The Advanced Safety Vehicle Programme

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Abstract

The development of *an advanced safety vehicle* (ASV) has primary importance for automobile manufactures and customers. The safety measures of modern vehicles involve active and passive safety. Active safety devices provide the driver with warning signals or affect the vehicle's motion in order to prevent an accident. Passive safety devices help to avoid injuires and post-collision hazards if an accident occurs. The main features of the ASV concept are illustrated by state-of-the-art examples, the development trends are discussed.

Introduction

The *Advanced Safety Vehicle* (ASV) programme was coordinated by the Japanese Ministry of Transport and carried out from 1991 to 1996. The aim of the programme was to develop methods and devices to improve the safety of the transportation system [1]. The Japanese automobile manufacturers (Daihatsu, Honda, Isuzu, Mitsubishi, Nissan, Subaru, Suzuki, Toyota) participated in the programme and developed demonstration vehicles.

Traffic safety is a complex problem involving technical aspects (vehicles, roads, traffic signs, etc.), human factors (mentality, reaction time, etc.), and legal aspects (driver responsibility, manufacturer liability, etc.). Current prototypes are equiped with various sensors (laser radar, CCD-camera, gyroscope, sonar, etc.). Gathered sensor data is processed by the vehicle's computer, which consults the driver or produces warning signals. Driving decisions and further actions are left to the driver. Recent research and development efforts have led to the implementation of various automation devices. The French Praxitèle programme gives an example of the development of a future transportation system based on electric vehicles capable of autonomous motion, e.g. autonomous parking or platooning [2]. Such automation of vehicle maneuvers will contribute to the safety and comforty travel.

This paper focuses on technical aspects of ASV: methods and devices which provide increased traffic safety and make the vehicles more "friendly" to humans [1]. Both active and passive safety measures are considered. Active safety means that the vehicle's

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computer observes sensor data about the traffic situation and driving conditions, makes decisions, and supports the driver or even takes control of the vehicle to prevent an accident. Active safety can be characterized as preventive: the human driver is supported by a co-driver system that helps him to avoid accidents. Passive safety serves to reduce injuries and minimize post-collision hazards in the case of an accident.

Active Safety

Most accidents are caused by careless or inattentive driving and driver errors. Hence, an active support system for the driver is necessary. Such a system monitors the traffic environment and the driver's attention, and notifies him about potential dangers or even takes control of the vehicle's maneuvers if the driver does not react properly or quickly enough in dangerous situations.

The concept of active safety is illustrated by the recent results reported by the Mitsubishi Motors Corporation [3], [4]. Main devices of the Mitsubishi's Active Safety are shown in Figure 1. Their features are:

- *Drowsiness Warning System (1).* The driver's wakefulness is monitored by the steering controls and the vehicle's behavior. If necessary, warning sounds, a stimulating fragrance and vibration of the seat and steering wheel alert the driver.
- *Low Tire Pressure Warning System (2).* Sensors track differences in rotation speed of tires to check for a decreased air pressure. The driver is alerted if necessary.
- *Vision Enhancement System (3).* Discharge-type headlights and water repellent glass are installed to provide the driver with greater visibility at night or in rain.

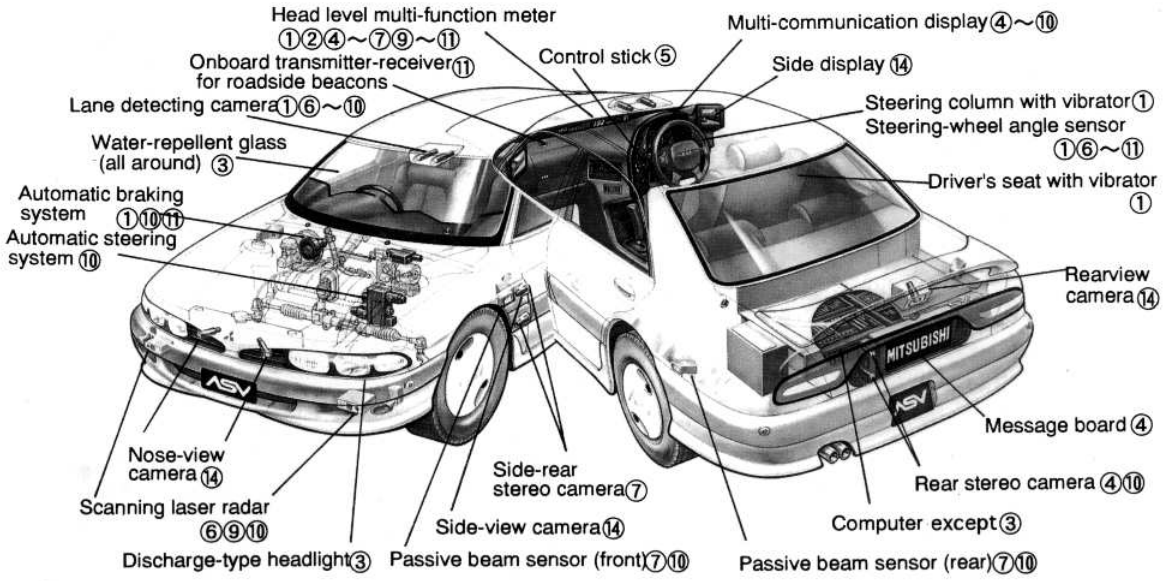

Figure 1: Main equipments of active safety

- *Rear Warning System (4).* Monitors approaching vehicles from behind and alerts the ASV driver by text messages and sound warnings. The approaching vehicles are alerted to the ASV's presence by a tail-mounted message board.

