Behavior Changes of Drivers in Traffic Jams Due to Traffic Information Provision Based on Portable Traffic Detectors

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Traffic congestion measure at SANYO EXPWY
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Installation of Traffic Detectors in Urban Areas in Japan

- We have installed traffic detectors approximately every 2 km.
- Traffic congestion is automatically detected by analyzing those detectors’ velocity data.
- Information of congestion is provided automatically on VMS in order for warning rear-end collision.
- Traveling time information calculated by the detectors’ data is also provided automatically on VMS.

Traffic Congestion Starts
From A-IC to B-IC
Congestion is 40km

To A-IC 100min.
To B-IC 2hours or more
To C-IC 2hours or more
Installation of Traffic Detectors in Rural Areas in Japan

- Traffic congestion occur **only in heavy traffic season** such as **winter and summer holiday**.
- Most sections in rural area **do not have many traffic detectors**.
- Traffic congestion occurrence **cannot** be collected automatically.
- It is obtained visually from **CCTV camera or traffic patrolling**.
Traffic Congestion at Sag or Tunnel Entrance

- It is difficult for drivers to notice slow down oneself.
- Distance to vehicle ahead shortens automatically.

- Braking waves are propagated to following vehicles gradually.
- Velocity of vehicle cluster slows down drastically.
Warning Slow Down by Visible LED VMS

- Information on VMS is changed depending on traffic flow condition.

Not congested

Here is climbing
Caution to slow down

After congestion starts

Congestion finishes soon
Please recover your speed

Promote congestion early dissolution

The purpose of this measure is to delay the congestion occurrence and promote its early dissolution.
Develop Portable Traffic Detector 1

- Since this measure requires counting traffic flow velocity, it has been implemented only in urban area where traffic detectors are highly installed.
- If we could measure the velocity even on rural expressway with few traffic detectors, we are able to implement this kind of measure similarly with urban area.
- We developed portable detector utilizing Doppler Effect by microwave.

\[ v = \frac{c}{2f_0} f_d \]

- \( c \): Light Speed
- \( f_d \): Difference between discharging radio wave and returning radio wave
Develop Portable Traffic Detector 2

- Installing cost
  loop coil detector: 65,000 USD, portable detector: 5,800 USD
- Measured vehicle velocity data are transmitted to mobile telephone communication and sent to PC for monitoring the internet network.
- Portable vehicle detector is used temporarily, we aimed to develop it to be installed in very short time without any traffic regulation or heavy equipment.
Cooperative System with Mobile VMS

- In order to implement warning automatic slow down, we have to **control VMS in accordance with traffic congestion**.
- However, since VMS **cannot be installed at so many bottlenecks**, **temporal VMS should be necessary**.
- We developed and examined mobile VMS. **Weights: only 7kg**, Excellent portability (**collapsible**)
- It realizes **remote control by using mobile telephone communication**.

**After collapse, you can put mobile LED VMS in your bag and carry it!**
Equipment Configuration

1. Portable Traffic Detector
   - Measure Vehicle Velocity
   - Mobile Telephone Communication

2. PC For Monitoring
   - Record Velocity Data And Observed Time
   - Mobile

3. PC For Control VMS
   - Deliver A Judgement Of Congestion Automatically
   - Mobile Telephone Communication

4. Mobile VMS (Up Stream)
   - Remote Handling Equipment
   - "Congestion finishes soon!" "Please recover your speed"

4. Mobile VMS (Down Stream)
   - Remote Handling Equipment
   - "Congestion finishes 1km ahead" "Please recover your speed"

5. WEB Camera

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**Not Congestion**
(Average Velocity for 5min. ≥ 40km/h)

- Caution to Slow Down
- Here is Climbing

**After Congestion**
(Average Velocity for 5min. < 40km/h)

- Please Recover Your Speed
- Congestion Finishes Soon
Effects of Warning Automatic Slow Down

- Average velocity on implemented days once decreased to 45km/h, but recovered soon. (traffic volume is similar on both days)

5 minutes Average Velocity (SANYO EXPWY Takedayama Tunnel)

- Measured Day: Recover speed, Congestion not occurred
- Not Measured: Speed not recover, Congestion occurred

Congestion Finishes Soon
Please Recover Your Speed

45km/h
Effects of Warning Automatic Slow Down

- Traffic congestion not occurred. (traffic volume is similar on both days)

[Traffic Volume and Congestion Length Apr.-29, 2012 SANYO EXPWY Takedayama Tunnel]

- Full line: Measured Apr.-29, 2012
- Dashed line: Not Measured Mar.-4, 2012

- Measured Day
  - Congestion not occurred

- Congestion Volume
  - Not Measured: 4.0 km/hr
  - Measured: 0.0 km/hr
  (Congestion not occurred)

- Daily Traffic Volume
  - Not Measure: 33,544 car
  - Measured: 33,160 car
  (▲1.1%)

- Max Congestion length
  - 4.0 km (Not Measured)
Changing Speed of Providing Information Speed Recovery

- **Average velocity** in congestion $41\text{km/h} \rightarrow 52\text{km/h} (11\text{km/h} \uparrow)$
- **5 minutes traffic volume:** $220\text{ cars/5 min.} \rightarrow 234\text{ cars/5 min.} (14\text{ cars/5 min.} \uparrow)$

### Average Velocity and Traffic Volume (SANYO EXPWY Hutago Tunnel Jan.-3, 2013)

- **Traffic Volume**
- **Average Velocity**

### Average Velocity and Traffic Volume (SANYO EXPWY Hutago Tunnel May.-1, 2011)

- **Traffic Volume**
- **Average Velocity**

**Not Measured**
Conclusion

- We confirmed that **effectiveness** of the cooperative system utilizing portable traffic detector and mobile LED VMS for warning automatic slow down as congestion reducing countermeasure.

- We will conduct more field tests on EXPWY with this system, and analyze the effectiveness of the system more in detail.
End of Presentation

Thank you for your kind attention!

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