Ann Arbor: National Test Environment for Connected Vehicles

The Business of IT

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Outline

- UMTRI’s increasing impact in transportation research
- Intelligent Transportation Systems (ITS) in SE Michigan
- Ann Arbor is the national test environment for connected vehicles – the USDOT Safety Pilot program
UMTRI’s strategic goals

- Elevate transportation as a priority in sustainability research and policy
- Conduct system-solution research for safe and efficient vehicle movement
- Apply the public health model to reduce transportation-related injuries and social disparities in access to safe mobility
- Advance the sciences of vehicle crash avoidance and occupant protection
- Develop the Center for Management of Information for Safe and Sustainable Transportation (CMISST)
Our footprint

Impact for Sustainable Contribution

- IVBSS Integrated Vehicle Based Safety Systems
- SAFETY PILOT V2V & V2I
- SWT Strategic Worldwide Transportation
- UTC University Transportation Center
- SMART Sustainable Mobility Accessibility Research & Transformation
- U-M INJURY CENTER

Scientific Excellence

- Scientific excellence is expected
- “Impact” for sustainable contribution will differentiate us
Collaboration with industry under federal funding

- Annual revenue of M$23 and 120 full-time staff
- Sponsored projects for Federal Government (75 %), auto industry (15 %), Michigan Government and others
- Federal Government sponsorship from DoT (75 %) and NIH
- Intelligent Transportation Systems (ITS) account for more than 30 % of revenue
UMTRI Overview

- Annual revenue of $23M and 120 full-time staff
- Sponsored projects for Federal Government (75%), auto industry (15%), Michigan Government and others
- Federal Government sponsorship from Department of Transportation (75%) and National Institutes for Health
- Wide-ranging disciplinary emphases, including engineering, psychology, and statistics.
UMTRI Research Groups

- Behavioral Sciences
- Biosciences
- Driver Interface
- Engineering Systems
- Human Factors
- Intelligent Transportation Systems Integration
- Transportation Data Center
- Vehicle Safety Analytics
- Vehicle Systems and Control
- Young Driver Behavior and Injury Prevention
Enabling large programs - USDOT supported studies

- IVBSS M$33 – awarded to UMTRI
  - Completed August 2010
- NHTSA heavy trucks advanced safety systems
- VII M$53 – awarded to CAMP and VII-C
  - UMTRI contracted by MDOT to evaluate and document VII data from SE Michigan Test Bed
- ITS, V2V, V2I and V2X
  - Heavy truck V2V award just announced
  - Safety Pilot is imminent
- NHTSA biomechanics program – UMTRI contract extended
  - U-M CIREN support
A major UMTRI strength: naturalistic driving studies
Naturalistic Data & Visualization
U.S. DOT Field Operational Tests Conducted by UMTRI

Light Vehicles – ACC
- ICC FOT: 131K mi, 108 drivers

Heavy Trucks - Rollover
- RSA: 480K mi, 23 drivers

Light Vehicles – Forward Crash/ACC
- ACAS FOT: 110K mi, 96 drivers

Light Vehicles – Lane Departure/Curve Speed
- RDCW FOT: 137K mi, 78 drivers

Light Vehicles & Heavy Trucks – Multiple Systems
- IVBSS: Est. 750K mi, 150+ drivers

1990 2010
Vehicle technology that recognizes and targets critical situations

USDOT’s IVBSS: NHTSA & RITA
IVBSS Scope and Purpose

- A 5 year effort to develop and field test integrated safety systems for passenger vehicles and heavy trucks
- Safety systems will provide warnings for rear-end, lane change and road departure crashes in addition to arbitration of multiple crash threats
  - Forward crash warning, lane departure warning, lane change/merge warning, curve speed warning
- Includes a one-year field test on public roads to determine system performance, safety benefits, and user acceptance
Light Vehicle Sensor Coverage

- Radar
- Vision

- Curve speed Warning (CSW)
- Lane-change/Merge (LCM)
- Lateral Drift Warning (LDW)
- Forward Crash Warning (FCW)

**Legend:**
- Radar
- Vision
Timeline - Vehicle Deployment

Phase I – 30 months

- Nov 2005: Engineering Development Vehicles
- Nov 2006: Prototype Vehicles
- June 2008: Pilot Vehicles

Phase II – 27 months

- Nov 2008: Extended Pilot FOT
- Feb 2009: FOT Data Collection
- August 2010: FOT Data Collection
Field Operational Test Scope

- 108 drivers @ 6 wks
  - Baseline (2 weeks), IVBSS enabled (4 weeks)
  - Evenly split by gender
  - Three age groups (20-30, 40-50, 60-70 years)

- Estimated* 272,000 Miles, 9300 hours
  - 500+ data channels, 7 radar tracks, 5 video images, vehicle state, system measures
  - All stored in a relational database

*Prediction based on previous FOTs
Field Operational Test: Crash Warnings

- 108 drivers each drive for six weeks, unaccompanied
- 16 vehicles each with four prototype crash warning systems
- 7 radars, 5 video streams, GPS, >500 other signals at 10 to 50 Hz

LV system: Visteon Corporation & Takata Corp. Thanks to Honda R&D.
Willingness to pay

What is the maximum amount that you would pay for the integrated system?

Drivers like some systems more

Lane departures decreased

No increase in distraction

Departures per 100 miles

Baseline

Treatment

Departures per 100 miles

Response Frequency

Maximum Price

What is the maximum amount that you would pay for the integrated system?

Drivers like some systems more

Usefulness

Satisfaction

Ideal

Neutral

Baseliner

Treatment

Departures per 100 miles

Lane departures decreased

No increase in distraction

Drivers like some systems more

Willingness to pay

What is the maximum amount that you would pay for the integrated system?
Simulates the movements of individual vehicles

Simulates interactions with
- Road geometry
- Other vehicles
- Traffic signals
- Variable message signs
- Incidents
- Pedestrians

Offers an extensive application programming interface
- Allows a wide array of new functionalities to be modeled
- Allows overriding of driver behavior models
U.S. DOT VII Proof-of-Concept Testbed

[Map showing locations of Novi and Detroit]
IntelliDrive System Modeling Concept

Simulation of RSEs using VMS Beacons

Snapshot generation to be performed by vehicles

Snapshots to remain within vehicle until upload by an RSE

Data storage within link objects used a emulator of link-based database at a central server

Applications associated with the network or specific simulation objects
USDOT ITS programs

- V2V (V2I, V2X) dominates til at least 2013
- USDOT partnership thru RITA
  - NHTSA champions V2V, with a 2013 deadline
  - FHWA champions V2I
  - RITA champions other modes
- RITA champions environmental benefits (AERIS program)
- Heavy truck applications are late to the party