- *Navigation System (5).* Precisely determines the geographical location of the vehicle using sophisticated localization methods. Navigation guidance is provided by indication on the map and sound messages.

- *Distance Warning System (6).* Laser radar determines distance between ASV and the vehicle in front. If this distance is too short relative to the speed of the vehicles, a warning sounds.

- *Side-rear Warning System (7).* Stereo cameras monitor the situation at the side and in the rear; the results are shown to the driver on a graphic display. If the driver attempts a lane change when another car is moving alongside, a warning sounds.

- *Lane Departure Warning System (8).* The white lines which indicate the lanes are monitored by the camera. If ASV drifts too close to a white line and a turn signal is not activated, a warning sounds.

- *Preview Distance Control (Intelligent Cruise Control) (9).* The laser radar and video camera monitor vehicles in front of ASV. To prevent ASV from getting too close to the vehicle in front, the engine and transmission are automatically controlled.

- *Automatic Collision Avoidance System (10).* Multi-Eye System monitors the driving conditions. If a danger is detected, a warning sounds. If a collision appears otherwise inevitable, ASV takes the evasive action automatically.

- *Cornering Speed Regulation System (11).* Receives data transmissions on upcoming corners from roadside beacons. If ASV is moving too fast, a warning sounds. If the driver fails to slow down the vehicle, ASV reduces its speed automatically for safe cornering.

Passive Safety

If an accident is unavoidable, injury of passengers and post-collision hazards must be minimized. The Mitsubishi Motors Corporation's concept of passive safety [3] includes, as shown in Figure 1 and Figure 2:

- *Impact Absorbing Body (12).* The ASV uses advanced materials including hybrid front side members of CFRP (Carbon Fiber Reinforced Plastic) and steel as well as large foam-filled frame members. These materials create a lightweight body that efficiently absorbs collision energy while reducing cabin deformation to protect the passengers.

- *Occupant Protection System (13).* In addition to airbags for the driver and front passenger, each front seat back is equiped with an airbag for a rear passenger and with a side airbag. These airbags work in conjunction with seat-belt pre-tensioners and anti-laceration glass, in order to provide an enhanced degree of safety.

- *Pedestrian Protection System (14).* The CFRP Honeycomb Bonnet helps to absorb collision energy, in order to reduce injury of a pedestrian in the case of impact. The nose-view system consists of two cameras. Their images are shown on the side displays to help the driver notice pedestrians, cyclists, etc. who would otherwise be concealed around blind corners. Similarly, side-view and wide angle rear-view cameras display images of the ASV's rear and sides. As the cameras replace conventional side mirrors, the vehicle's side protrusions are eliminated.

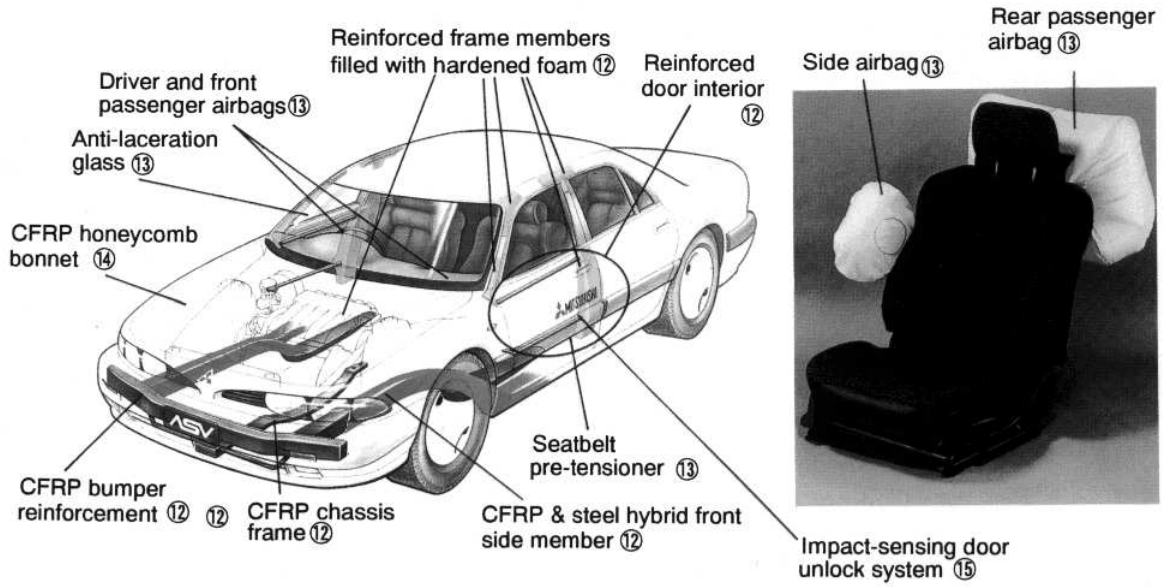

Figure 2: Main equipments of passive safety

- *Impact Sensing Door Unlock System (15).* It instantly unlocks the doors if the sensor detects an impact over a certain level. The doors can be easier opened in the case of impact that helps the passengers to escape the vehicle or be rescued.

Conclusion

Advanced automation will increase the level of safety on roads of the 21st century. The following levels of vehicle automation are being examined: autonomous cruise control → stop and go automation → autonomous lateral control → traffic sign assistance → platooning → autonomous highway cruising → autonomous vehicles for urban traffic [5]. The ASV concept being considered will contribute to the development of intelligent vehicles for safe and comfortable travel.

Acknowledgment

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References

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