ITS-Connected Vehicle Technology research initiative

April 24, 2015
Agenda

• IUCRC. Dr. David (Butch) Irick is working on this proposal.
• Discuss the VW initiative briefly (internal, UT RFP)
• The strategy going forward
• Presentation (time permitting)
• Announcements or other items of common interest
U/UCRC

- I/UCRC programs develop long-term partnership among academia, industry and government
- Dr. David (Butch) Irick
- Industry/University Cooperative Research Center (I/UCRC) proposal
- Theme is "Planning for Efficient Vehicles and Sustainable Transportation Systems (EV-STS)"
- Partners: The University of Alabama, Tuscaloosa, Arizona State University, University of Louisville, State University of New York, Buffalo, University of Tennessee, Knoxville, and University of Texas, Austin.
- PPT presentation that Butch shared with the group for information and input...
VW

- Discuss the VW initiative briefly (internal, UT RFP)
- Up to $200K max
- Build on previous projects
- Acquire technology
- VW seems to be in the news lately...
- [http://www.dw.de/vw-power-struggle-enters-new-round/a-18402882](http://www.dw.de/vw-power-struggle-enters-new-round/a-18402882)
Strategy

• The strategy going forward
  – Funding opportunities: Samsung
• Purchasing connected vehicle equipment
• Creation of a small testbed
• Analytics for basic safety messages (Jun Liu)
• Company provides the equipment

• Announcements or other items of common interest
  – ITS America, May 31-June 3, Pittsburgh
  – IEEE; 15 Sep 15 Sep 18 2015, Canary Islands, Spain
  – ITS World Congress, Oct. 5- Oct. 9, Bordeaux
  – Transportation Research Board
Improved Warning and Control Assistance Information from Basic Safety Messages Transmitted between Connected Vehicles

Accepted for the presentation at 22nd ITS World Congress

Asad Khattak

The University of Tennessee
Knoxville
Data Description

- Basic Safety Messages (BSM) sent/received by vehicles and roadside equipment
- Safety Pilot Model Deployment (SPMD) in Ann Arbor, Michigan

- Research Data Exchange (RDE) [https://www.its-rde.net/home](https://www.its-rde.net/home),
- Federal Highway Administration under US DOT
- One-day sample data: 155 trips by 49 vehicles
- 968,522 records (10 Hz) of BSM
# Data Description

## Variable Descriptions

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Position</strong></td>
<td></td>
</tr>
<tr>
<td>Altitude</td>
<td>A GPS-based estimate of height above sea level (height above the reference ellipsoid that approximates mean sea level)</td>
</tr>
<tr>
<td>Latitude</td>
<td>Current degree of latitude at which the vehicle is located</td>
</tr>
<tr>
<td>Longitude</td>
<td>Current degree of longitude at which the vehicle is located</td>
</tr>
<tr>
<td><strong>Motion</strong></td>
<td></td>
</tr>
<tr>
<td>Speed (host vehicle)</td>
<td>Current vehicle speed, as determined from the vehicle’s transmission</td>
</tr>
<tr>
<td>Longitudinal Acceleration</td>
<td>Longitudinal acceleration measured by an Inertial Measurement Unit (IMU)</td>
</tr>
<tr>
<td>Lateral Acceleration</td>
<td>Lateral acceleration measured by an IMU</td>
</tr>
<tr>
<td><strong>Vehicle Maneuvering</strong></td>
<td></td>
</tr>
<tr>
<td>Accelerator Pedal</td>
<td>Reflects the amount the accelerator pedal is displaced with respect to its neutral position</td>
</tr>
<tr>
<td>Brake Pedal</td>
<td>Indicates whether the brake light is on or off</td>
</tr>
<tr>
<td>Cruise Control</td>
<td>Indicates whether cruise control is active/engaged</td>
</tr>
<tr>
<td>Turn Signal</td>
<td>Provides information regarding the state of the vehicle turn signals</td>
</tr>
<tr>
<td><strong>Driving Context</strong></td>
<td></td>
</tr>
<tr>
<td>Number of objects</td>
<td>Number of identified objects, as determined by the Mobileye sensor</td>
</tr>
<tr>
<td>Distance to the closest object</td>
<td>Position of the closest object, relative to a reference point on the host vehicle, according to the Mobileye sensor</td>
</tr>
<tr>
<td>Relative speed of the closest object</td>
<td>Longitudinal velocity of the closest object, relative to the host vehicle according to the Mobileye sensor</td>
</tr>
</tbody>
</table>
Data Visualized on Roads

(i) Local Road
- Variance of Lateral Acceleration in One Second
- Lateral Acceleration
- Variance of Longitudinal Acceleration in One Second
- Longitudinal Acceleration
- Speed

(ii) Freeway
- Variance of Lateral Acceleration in One Second
- Lateral Acceleration
- Variance of Longitudinal Acceleration in One Second
- Longitudinal Acceleration
- Speed
2D Distributions of Longitudinal and Lateral Acceleration

Key question: How to identify the extreme driving seconds?
Previous studies “warning threshold”

Given a distribution of accelerations, find the seconds with values beyond mean +/- 1 SD or 2 SD

A cut-off threshold

No driving context
Previous studies

Or, give a distribution of accelerations across speeds, find the seconds with values beyond mean +/- 1 SD or 2 SD

Varying thresholds across speeds, indicating varying driving contexts

But, no lane change, driving on curves, etc.

See:
New ways to give the thresholds

Get the distributions of accelerations in different directions
→ give “warning thresholds” in different directions across the speeds
3D Distributions of Longitudinal and Lateral Acceleration

Same color shows same magnitudes of Longitudinal and Lateral Acceleration within given bins.

Blue: Low magnitudes (< 15 percentile)
Red: High magnitudes (> 85 percentile)
• Animations
Warning and control assist based on extreme driving seconds
Warning and control assist on Road

(i) Warning
(ii) Warning

A six-way intersection involving three two-way roads with pedestrian sidewalks

1 → poor sight distance owing to the roadside plantings on E Madison St.
2 → intersecting traffic from Packard St.
3 → pedestrians crossing S Division St.
Applications & Future Study

Applications:
• Traveler information systems incorporated with V2V and V2I applications
• Proactive traffic management
• And more...

Continuing Study:
• Data expansion (this study uses one-day BSM)
• Warning type, according to the directions of extreme driving second identified, such as side collision warning, rear-end warning, etc.
• Relationships between warnings and driving contexts
• Change of driving behaviors after implementing such applications
• And more...
Thank You!!