Developing a V2I Motorcycle Warning Algorithm using Naturalistic Driving Data

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Outline

- Introduction to Motorcycle Hazards
- Connected Vehicle Technology
- Motorcycle Warning Algorithm - System Overview
- Framework for Algorithm Development
- Future Work
- Summary
- References
Background

- Road hazards such as gravel, potholes, and debris, may cause a rider to lose control of his or her bike.
- These conditions can occur on any roadway where activity has altered the quality of the existing pavement.
- Motorcyclists are more likely to be seriously injured or killed when interacting with pavement abnormalities than passenger vehicles.
Connected-Vehicle Technology
Motorcycle Warning Algorithm - Application
The Process

Crash Report Analysis

Motorcyclist Subjective Feedback

SHRP 2 Kinematic Data

Functional Detection Algorithm

Classification Data

Data Mining
Determining Events of Interest

- Crash Report Analysis
- Motorcyclist Survey Response

Events in SHRP2 Data
Advancing Transportation Through Innovation

• LARGE

• VARIETY –

• LARGE
• VARIETY
• MANY
•
Getting into the data

- Variables of interest will be identified for different event types
- Some variables include:
  - Speed
  - Acceleration (x,y,z)
  - Braking/Steering input
  - Activation of integrated safety systems
Video Assessment to further algorithm development

**Event Classification**
- Transverse Surface Irregularities
- Longitudinal Surface Irregularities
- Low Traction Situations
- Debris in Roads

**Hazard Severity Assessment**
- Low Level
- Medium
- High Level

**Driver Response Classification**
- Driver Strikes Surface Abnormality
- Driver Takes Evasive Action
## Driver Response Classification

<table>
<thead>
<tr>
<th>Data Collected:</th>
<th>Driver Hits Deformation</th>
<th>Driver Takes Evasive Action</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Vehicle Kinematic Data before, during, and after striking the deformation</td>
<td>Driver response data</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Steering</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Braking</td>
</tr>
<tr>
<td>How it will be used:</td>
<td>Deformation type and severity identification</td>
<td>Directional information for motorcyclist for hazard avoidance</td>
</tr>
</tbody>
</table>
Future Work

- Algorithm, false-positive and false-negative rates will be ascertained using a confusion matrix
- After preliminary algorithm validation and refinement, a Field Operational Test will be deployed on a small set of passenger vehicles and motorcycles

<table>
<thead>
<tr>
<th>Actual Value (Experiment)</th>
<th>Predicted Outcome</th>
<th>Positive</th>
<th>Negative</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive</td>
<td>TP</td>
<td>True Positive</td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>FN</td>
<td>False Negative</td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>FP</td>
<td>False Positive</td>
<td></td>
</tr>
<tr>
<td>Negative</td>
<td>TN</td>
<td>True Negative</td>
<td></td>
</tr>
</tbody>
</table>
In Summary

- Motorcyclists are a vulnerable group of road users

- Using naturalistic data with subjective feedback from motorcyclists allows this to be holistic and human based

- Implementation of a warning algorithm using advanced technology has the potential to reduce motorcyclist injuries and fatalities
References


Thank you!

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