Event marker

Rider camera
Data channels

Videos (720p /30 fps)
- Rider
- Forward
- Left-rear
- Right-rear
- Audio channel

GPS (20 Hz / 2.0 m)
- Latitude
- Longitude
- Elevation
- GPS speed
- GPS heading
- GPS time
- # of satellites

IMU
- Ax
- Ay
- Az
- Roll rate
- Pitch rate
- Yaw rate

Bike Operations
- Wheel speed
- Front brake
- Rear brake
- Pedal cadence
- Event marker
KISS (Keep It Simple, Stupid)

- Sturdy, robust, small-size, weather-proof
- No charging needed for DAS (powered by e-bike battery)
- Automatic recording (triggered by bike motion)
- “Just ride”
Data collection

• 2018-2019 (two summers / falls)
• Study subjects were recruited in Ann Arbor.
• Each subject had the bike for two weeks
• Data set size (as of today):
  • 77 subjects
  • 8,134 km / 357 hours
# Safety critical events

<table>
<thead>
<tr>
<th>Event type</th>
<th>Definition</th>
<th>Count</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collision</td>
<td>Bicyclist hits or is hit by a vehicle driver.</td>
<td>1</td>
<td>0%</td>
</tr>
<tr>
<td>Near miss</td>
<td>A more severe conflict in which sudden and rapid evasive maneuvers (e.g. braking or swerving) are required by either or both the bicyclist and driver in order to avoid a collision. See Fig. 2 for an example.</td>
<td>17</td>
<td>7%</td>
</tr>
<tr>
<td>Close pass</td>
<td>A driver overtakes a bicyclist without leaving enough room between the vehicle and the bicyclist such that the latter feels unsafe. See Fig. 5a for an example.</td>
<td>29</td>
<td>13%</td>
</tr>
<tr>
<td>Conflict</td>
<td>A vehicle’s path crosses a bicyclist’s path, but little or no evasive maneuvers are required to avoid a collision. See Fig. 5b for an example.</td>
<td>44</td>
<td>19%</td>
</tr>
<tr>
<td>Unsafe infrastructure</td>
<td>Either the design of the facility is unsafe (e.g. sudden end of a bike lane), or the condition of the facility (e.g., potholes) is unsafe. See Fig. 5c for an example.</td>
<td>50</td>
<td>22%</td>
</tr>
<tr>
<td>Path obstruction</td>
<td>Something, usually a vehicle, trash can, or sign stand, is blocking bicyclist’s path, usually the bike lane. See Fig. 5d for an example.</td>
<td>47</td>
<td>20%</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td>Complex or miscellaneous conflicts that are related to, for example, road constructions, pedestrians, or animals.</td>
<td>21</td>
<td>9%</td>
</tr>
<tr>
<td>Not critical event</td>
<td>The study team could not identify a reasonable safety-critical issue from the video.</td>
<td>19</td>
<td>8%</td>
</tr>
<tr>
<td>Cannot verify</td>
<td>The event cannot be verified by the study team due to issues such as an obstructed or missing camera view.</td>
<td>3</td>
<td>1%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>231</td>
<td>100%</td>
</tr>
</tbody>
</table>
Post-study comments on e-bikes

• “appreciated the power assist for climbing hills.”

• “in areas with stop signs, it was much speedier to accelerate with the power assist, after stopping.”

• “the Assist help me get through intersections faster.”

• “Didn't sweat once getting to work.”

• “It removed the mental block of too much effort.”
• “I stopped looking for the absolutely shortest, flattest route and went for a more pleasant one.”

• “the speed was higher. That allowed me to match vehicle speed at some places where it was helpful (safer) to do so.”

• “Knowing I could accelerate faster than I'm used to became helpful sometimes, like when I was in traffic and making a left turn, to know I could quickly cross the oncoming lane safely.”
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