Distance Control Assist System with Active Accelerator Pedal

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1. Introduction

Under the congested road conditions drivers operate their vehicles by repeating a pattern of accelerating, decelerating, and cruising with a constant speed for maintaining the distance between their cars and cars ahead of them. Especially during times of heavy traffic, they must maintain this distance by repeating the above operational sequence frequently. Focusing on the sequence of actions under these conditions where the driver releases the accelerator pedal and applies the brakes as needed, we have developed a driver-assistance system that alleviates the driver's workload while assisting in maintaining the distance between cars by giving push back force to the accelerator pedal and controlling deceleration depending on the distance to the preceding car (figure 1).

Fig. 1 Distance Control Assist

2. System Characteristics

This system assists driver's distance control management, in the case that the accelerator pedal is unnecessarily being applied, by generating force to push back the accelerator pedal via the accelerator pedal actuator and controlling the break depending on the distance between the host car and the lead car and their relative velocity. The distance information is given from the radar sensor located in the front of the vehicle. Examples of the system functions are outlined below.

(1) Case where the distance between the host car and the lead car decreases:
If the driver releases the accelerator pedal, the system smoothly applies the break and prompts deceleration, thus assisting in the driver's distance control management. If the driver is applying the accelerator, the accelerator pedal actuator gives push-back force to the accelerator pedal to prompt the driver to lift off the pedal.

(2) Case where the system determines that the driver must apply the brakes:
The accelerator pedal actuator generates force to push back the pedal while alerting the driver through a buzzer and visual indication, thereby assisting the driver in switching from the accelerator pedal to the brake pedal.

This system's components are outlined in figure 2. If the system's operating switch located on the steering wheel, is enabled, the relative velocity and distance between the host car and the lead car is detected via an electric control unit with the radar sensor located on the front bumper. Based on the relative relationship to the lead car detected, accelerator pedal reaction force control, and brake control operations are conducted. Based on the results of these operations, control signals are sent to the accelerator pedal and active booster and push-back force is generated against the accelerator pedal. Moreover, if the driver releases the accelerator, brake fluid pressure signal is sent to the active booster, forcing the host car to decelerate. A visual indicator and a buzzer mounted on the instrument panel present status of the system and warn the driver when the host vehicle comes too close to a lead vehicle. If the system operations switch is turned off, system operations are suspended.

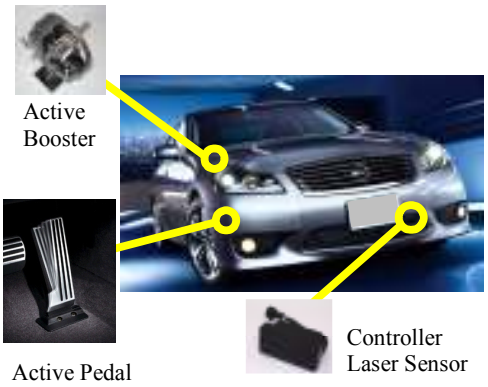

Fig. 2 Components of

Through a field operational test, it is confirmed that situations requiring deceleration on the part of the driver were decreased. Main results are as follows:

1 Alleviation of the driver's deceleration workload,
2 Decrease in instances of deceleration during following of lead car with system enabled (figure 3).
3 Decrease in shortened “Time to Collision” situations.

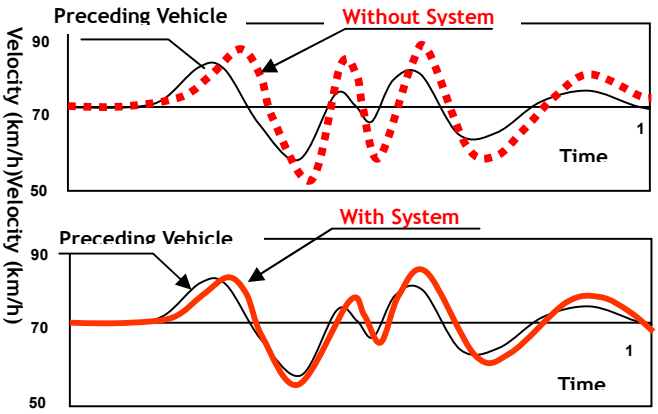

Fig.3 Following maneuver

3. Conclusion

We have developed a system that utilizes deceleration control and accelerator pedal push-back force functions to assist in the driver's distance control management. We have confirmed that driver workload is alleviated in a variety of road conditions through the use of this system.