Appendix: 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.

### Human Performance and Behavior

**Gary Davis and John Hourdors, Department of Civil Engineering**
- Field Study of Driver Behavior at Flashing Yellow Arrow vs. Green-Ball Permitted Left-Turn Indications
  - Status: New

**Max Donath, Alec Gorjestani, Janet Creaser, and Michael Manser, Department of Mechanical Engineering**
- Smartphone-Based Novice Teenage Driver Support System
  - Status: Complete

**Caroline Hayes, Department of Mechanical Engineering**
- In-Vehicle Decision Support to Reduce Crashes at Rural Thru-Stop Intersections
  - Status: In progress

- Hand Images in Virtual Spatial Collaboration for Traffic Incident and Disaster Management
  - Status: New

- Speed Impacts of Occasional Hazard Residential Street Warning Signs
  - Status: In progress

**John Hourdors and Gary Davis, Department of Civil Engineering**
- Investigation of Pedestrian/Bicyclist Risk in Minnesota Roundabout Crossings
  - Status: In progress

**Chen-Fu Liao, Department of Civil Engineering**
- Spatial Cognition of the Blind and Visually Impaired while Using a Mobile Accessible Pedestrian System (MAPS) at Intersection Crossings
  - Status: New

**Michael Manser, Department of Mechanical Engineering, and Michael Rakauskas, formerly of Department of Mechanical Engineering**
- Requirements for Effective Fuel Economy Displays for Improving Fuel Economy and Safety
  - Status: Complete

**Michael Manser**
- Integration of Pedestrian/Bicyclist Risk in Minnesota Roundabout Crossings
  - Status: New

**John Hourdors and Craig Shankwitz, Department of Mechanical Engineering**
- An Evaluation of a Prototype Safe Teen Car
  - Status: In progress

**Xun Yu, Department of Mechanical & Industrial Engineering (Duluth)**
- Real-Time Noninvasive Detection of Driver Drowsiness
  - Status: Complete

**John Evans, Department of Chemistry and Biochemistry (Duluth)**
- Detection of Water and Ice on Bridge Structures by AC Impedance and Dielectric Relaxation Spectroscopy (Phase II)
  - Status: In progress

**John Evans, Department of Chemistry and Biochemistry (Duluth)**
- Detection of Water and Ice on Bridge Structures by AC Impedance and Dielectric Relaxation Spectroscopy (Phase III)
  - Status: In progress

**John Evans, Department of Chemistry and Biochemistry (Duluth)**
- Deployment and Field Testing of Novel Water and Ice Sensor Systems on Bridge Decks
  - Status: In progress

**John Evans, Department of Chemistry and Biochemistry (Duluth)**
- Continued Field Testing and Refinement of Novel Water and Ice Sensor Systems on Bridge Decks
  - Status: New

**M. Imran Hayee, Department of Electrical & Computer Engineering (Duluth)**
  - Status: In progress

**M. Imran Hayee, Department of Electrical & Computer Engineering (Duluth)**
- Development of a Low-Cost Interface between Cell Phones and DSRC-Based Vehicle Unit for Efficient Use of V.I. Infrastructure
  - Status: Complete

**Eil Kwon, Department of Civil Engineering (Duluth)**
- Assessment of Capacity Estimation Methods for a Multi-Lane Roundabout with Field Traffic Data
  - Status: In progress

**Eil Kwon, Department of Civil Engineering (Duluth)**
- Development of Freeway Management and Operational Strategies with IRIS-in-LOOP Simulation
  - Status: In progress

**Eil Kwon, Department of Civil Engineering (Duluth)**
- Estimation of Winter Snow Operation Performance Measures with Traffic Flow Data
  - Status: In progress

**Taek Kwon, Department of Civil Engineering (Duluth)**
- Advanced Dynamic (LED) Warning Signs for Rural Intersections Powered by Renewable Energy
  - Status: Complete

**Taek Kwon, Department of Electrical & Computer Engineering (Duluth)**
- Development of a Weigh-Pad-Based Portable Weigh-in-Motion (WIM) System
  - Status: In progress

**Taek Kwon, Department of Electrical & Computer Engineering (Duluth)**
- New Reporting Capabilities for Continuous Vehicle and WIM Data
  - Status: In progress

**Nikolaos Papanikolopoulos, Department of Computer Science and Engineering**
- Deployment of Practical Methods of

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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
Rollovers Prediction and Prevention of Tripped
» 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 Iminent 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
Rural 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

Hua Tang, Department of Electrical and Computer Engineering (Duluth)
Development of a Multiple-Camera Tracking System for Accurate Traffic Performance Measurements at Roundabouts/Intersections
» Status: New

Peter Willemsen, Department of Computer Science (Duluth), Lee Zimmerman, Department of Electrical & Computer Engineering (Duluth), and Albert Yonas, Institute of Child Development
Snow Rendering for Interactive Snowplow Simulation – Supporting Safety in Snowplow Design
» Status: Complete

Peter Willemsen, Department of Computer Science (Duluth), Lee Zimmerman, Department of Electrical & Computer Engineering (Duluth), and Albert Yonas, Institute of Child Development
Snow Rendering for Interactive Snowplow Simulation – Supporting Safety in Snowplow Design (Phase II)
» 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

Debao Zhou, Department of Mechanical & Industrial Engineering (Duluth)
Infrared Thermal Camera-Based Real-Time Identification and Tracking of Large Animals to Prevent Animal-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

Debao Zhou, Department of Mechanical & Industrial Engineering (Duluth)
Analysis of the Impact of Road Use for Alternate Transportation in Denali Park
» Status: In progress

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

Gary Davis and John Hourdos, 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 Hourdos, 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
Analyzing Aircraft Operations and Ground Handling Activities at SFO
» Status: In progress

Gary Davis, John Hourdos, 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, Department of Mechanical Engineering
Analyzing Aircraft Operations and Ground Handling Activities at SFO
» 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
Analysis of Uninhabited Aerial Vehicles ITS Concept of Operations
» Status: Complete
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

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 (ASAPTR) 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 Disruption: Gauging Equilibrium
✔ 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

Henry Liu, Department of Civil Engineering
Low Cost Portable Video-Based Queue Detection for Work Zone Safety
✔ Status: Complete

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

Panos Michalopoulos, Department of Civil Engineering
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

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 Krizek, 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