Naturalistic Bicycling Behavior Study Update

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Background

• Bicyclists experience disproportionate rates of injuries and fatalities compared to other roadway vehicle types.

• The safety of bicyclists is of particular concern in Florida, where bicycle fatality rates were nearly triple the national average.

• Florida has been ranked #1 on bicycle fatality rate in the nation for years.
Background

- Understanding of naturalistic bicycling behaviors and interactions with vehicles in Florida are essential for effective countermeasure development.

- Use of instrumented bicycles to collect naturalistic bicycling behavior data.

Literature Review

<table>
<thead>
<tr>
<th>#</th>
<th>Year</th>
<th>Title</th>
<th>Objective</th>
<th>Sensors</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2006</td>
<td>Driver Overtaking Bicyclists: Objective Data on the Effects of Riding Position</td>
<td>Identify factors influencing riding position of bicycle based on vehicle passing distance</td>
<td>Distance proximity sensor, camera</td>
<td>1</td>
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<tr>
<td>2</td>
<td>2010</td>
<td>The Effect of Cycle Lanes on the Proximity Between Motor Traffic and Cycle Traffic</td>
<td>To establish influence of bike lane width to vehicle passing distance</td>
<td>Cameras</td>
<td>1</td>
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<td>3</td>
<td>2010</td>
<td>Naturalistic Cycling Study: Identifying Risk Factors for On-Road Commuter Cyclists</td>
<td>To identify risk factors for collisions/near-collisions involving on-road commuter cyclists and drivers</td>
<td>Cameras</td>
<td>13</td>
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<td>4</td>
<td>2012</td>
<td>Observations of Driver Behavior During Overtaking of Bicycles on Rural Roads</td>
<td>To understand the behavior of drivers passing bicycles on rural roads</td>
<td>Cameras, GPS, ultrasonic range sensor</td>
<td>1</td>
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<td>5</td>
<td>2012</td>
<td>Understanding Bicycle Dynamics and Cyclist Behavior from Naturalistic Field Data</td>
<td>To establish the methods and equipment in collecting naturalistic cycling data</td>
<td>Cameras, GPS, accelerometer, gyroscope, brake force</td>
<td>20</td>
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<td>#</td>
<td>Year</td>
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<td>6</td>
<td>2012</td>
<td>Piloting the Naturalistic Methodology on Bicycles</td>
<td>Investigating the effort to adapt the naturalistic driving methodology to bicycles at SAFER</td>
<td>Cameras, GPS, accelerometer, gyroscope, magnetometer, brake force, speed</td>
<td>17</td>
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<td>7</td>
<td>2013</td>
<td>The Use of Quasi-Naturalistic Fusing Behavior Methods to Investigate Bicycle Riders’ Behaviors When Motorists Pass</td>
<td>Investigating how vehicle-related factors, road-related factors, and cyclist-related factors influenced motorists’ decisions about initial passing distances and cyclists’ behaviors after the motorists started to pass</td>
<td>GPS, Accelerometer, gyroscope, distance sensors, proximity, steering angle, cameras</td>
<td>34</td>
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<td>8</td>
<td>2013</td>
<td>A Naturalistic Study of Commuter Cyclists in the Greater Stockholm Area</td>
<td>To describe and pinpoint accessibility and safety problems, but also to generate an accessible geographical interface that could serve as a traffic planning tool for cycle network improvement</td>
<td>GPS, Camera</td>
<td>22</td>
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<tr>
<td>9</td>
<td>2014</td>
<td>Introducing Naturalistic Cycling Data: What Factors Influence Cyclists’</td>
<td>To establish cyclists’ risk on the road</td>
<td>Camera, GPS, inertia units, brake force</td>
<td>16</td>
</tr>
</tbody>
</table>

### Study Methodology

1. Develop Bicycle Data Acquisition System (BDAS) including trip information app
2. Recruit **100 participants**
3. Develop analysis tools including machine vision
4. Collect 3,000 person-hour data
5. Compile analyze behavioral data
6. Research six specific research questions
7. Recommend countermeasures
Six Specific Research Questions

1. What are the interactions between bicyclists and drivers making right turns at intersections (right-hook)?

2. What are the interactions between drivers making left turns and oncoming bicyclists (left-hook)?

3. What are the behavior, experience, and interactions of bicyclists and drivers at night?
Six Specific Research Questions

4. What are bicyclist route choice decisions with given origins and destinations?

5. What are the difference of bicycling behaviors with and without formal bicycle-riding training such as Cycling Savvy?

6. What are the contributing factors to bicycle crashes or close calls?

Side View of BDAS
BDAS Rear module includes:
- GPS
- Accelerometer
- Gyroscope
- Light
- Temperature
- 3 Ultrasonic distance sensor
- 1 camera

BDAS front module includes:
- 1 Ultrasonic distance sensor
- 1 camera
- 1 microphone
Next Steps

• Test and evaluate prototype
• Create 2\textsuperscript{nd} version
• Test and finalize BDAS
• Produce 50 BDAS systems