridge Structures by AC Impedance and Dielectric Relaxation Spectroscopy (Phase II)</td>
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<td>Detection of Water and Ice on Bridge Structures by AC Impedance and Dielectric Relaxation Spectroscopy (Phase III)</td>
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<td>John Hourdos, Department of Civil Engineering</td>
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<tr>
<td></td>
<td>Deployment and Field Testing of Novel Water and Ice Sensor Systems on Bridge Decks</td>
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<tr>
<td>John Hourdos, Department of Civil Engineering</td>
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<td>Real-Time Nonintrusive Detection of Driver Drowsiness</td>
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<td>John Hourdos, Department of Civil Engineering</td>
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<td>Integrated Approach for Nonintrusive Detection of Driver Drowsiness</td>
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<td>John Hourdos, Department of Civil Engineering</td>
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<tr>
<td></td>
<td>Continued Field Testing and Refinement of Novel Water and Ice Sensor Systems on Bridge Decks</td>
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<tr>
<td>John Hourdos, Department of Civil Engineering</td>
<td>M. Imran Hayee, Department of Electrical &amp; Computer Engineering (Duluth)</td>
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<td></td>
<td>Development of a Portable Work Zone Traffic Information System Based on DSRC and Bluetooth-Enabled Cell Phones</td>
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<td>John Hourdos, Department of Civil Engineering</td>
<td>Eil Kwon, Department of Civil Engineering (Duluth)</td>
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<td>Assessment of Capacity Estimation Methods for a Multi-Lane Roundabout with Field Traffic Data</td>
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<td>John Hourdos, Department of Civil Engineering</td>
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<tr>
<td></td>
<td>Development of Freeway Management and Operational Strategies with IRIS-in-LOOP Simulation</td>
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<td>John Hourdos, Department of Civil Engineering</td>
<td>Taek Kwon, Department of Civil Engineering (Duluth)</td>
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<td>Estimation of Winter Snow Operation Performance Measures with Traffic Flow Data</td>
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<td>John Hourdos, Department of Civil Engineering</td>
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<td>Advanced Dynamic (LED) Warning Signs for Rural Intersections Powered by Renewable Energy</td>
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<td>Development of a Weigh-Pad-Based Portable Weigh-in-Motion (WIM) System</td>
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<td>Nikolaos Papanikolopoulos, Department of Computer Science and Engineering</td>
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<td>In-vehicle Decision Support to Reduce Crashes at Rural Thru-Stop Intersections</td>
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<td>Michael Manser, Department of Mechanical Engineering, and Michael Rakauskas, formerly of Department of Mechanical Engineering</td>
<td>John Evans, Department of Chemistry and Biochemistry (Duluth)</td>
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<td>Requirements for Effective Fuel Economy Displays for Improving Fuel Economy and Safety</td>
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Appendix: Research Projects

Counting Bicycling and Pedestrian Use of a Transportation Facility
➤ Status: In progress

Nikolaos Papanikolopoulos and Vassilios Morellas, Department of Computer Science and Engineering
Counting Empty Parking Spots at Truck Stops
✔ Status: Complete

Nikolaos Papanikolopoulos and Vassilios Morellas, Department of Computer Science and Engineering
Monitoring the Use of HOV and HOT Lanes
➤ Status: In progress

Rajesh Rajamani, Department of Mechanical Engineering
Enhancement and Field Test Evaluation of New Battery-Less Wireless Traffic Sensors
➤ Status: In progress

Rajesh Rajamani, Mechanical Engineering
Ultra-Reliable Detection of Imminent Collision for Enhanced Passenger Safety
➤ Status: In progress

Ryan Rosandich, Department of Industrial Engineering (Duluth)
Improve Safety and Efficiency of Roadway Maintenance by Developing a Robotic Roadway Message Painter
➤ Status: In progress

Ryan Rosandich, Department of Industrial Engineering (Duluth)
Improve the Safety and Efficiency of Roadway Maintenance Phase II: Developing a Vision Guidance System for the Robotic Roadway Message Painter
★ Status: New

Craig Shankwitz, Department of Mechanical Engineering
Urban Intersection Collision Avoidance System (RICAS) Design, Integration and Project Management Services
✔ Status: Complete

