Naturalistic Driving Study for Understanding Causes & Effects in Major Crash Types in Japan

Nobuyuki Uchida
Japan Automobile Research Institute (JARI)

Tsutomu Mochida
Japan Automobile Manufacturers Association (JAMA)
Police reported statistics in Japan
(Relative proportion of collision types, vehicle as a primary party)

Four major crash types (80%)

- Rear-end: 33.6%
- Crossing/angle: 26.8%
- Right-turn: 9.8%
- Pedestrian: 8.0%
- Left-turn: 5.4%
- Head-on: 2.9%
- Single vehicle: 2.6%
- Other multiple: 10.8%

ITARDA (2004)
1. Overview of Naturalistic Driving Study
   • Preceding project in Japan
   • Data acquisition system
   • Result of 2 years field study

2. Reproduction of conflicting situations
Preceding project in Japan


- Purpose: Driver education
- Vehicle: Taxi (200 vehicles)
- DATA: 1ch video & vehicle data
Five channels of video data

- Forward view
- Pedal/Foot
- Driver Face (mirror image)
- Left side forward view
- Right side forward view

Horizontal Angle: 53 deg

Horizontal Angle: 85 deg

Horizontal Angle: 85 deg
### Numerical data

<table>
<thead>
<tr>
<th>Sensor</th>
<th>Parameter</th>
<th>Unit</th>
<th>Frequency</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>GPS</strong></td>
<td>Position</td>
<td>Latitude, Longitude</td>
<td>4Hz</td>
<td>N13434.256, E04523.236</td>
</tr>
<tr>
<td></td>
<td>Speed</td>
<td>0.1km/h</td>
<td>4Hz</td>
<td>65.2</td>
</tr>
<tr>
<td></td>
<td>Date</td>
<td>Year, Month, Day</td>
<td>4Hz</td>
<td>20060129</td>
</tr>
<tr>
<td></td>
<td>Time</td>
<td>Hour, Min., Sec.</td>
<td>4Hz</td>
<td>124535 (12h 45m 35s)</td>
</tr>
<tr>
<td></td>
<td>Direction</td>
<td>Deg.</td>
<td>4Hz</td>
<td>035 (clockwise 35 deg)</td>
</tr>
<tr>
<td></td>
<td>Angular Velocity</td>
<td>Deg/sec</td>
<td>4Hz</td>
<td>025 (25 deg/sec)</td>
</tr>
<tr>
<td><strong>G Sensor</strong></td>
<td>XY Acceleration</td>
<td>0.01G</td>
<td>10Hz</td>
<td>Max 2.0G</td>
</tr>
<tr>
<td><strong>OBD</strong></td>
<td>Throttle</td>
<td>%</td>
<td>10Hz</td>
<td>Full Throttle 100%</td>
</tr>
<tr>
<td><strong>Steering Sensor</strong></td>
<td>Steering Angle</td>
<td>Deg.</td>
<td>10Hz</td>
<td>If Available</td>
</tr>
<tr>
<td><strong>Digital Switch</strong></td>
<td>Brake</td>
<td>On/Off</td>
<td>10Hz</td>
<td>Lamp On/Off</td>
</tr>
<tr>
<td></td>
<td>Turn Signal (L)</td>
<td>On/Off</td>
<td>10Hz</td>
<td>Lamp On/Off</td>
</tr>
<tr>
<td></td>
<td>Turn Signal (R)</td>
<td>On/Off</td>
<td>10Hz</td>
<td>Lamp On/Off</td>
</tr>
</tbody>
</table>
Data Acquisition System (DAS)

Duration: 40s (Pre-30s, Post-10s)
Trigger methods

1. Deceleration of 0.35G or more AND brake ON
2. Deceleration of 1.00G or more AND brake OFF
3. Acceleration of 0.50G or more AND brake ON
4. Acceleration of 0.80G or more AND brake OFF
5. Lateral acceleration of 0.50G or more
1. Drivers & Vehicles
   • Non-professional drivers
   • Daily business activity
   • Passenger car (1500cc)

2. Field study (subject vehicles)
   • 3 vehicles: Oct. 2006 - Dec. 2006 (3 months)
   • 20 vehicles: Jan. 2007 - Jun. 2007 (6 months)
   • 60 vehicles: Jul. 2007 - Dec. 2008 (18 months)
Data sampling and classification diagram

- Sent every 2 weeks
- Stored in network storage
- Screened and classified by manual inspection

Contracted Company

Driver replaced HDD

11 regions

JARI

DATA HDD × 60

Sent back every 2 weeks
## Result of data classification

<table>
<thead>
<tr>
<th>Event Classification</th>
<th>Trigger type</th>
<th>Total Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Deceleration G</td>
<td>Acceleration G</td>
</tr>
<tr>
<td>Crash</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Incident</td>
<td>1,110</td>
<td>3</td>
</tr>
<tr>
<td>Traffic event</td>
<td>2,848</td>
<td>3</td>
</tr>
<tr>
<td>Normal driving</td>
<td>101,945</td>
<td>3,137</td>
</tr>
<tr>
<td>Others (private area)</td>
<td>7,953</td>
<td>266</td>
</tr>
<tr>
<td>Total Frequency</td>
<td>113,861</td>
<td>2,960</td>
</tr>
</tbody>
</table>
Incidents corresponding to crash types

(1,124 incidents)

- Rear-end: 473
- Crossing/Angle: 248
- Right-turn: 113
- Pedestrian: 112
- Left-turn: 45
- Head-on: 26
- Single vehicle: 6
- Other multiple vehicle: 101

Incident corresponding to crash types
Event coding and database

- Event coding variables (80 variables)
  - Event description (10 var.)
  - Traffic environment (21 var.)
  - V1/D1, Naturalistic driving subject (22 var.)
  - V2/D2, The other participant (12 var.)
  - Other information (5 var.)

- Database contains 500 incidents
  - Rear-end (205 cases)
  - Angle/Crossing (105 cases)
  - Right-turn (95 cases)
  - Pedestrian (95 cases)

Delivered by copy protected CD-R
2. Reproduction of conflicting situation

Purpose

・ Understand contributing factors in major crash types in Japan
・ Learn possible preventive approaches

Research steps

① Scenario identification (hypothetical causes)
② Reproduction experiments
① Characteristic conflict scenario

*Half of Right-turn (LTAP/OD) incidents*

1. Waiting to make right turn (Brake ON, -2.3 sec.)
2. Initiating right turn (Accelerator ON, -0.7 sec.)
3. Emergence of motorcycle going straight (Accelerator ON, 0 sec.)
4. Initiating braking (Brake ON, 0.63 sec.)
② Conflict scenario reproduction
(Test course experiment)
Future research

- Incident data analysis
  Typical scenario and causes identification
  Aggregation method (DREAM)

- Reproduction of experimental methods
  More applicable and realistic instruments
Thank you for your attention