APPLICABILITY OF AHS FOR TRAFFIC CONGESTION IN SAG SECTIONS

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STUDY BACKGROUND

• The average amount of congestion is a total value for all 18 toll gates.

Breakdown of congestion incidence on expressways

Reduction of congestion due to the spread use of ETC

ETC utilization rate (%)

Amount of congestion (km/h/day)

- April 2002: 30.6 km/h/day
- April 2003: 26.6 km/h/day
- April 2004: 21.1 km/h/day
- April 2005: 2.6 km/h/day

As the next issue

• The average amount of congestion is a total value for all 18 toll gates.
ANALYSIS OF THE FACTORS CAUSING SAG CONGESTION

1. BEHAVIOR OF THE VEHICLES FORWARD
   - Speed reduction due to careless driving
   - Misunderstanding of changes in the degree of the slope

2. UNBALANCED USE OF THE LANES
   - Drivers who “want to go as fast as possible” concentrate in the passing lane

3. FORMATION OF VEHICLE GROUP
   - Because of a specific vehicle, for example the slow driver.
     □ Speed reduction shock wave transmits easily
MEASURES AGAINST SAG CONGESTION

- PREVIOUS FOCUS ON HARDWARE MEASURES EX.) ROAD WIDENING
  - LOW-COST AND EFFECTIVE SOFTWARE MEASURES USING “ITS”

THE KEY TO SUCCESSFUL MEASURES:
- Provide appropriate information before congestion occurs
- Respond to these needs with the “AHS” concept

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<th>Issue in Sag Sections</th>
<th>Measures</th>
<th>Services</th>
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<td>i) Careless driving</td>
<td>Urge the careless drivers to accelerate</td>
<td>(1) Service to prevent speed reduction</td>
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<td>Reduce time headway</td>
<td>(2) Service to recover speed</td>
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<td>ii) Imbalance in traffic lane</td>
<td>Adjust the balance of lane utilization</td>
<td>(3) Service to adjust traffic lane utilization rate</td>
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<td>lane utilization</td>
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<td>(4) Service to adjust traffic lane utilization rate by use of road shoulder</td>
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<td>iii) Formation of vehicle</td>
<td>Prevent and eliminate the formation of vehicle groups</td>
<td>(5) Service to prevent the formation of vehicle groups</td>
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<td>groups</td>
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JH testing complete  Object of short-term development  Object of medium to long term development
CONCEPT OF AHS FOR CONGESTION IN SAG SECTIONS

SERVICE TO ADJUST TRAFFIC LANE UTILIZATION RATE

- Adjust the balance of lane utilization by providing appropriate and timely information before congestion occurs

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Sensors

Vehicle to-Road communication

On-board unit

Stay in cruising lane

Passing Lane is Crowded
While traffic concentrate in the passing lane, the cruising lane is less congested.
Traffic volume for the Tomei Yamato sag section when typical congestion occurs
(Tomei Expressway outbound line 21.520 kilometer post)
ANALYSIS OF THE POSSIBILITY OF LANE CHANGES IN SAG SECTION

THE “LANE CHANGE POSSIBILITY RATE” IS DEFINED AS:

The expected value of the distance over which the driver can find enough headway in the neighboring lane to change lanes while driving a unit distance.

\[
\text{(Lane change possibility rate)} = \frac{700}{1000} = 0.7
\]
Vehicles are able to keep the gap necessary for lane changes until just before congestion occurs.

ANALYSIS OF THE POSSIBILITY OF LANE CHANGES IN SAG SECTION

Traffic volume per lane (PCU/5 minutes)
STUDY OF AN ALGORITHM FOR DECIDING THE SERVICE PROVISION TIMING

DECISION METHOD USING VEHICLE SENSOR DATA

Traffic conditions measured with vehicle sensors and window frames indicating two of the traffic conditions:

- Free Flow
- Cruising lane 1
- Cruising lane 2
- Passing lane

Q-V Graph (Teinei Expressway outward bound side, 21.52 km post date of congestion)

Critical state
Congestion cleared
State 3 window frame
State 2 window frame
Congestion

Traffic volume (PCU/5 minutes)
Average point speed (km/h)
STUDY OF AN ALGORITHM FOR DECIDING THE SERVICE PROVISION TIMING

EVALUATION OF THE ALGORITHM

- Assumed the service provided using this decision algorithm
- Checked against past traffic data to verify its validity

\[
\text{(HIT RATE)} = \frac{\text{Number of times service was provided and congestion actually occurred}}{\text{Number of times congestion actually occurred}}
\]

\[
\text{(MISS RATE)} = \frac{\text{Number of times service was provided but congestion did not actually occur}}{\text{Number of times service was provided}}
\]

- Case where the service is provided in “STATE 2”
  
  HIT RATE = 71%
  MISS RATE = 70%

- Case where the service is provided in “STATE 3”
  
  HIT RATE = 70%
  MISS RATE = 32%

APPROACH TO SERVICE PROVISION TIMING (PROPOSAL):

“Provide the service in conditions in which congestion can be predicted with a given degree of certainty”
CONCLUSION

RESULT OF THE STUDY OF THE FEASIBILITY OF AHS FOR CONGESTION IN HIGHWAY SAG SECTIONS

1) Confirmed the feasibility of the service to adjust traffic lane utilization rate through an analysis of sag section traffic conditions.

2) Studied an algorithm for deciding the timing of service provision based on vehicle sensor data.

FUTURE MEASURES

1) Collect more precise data and conduct a more precise analysis of the characteristics of vehicle behavior in sag sections.

2) Conduct experiments and studies of the service in a virtual environment which combines a traffic simulator and a driving simulator.

3) Evaluate and verify the service with road tests.