Craig Shankwitz, Department of Mechanical Engineering
In-Situ Testing of State Patrol Vehicle Lighting, Retro-Reflectors, and Paint
➤ Status: In progress

Craig Shankwitz, Department of Mechanical Engineering
Inexpensive 2-D Optical Sensor for DGPS Augmentation
➤ Status: In progress

Craig Shankwitz and Max Donath, Department of Mechanical Engineering
GPS Augmentation for Robust Lane Assistance on Cedar Avenue in Support of the Urban Partnership Agreement
✔ Status: Complete

Shashi Shekhar, Department of Computer Science and Engineering, and Henry Liu, Department of Civil Engineering
III-CXT: Spatio-Temporal Graph Database for Transportation Science
✔ Status: Complete

Hua Tang, Department of Electrical and Computer Engineering (Duluth)
Development of a New Tracking System Based on CMOS Vision Processor Hardware: Phase II
➤ Status: In progress

Hua Tang, Department of Electrical and Computer Engineering (Duluth)
A Tracking-Based Traffic Performance Measurement System for Roundabouts and Intersections
➤ Status: In progress

Peter Willemsen, Department of Computer Science (Duluth)
Snow Rendering for Interactive Snowplow Simulation: Improving Driver Ability to Avoid Collisions when Following a Snowplow
➤ Status: In progress

Peter Willemsen, Department of Computer Science (Duluth)
An Onboard Virtual Rumble-Strip Based Operation for Road Departure Warning
➤ Status: In progress

Debao Zhou, Department of Mechanical & Industrial Engineering (Duluth)
Infrared Thermal Camera-Based Real-Time Identification and Tracking of Large Animals to Prevent Vehicle Collisions (AVCs) on Roadways
➤ Status: In progress

Debao Zhou, Department of Mechanical & Industrial Engineering (Duluth)
Thermal Imaging-Based Driver Alert System with Real-Time Mapping of Roadside Deer Locations
★ Status: New

Technologies for Modeling, Managing, and Operating Transportation Systems

Hongyi Chen, Department of Mechanical Engineering
Developing an Intelligent Decision Support System for the Proactive Implementation of Traffic Safety Strategies
➤ Status: In progress

Gary Davis and John Houros, Department of Civil Engineering
Access to Destinations: Streamlining the Arterial Data Acquisition and the Estimation of Network-Wide Travel Link Times
➤ Status: In progress

Gary Davis and Henry Liu, Department of Civil Engineering
Using Detailed Signal and Detector Data to Investigate Intersection Crash Causation
➤ Status: In progress

Gary Davis, John Houros, and Chen-Fu Liao, Department of Civil Engineering
Estimating the Crash Reduction and Vehicle Dynamic Effects of Flashing LED Stop Signs
➤ Status: In progress

Max Donath, Craig Shankwitz, and Michael Manser, Department of Mechanical Engineering
CICAS Stop Sign Assist (SSA) System
✔ Status: Complete

Max Donath, Department of Mechanical Engineering
Aggregating VMT within Predefined Geographic Zones Using a Cellular Network
➤ Status: In progress

Max Donath, Department of Mechanical Engineering
Analysis of the Impact of Road Use for Alternate Transportation in Denali Park
➤ Status: In progress

Demoz Gebre-Egziabher and Greg Nelson, Department of Aerospace Engineering & Mechanics
Analysis of Uninhabited Aerial Vehicles ITS Concept of Operations
✔ Status: Complete

Demoz Gebre-Egziabher, Department of Aerospace Engineering & Mechanics
and Craig Shankwitz, Department of Mechanical Engineering
Development of an Accurate and Low Cost GPS-Based Heading Determination System
▶ Status: In progress

Demoz Gebre-Egziabher, Department of Aerospace Engineering & Mechanics, and Craig Shankwitz, Department of Mechanical Engineering
Using Velocity Constraints to Enhance Carrier Phase GPS Robustness
▶ Status: In progress

John Hourdos and Panos Michalopoulos, Department of Civil Engineering
Development of Next Generation Simulation Models for Twin Cities: Freeway Metro-Wide Simulation Model (Phase I)
▶ Status: In progress

