Verification of Traffic Accident Reduction
Effect of AHS

Technical Session TP 084

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Number of traffic accidents

Number of Traffic Accident Fatalities are Decreasing and Number of Accidents are Increasing

- 1970: 16,765
- 1979: 8,466
- 2003: 947,993

(Fiscal Year)
Causes of accidents

Cause of accident in 75% of cases was driver error immediately before accident.

Breakdown of Traffic Accident Causes

- Error in Operation: 25%
- Error in Judgement: 12%
- Delay in Recognition: 47%
- Other (Recklessness, Drinking, Etc.): 16%

Source: Institute for Traffic Accident Research and Data Analysis,
Traffic Accident Statistics 2000
Needs for measures immediately before accidents

Classified Traffic Accident Countermeasures with temporal transition

**Before**
- Countermeasures Taken in Advance
  - Improving Roadway Itself
  - Installing Road Signs and Lightings
  - Safety Driving Education

**Immediately before Accident**
- Areas Where Measures Were Delayed for Technical Reasons

**During & Immediately after**
- Countermeasures Taken During Accident and "Immediately after" Accident
  - Mandatory of Seatbelt Use
  - Widespread of Airbag Use
  - Installation of Guardrails

**After**
- Countermeasures Taken After Accident
  - Establishing Emergency Call Systems
  - Advanced Emergency Medical Service

Areas of Accident Fatalities Reduction
Areas of Accidents Reduced

Target of AHS services
Limitation of the Usual Countermeasures

- It needs a large fund for the curve shape improvement which area accidents are abundant in.
- Most of the accidents due to the human errors like as recognition delay and the mistake of the judgment. And the radical solution of the curve accidents, existent countermeasure such as eyes guidance countermeasure are so difficult.
- Near future, vehicles become high performance and more safety, but obstacle detection functions in the sharp curve (R ≥ 250m) by the vehicles alone is still difficult.
What is AHS?

Next-Generation Traffic Safety Technology by Vehicle-Highway Coordination

Collisions Prevention Systems: Forward Obstacles Warning

- Information collection technologies
- Operational support
- Warning
- Information

Two-way communication

Road-to-vehicle

Communication

technologies

Obstacle (stopped vehicle)

Road condition detection

Decelerates

Caution, stopped vehicle ahead

Stopped vehicle 300m ahead
Verification of Effectiveness on Actual Roads
Information Provision:
Reduce sudden braking where obstacle is visually perceived
Drivers tend to change behavior to safe side as result of services.

Test track result
Comparison of maximum deceleration after obstacle visually perceived with and without services
Due to information provision, deceleration and stopping tend to become more gradual

[Graph showing comparison of maximum deceleration (m/s²) between with and without services]

(N=30)
Without services: 4.8 m/s²
With services: 3.6 m/s²
Shifted to safe side

Test conditions
Vehicle following behind
Cruising at 110 km/h
Information provision location
Approximately 390 m
Obstacle
Obstacle distance from location where visually perceived 110 m
Driver decelerates
Location where obstacle is visually perceived
Provide vehicle with information on obstacle
Braking rate when forward-obstacle information provided
Message sign: More than 50% of drivers respond
On-board: More than 80% of drivers respond

Information provision (message sign)  
Information provision (on-board)  
Information provision and warning (on-board)  
Rate of drivers braking until seeing obstacles (Test of 30 drivers)
Field Operation Tests

Conducted to verify the effectiveness of AHS at 7 test sites in 2002-2003

- Higashimeihan Expressway (Kamiyashiro JCT)
- Higashimeihan Expressway (Nagoya Nishi JCT)
- National Highway No. 25 (Meihan Expressway, Maitani Curve)
- National Highway No. 45 (Miyako tunnels)
- Metropolitan Expressway (Sangubashi Curve)
- National Highway No. 246 (Matsuda-Soryo Curve)
- Tomei Expressway (Osawagawa Viaduct)

* The Test of infrastructure-based systems was conducted on National Highway No. 45 (Miyako Tunnels) in Iwate Prefecture using dynamic massage signs to provide drivers with real time information.
Sangubashi Curve on Metropolitan Expressway

- Sharply curved with a radius of 88m
- In 2002, 140 accidents occurred on this section
- Poor visibility because of buildings alongside the road
Large Number of Unreported Accidents

Analysis of sensor detection data and images
- 30 accidents observed during the 4-week test period
- 11 accidents caused by forward obstacle
- 19 accidents caused by over-speed
- 60% of those accidents not reported by drivers

Test period:
2003.10.15 10:00 – 2003.11.12 10:00
Examples of accidents
Analysis of behavior of almost 200 vehicles entering curve at speed greater than 40km/h when there was an obstacle ahead
- Approximately 15% of these vehicles braked suddenly
- 4 times greater than when there was no obstacle ahead

Potential risk of obstacles on sections with poor visibility.

<table>
<thead>
<tr>
<th>Obstacles ahead</th>
<th>Number of vehicles entering curve at speed greater than 40km/h (per day) (A)</th>
<th>Number of vehicles suddenly braking (per day) (B)</th>
<th>Rate of sudden braking (B/A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obstacles ahead</td>
<td>196</td>
<td>29</td>
<td>14.8%</td>
</tr>
<tr>
<td>No obstacle ahead</td>
<td>20,106</td>
<td>753</td>
<td>3.7%</td>
</tr>
<tr>
<td>Total</td>
<td>20,302</td>
<td>782</td>
<td>3.9%</td>
</tr>
</tbody>
</table>

In this study, sudden braking is defined as braking at an average of >0.5G per second.
Potential for information provision by AHS

Potential for information provision in the case of 11 accidents caused by forward obstacle

<table>
<thead>
<tr>
<th>Traffic situations about which AHS was able to provide information</th>
<th>Number of accidents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information can be provided with present system</td>
<td>10</td>
</tr>
<tr>
<td>Slow-moving vehicles</td>
<td>2</td>
</tr>
<tr>
<td>Stationary vehicles</td>
<td>2</td>
</tr>
<tr>
<td>Rearmost congestion</td>
<td>6</td>
</tr>
<tr>
<td>Information can be provided with modifications to the system</td>
<td>1</td>
</tr>
<tr>
<td>No situation*</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>11</td>
</tr>
</tbody>
</table>

At the time the vehicle passed the antenna, the situation ahead had not developed; provision of information will be enabled by positioning an antenna directly before the commencement of the curve, etc.
Effectiveness of Information Provision on Obstacles Ahead - Reducing Speed -

Nagoya Nishi Junction on Higashimeihan Expressway

Maitani Curve on National Highway No.25 (Meihan Expressway)
Effectiveness of Information Provision on Obstacles Ahead - Reducing Accidents -

Comparison the number of accidents with before and after introduction of message sign services in Maitani Curve.
Summary

Current Status of AHS:
- Field operation tests conducted at 7 locations over FY2003–2004
- The technology confirmed to be at a level where services can be initiated

Future subjects:
- Deployment will begin with existing means of providing information.
- Services with ITS on-board unit are scheduled around FY2007.