

## Congestion countermeasures by road-vehicle cooperation using automobile technology

KANAZAWA Fumihiko, Head

SAKAI Koichi, Senior Researcher

SUZUKI Kazufumi, Researcher

IWATAKE Koichi, Guest Research Engineer

Intelligent Transport System Division, Research Center for Advanced Information Technology

(Key words) Expressway, sag, congestion countermeasure, ACC

### 1. Introduction

Approximately 60% of congestion on inter-city expressways in Japan occurs in sections called sags where the road gradient is gradually changing to a rising gradient, a problem demanding urgent measures. This division is cooperating with auto makers on research and development of expressway congestion countermeasures based on road-vehicle and vehicle-vehicle cooperation of the road infrastructure and automobiles. This report introduces initiatives concerning research and developments of these congestion countermeasure services.

### 2. Outline of the service and its expected congestion mitigation effectiveness

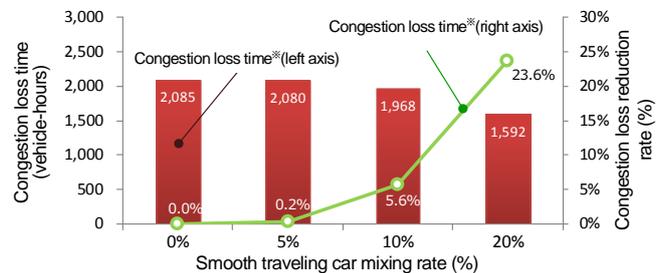
This service provides information from the road side about traveling methods which effectively mitigate congestion according to traffic conditions in order to maintain smoother and more stable traffic flows by having drivers operate their automobiles based on this information, using a system that consists of roadside information provision antennae called ITS Spots, which are already installed at more than 1,600 locations on expressways as part of the road infrastructure, and an automatic control system that controls following distance between vehicles and vehicle speeds at fixed levels called ACC (Adaptive Cruise Control) and which has spread in recent years as automobile technology (Fig. 1).

To confirm the effectiveness of these congestion countermeasure services, based on the results of various test drives conducted on test courses, vehicle behavior models were built and simulation calculations performed on computers to trial calculate effectiveness. Hypothesizing a case of relatively small-scale congestion (congestion of about 15km/h) with occurrence frequency accounting for about 70% of all congestion on the Yamato Sag on the outbound Tomei Expressway, the rate of decrease of congestion loss time was trial calculated according to the mixing rate of vehicles receiving the service and cooperating with any one of the driving operations in [1] to [3] in Figure 1 (smooth traveling vehicles) (Fig. 2). The

Figure 1. Image of the Congestion Countermeasure Service based on Road-Vehicle Cooperation



Figure 2. Congestion Loss Time According to the Smooth Traveling Vehicles Mixing Rate



※ Congestion loss time means the time obtained by subtracting the actual traveling time from the standard traveling time (assuming speed of 70km/h) required when traveling in a certain section. It was assumed that the average following distance of a smooth traveling vehicle was about 1.75 seconds before the sag and about 1.5 seconds on the rising slope, and that on the rising slope, it follows the leading car alertly so it does not fall beyond it.

Figure 3. Showcase at the ITS World Congress Tokyo 2013



➤ View of preliminary explanation at the booth before the participants get in the car

➤ View inside the car during the demonstration drive (lower right is a table terminal displaying vehicle information)

results indicated that at a mixing rate of smoothed traveling vehicles of about 20%, the congestion loss time can be cut by about 24%.

### **3. Application of the results and future development**

Based on this research, in the showcase event of the ITS World Congress held in Tokyo in October 2013, in cooperation with five domestic auto makers, the world's first demonstration drive providing experience of the service was held, showing off Japan's advanced initiatives in this field (Fig. 3).

In the future, we will study advertising and public awareness-raising methods to increase the social acceptability of these services and methods of providing drivers with easy to understand information by carrying out questionnaire surveys and performing testing using test subjects, and at the same time, perform simulations to clarify the road-vehicle cooperation system development goals and the congestion mitigation effectiveness at the nation-wide level.