John Hourdos, Nikolas Geroliminis, and Gary Davis, Department of Civil Engineering
Vehicle Probe-Based Real-Time Traffic Monitoring on Arterials
▶ Status: In progress

John Hourdos, Department of Civil Engineering, and Seraphin Chally Abou, Department of Mechanical & Industrial Engineering (Duluth)
Effectiveness of Urban Partnership Agreement (UPA) Measures in the I-35W Corridor
▶ Status: In progress

John Hourdos and Gary Davis, Department of Civil Engineering
Expanding and Streamlining the RTMC Freeway Network Performance Reporting Methodologies and Tools
▶ Status: In progress

John Hourdos and Zuduo Zheng, Department of Civil Engineering
Evaluating Twin Cities Transitways’ Performance and their Interaction with Traffic on Neighboring Major Roads
▶ Status: New

David Levinson, and Henry Liu, Department of Civil Engineering and Kathleen Harder, College of Design
Traffic Flow and Road User Impacts of the Collapse of the I-35W Bridge Over the Mississippi River
✓ Status: Complete

Chen-Fu Liao and Gary Davis, Department of Civil Engineering
Bus Signal Priority Based on GPS and Wireless Communications (Phase III)—Bus to Roadside Infrastructure Communication Framework for Intelligent Transportation
▶ Status: In progress

Chen-Fu Liao, Department of Civil Engineering, and Michael Rakauskas, formerly Department of Mechanical Engineering
Accessible Traffic Signals for Blind and Visually Impaired Pedestrians
✓ Status: Complete

Chen-Fu Liao and Henry Liu, Department of Civil Engineering
Advanced System Analysis for Public Transit (ASAPT) Using Data-Driven Transit Performance Measures for Transit Network Analysis
▶ Status: In progress

Chen-Fu Liao and Gary Davis, Department of Civil Engineering
Automate Traffic Data Quality Verification and System Malfunction Identification for ATR and WIM Systems
▶ Status: In progress

Henry Liu, Department of Civil Engineering
BECS Collaborative Research: Modeling the Dynamics of Traffic User Equilibria Using Differential Variational Inequalities
▶ Status: In progress

Henry Liu and Panos Michalopoulos, Department of Civil Engineering
Development of Algorithms for Travel-Time-Based Traffic Signal Timing, Phase I
✓ Status: Complete

Henry Liu and Panos Michalopoulos, Department of Civil Engineering
Development of the Next Generation Metro-Wide Simulation Models for the Twin Cities’ Metropolitan Area: Mesoscopic Modeling
✓ Status: Complete

Henry Liu and Chen-Fu Liao, Department of Civil Engineering
SMART-Signal: Systematic Monitoring of Arterial Road Traffic and Signals, Phase II
▶ Status: In progress

Henry Liu and David Levinson, Department of Civil Engineering, and Kathleen Harder, College of Design
BRIDGE: Behavioral Response to the I-35W Collapse of the I-35W Bridge Over the Mississippi River
✓ Status: Complete

Henry Liu, Department of Civil Engineering
Research Implementation of the SMART-Signal System on TH13
▶ Status: In progress

Henry Liu, Department of Civil Engineering
Further Development of the SMART-Signal System with the City of Eden Prairie
▶ Status: In progress

Henry Liu, Department of Civil Engineering
Estimating and Measuring Arterial Travel Time and Delay
▶ Status: In progress

Panos Michalopoulos and Nikolas Geroliminis, Department of Civil Engineering
Development of the Next Generation Stratifed Ramp Metering Algorithm Based on Freeway Density
✓ Status: Complete

Panos Michalopoulos, Department of Civil Engineering
Low Cost Portable Video-Based Queue Detection for Work Zone Safety
✓ Status: Complete

Xun Yu, Department of Mechanical & Industrial Engineering (Duluth)
Intelligent Pavement for Traffic Flow Detection - Phase I
▶ Status: In progress

Xun Yu, Department of Mechanical & Industrial Engineering (Duluth)
Intelligent Pavement for Traffic Flow Detection - Phase II
▶ Status: In progress

Social and Economic Policy Issues Related to ITS

John Bryson, Barbara Crosby, and Melissa Stone, Humphrey School of Public Affairs
Urban Partnership Agreement: A Comparative Study of Technology and Collaboration in Transportation Policy Implementation
✓ Status: Complete

John Bryson, Barbara Crosby, and Melissa Stone, Humphrey School of Public Affairs
From Start to Finish: Cross-Sector Collaboration and the Urban Partnership Agreement
✓ Status: In progress

Jason Cao and Frank Douma, Humphrey School of Public Affairs
Substitution between E-shopping and Travel: Evidence from the Twin Cities
✓ Status: Complete

Jason Cao and Lee Munnich, Humphrey School of Public Affairs
Benefit-Cost Analysis of Price Voting: Case Study for MnPASS
✓ Status: In progress

Frank Douma, Humphrey School of Public Affairs
ITS and Locational Privacy: Suggestions for Peaceful Coexistence
✓ Status: In progress
Appendix: Research Projects

Frank Douma, Humphrey School of Public Affairs
ITS Data Needs: How Much Do We Really Need to Know?
▶ Status: In progress

Yingling Fan and Frank Douma, Humphrey School of Public Affairs, and Chen-Fu Liao and Julian Marshall, Department of Civil Engineering
Smartphone-Based Travel Experience Sampling and Behavior Intervention among Young Adults (UbiActive Phase I)
▶ Status: In progress

Thomas Horan and Benjamin Schooley, Humphrey School of Public Affairs
ITS and Transportation Safety: EMS System Data Integration to Improve Traffic Crash Emergency Response and Treatment (Phase II)
▶ Status: In progress

Thomas Horan and Benjamin Schooley, Humphrey School of Public Affairs
ITS and Transportation Safety: EMS System Data Integration to Improve Traffic Crash Emergency Response and Treatment (Phase III)
▶ Status: In progress

Thomas Horan and Benjamin Schooley, Humphrey School of Public Affairs
ITS and Transportation Safety: EMS System Data Integration to Improve Traffic Crash Emergency Response and Treatment (Phase IV)
▶ Status: In progress

David Levinson, Department of Civil Engineering
Computing Auto Accessibility to Other Destinations
▶ Status: In progress

David Levinson, Department of Civil Engineering
Consumer Travel Behavior and Retail Geography: A Microscopic Investigation Using GPS Data and Parcel-Level Land Use
▶ Status: In progress

Greg Lindsey, Humphrey School of Public Affairs
Understanding the Use of Nonmotorized Transportation Facilities through Application of Infrared and Radio-Frequency Technologies
▶ Status: In progress

Lee Munnich, Ferrol Robinson, and Zhirong Zhao, Humphrey School of Public Affairs
Implementing Distance-Based User Fees as a Replacement for the Gas Tax
▶ Status: In progress

Carissa Schively Slotterback, Humphrey School of Public Affairs, and John Hourdos, Department of Civil Engineering
Technology in Planning and Participatory Processes: Identifying New Synergies through Real World Application
✔ Status: Complete

Elizabeth Wilson, Humphrey School of Public Affairs, Kevin Križek, University of Colorado (formerly Humphrey School of Public Affairs), and Julian Marshall, Department of Civil Engineering
School Travel and the Implications for Advances in Transportation Related Technology
✔ Status: Complete
Selected Publication of Work by ITS Institute Researchers


Chatterjee, I., and Davis, G. “Using High-Resolution Detector and Signal Data to Support Crash Identification and Reconstruction.” Transportation Research Record (in press).


Selected Presentations by ITS Institute Researchers


Donath, M. (2011, May; 2010, October). “Driver Assist Technology: Deploying Bus Rapid Transit (BRT) along a Narrow Lane or Road Shoulder.” Northwestern University Transportation Center, Evanston, Illinois; and ITS World Congress, Busan, Korea.


Appendix: Selected Publications and Presentations

and Reopening: Empirical Observations and Theoretical Models." Department of Civil and Engineering and Mechanics, University of Wisconsin at Milwaukee, Wisconsin.


Published Research Reports

Published Reports on ITS Institute Research

Reports are available in PDF format at www.its.umn.edu/Publications/ResearchReports.

Advanced LED Warning Signs for Rural Intersections Powered by Renewable Energy
Taek Mu Kwon and Ryan Weidemann
MnDOT 2011-04

Usability Evaluation of a Smart Phone-based Teen Driver Support System (TSSS)
Janet Creaser, Alec Gorjestani, Michael Manser, and Max Donath
MnDOT 2011-13

Gary A. Davis, Yorgos J. Stephanedes, and Jeong-Gyu Kang
CTS 95-05

Real Time Prediction of Freeway Occupancy for Congestion Control
Vladimir Cherkassky and Sangkug Yi
CTS 97-12

School Choice and Children’s School Commuting
Elizabeth Wilson, Julian Marshall, Kevin Kriek, and Ryan Wilson
CTS 09-01

Technology in Planning and Participatory Processes: Identifying New Synergies through Real World Application
Carissa Schively Slotterback and John Hurdos
CTS 09-09

Henry X. Liu and Xuan Di
CTS 10-10

The Interactions between E-Shopping and Store Shopping: A Case Study of the Twin Cities

Xinyu (Jason) Cao, Frank Douma, Fay Cleaveland, and Zhiyi Xu
CTS 10-12

Development of a Low-Cost Interface between Cell Phone and DSRC-Based Vehicle Unit for Efficient Use of IntelliDriveSM Infrastructure
Beau Roodell and M. Imran Hayee
CTS 10-14

Development and Field Demonstration of DSRC-Based V2I Traffic Information System for the Work Zone
Buddhika Malitpe and M. Imran Hayee
CTS 10-15

Real-Time Nonintrusive Detection of Driver Drowsiness — Phase II
Xun Yu
CTS 10-16

Low-Cost Portable Video-Based Queue Detection for Work-Zone Safety
Ted Morris, Jory A. Schwach, Panos G. Michalopoulos
CTS 11-02

Development of the Next Generation Metro-Wide Simulation Models for the Twin Cities’ Metropolitan Area: Mesoscopic Modeling
Henry X. Liu, Adam Dancyzk, and Xiaozheng He
CTS 11-03

Snow Rendering for Interactive Snowplow Simulation—Supporting Safety in Snowplow Design
Peter Willemsen
CTS 11-04

Development of the Next Generation Stratified Ramp Metering Algorithm Based on Freeway Density
Nikolas Geroliminis, Anupam Srivastava, and Panos Michalopoulos
CTS 11-05

Analysis of Unmanned Aerial Vehicles Concept of Operations in ITS Applications
Demoz Gebre-Egziabher and Zhiqiang Xing
CTS 11-06

The Urban Partnership Agreement: A Comparative Study of Technology and Collaboration in Transportation Policy Implementation
John M. Bryson, Barbara C. Crosby, Melissa M. Stone, Emily Saunoi-Sandgren, and Anders S. Imboden
CTS 11-07

Counting Empty Parking Spots at Truck Stops Using Computer Vision
Pushkar Modi, Vassilios Morellas, and Nikolaos P. Papanikolopoulos
CTS 11-08

Dual Frequency, Carrier Phase Differential GPS Augmentation
Eddie Arpin, Bryan Newstrom, and Craig Shankwitz
CTS 11-09

Development of Mobile Accessible Pedestrian Signals (MAPS) for Blind Pedestrians at Signalized Intersections
Chen-Fu Liao, Michael Rakauskas, and Avarsh Rayankula
CTS 11-11

Determination of the Alert and Warning Rotation and Location, using Random Gap Acceptance and Rejection Behavior at Rural Thru-Stop Intersections in the US – Data Collection Results in Eight States: CICAS-SSA Report #3
Alec Gorjestani, Arvind Menon, Pi-Ming Cheng, Craig Shankwitz, and Max Donath
FHWA-CICAS

Janet Creaser, Michael Manser, Justin Graving, and Max Donath
FHWA-CICAS

Traffic Flow and Road User Impacts of the Collapse of the I-35W Bridge Over the Mississippi River
Shanjiang Zhu, David M. Levinson, Henry Liu, Kathleen A. Harder, and Adam Dancyzk
MnDOT 2010-21