

Development of Advanced PCS (Pre-Crash Safety) System

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1. Overview

The ultimate target for technological developments related to safety in a motorized society is zero fatalities and casualties in traffic accidents. At Toyota Motor Corporation, steady progress has been made toward reducing the number of fatalities and casualties by actively developing and adopting passive safety technology such as airbags or energy-absorbing bodies. Meanwhile, Toyota has also been studying how to commercialize active safety technology, which utilizes ITS technology to prevent collisions, or reduce the collision damage. The results of long research and development finally bore fruit in February 2003 with the introduction of the world's first radar-type PCS system, which detects other vehicles and objects on the road and helps mitigate collision damage. With this PCS system,

- Detection targets are limited to vehicles and like objects
- Assistance is focused to the front of the host vehicle

The newly developed advanced PCS is a system that further increases the collision damage mitigation effect.

2. Description of the Technology

A recognition system (Fig. 1) with the following features was newly developed.

- a) In order to detect pedestrians and other objects that are difficult to detect using conventional millimeter wave radar due to their low reflection level, a sophisticated object recognition system was developed that merges the detection results from two sensors: a millimeter wave radar sensor with new functions added and a newly developed stereo image sensor.
- b) The newly developed stereo image sensor is used to recognize the horizontal width of objects, which is hard to detect with millimeter wave radar alone.
- c) Another radar is installed at the rear in addition to the front radar.

It was thus possible to obtain the following significant effects:

- 1) PCS operation targets have been expanded to also include pedestrians (a world first).
- 2) In addition, the PCS system operates with respect to objects (such as utility poles) that have relatively low reflection levels when detected using millimeter wave radar. Combined with 1), operation targets have expanded by a factor of approximately 2 to 3.
- 3) The PCS operating timing has been advanced (Fig. 2), resulting in considerable improvement of the operation effect (by a factor of 2 to 4 compared with conventional technologies).
- 4) Based on the capabilities of b) and others, a steering assist system for driver's collision avoidance maneuvers was commercialized as a lateral-direction driving assist system (a world first, Fig. 3).
- 5) A rear PCS system was commercialized as a collision damage mitigation system for rearward objects (a world first, Fig. 4).

3. Conclusion

The advanced PCS system achieves a dramatically increased collision damage mitigation effect. The advanced PCS system was installed in the LS460 in September 2006 and is now sold in regions all over the world. This technology shows the future direction for the next generation of PCS systems and at the same time marks a significant milestone toward the goal of zero traffic accidents, a goal that the automotive industry must continue to work to achieve in the future.

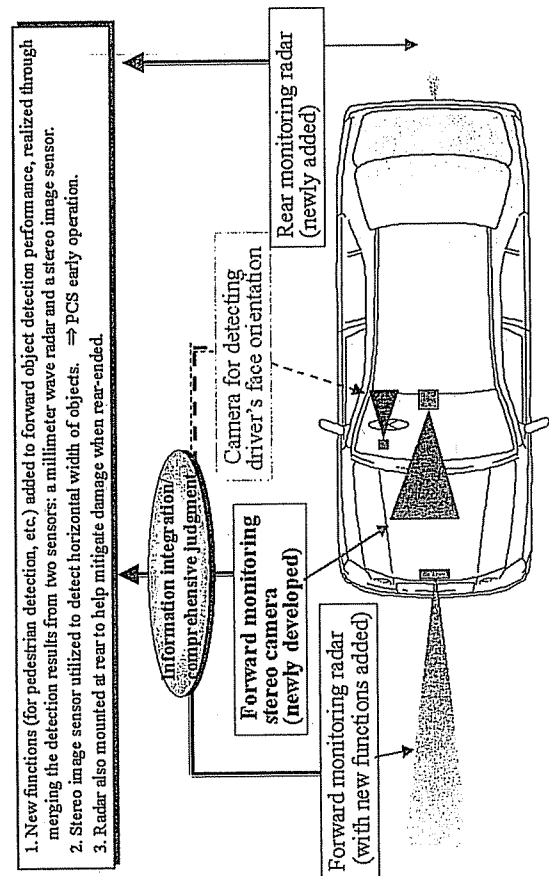


Fig. 1 Recognition System for Advanced PCS

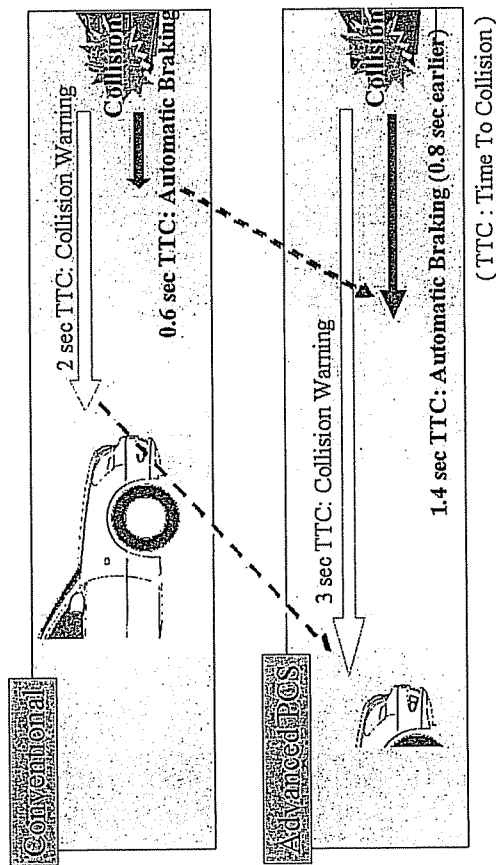


Fig. 2 Effect of Advanced PCS: Example of PCS Early Operation

(1) Collision Warning

(2) For a driver's emergency steering, the Variable Gear Ratio Steering (VGRS) system decreases the steering gear ratio to increase tire-turning angle.

(3) Deceleration through brake control: ensure steering stability during and after emergency avoidance

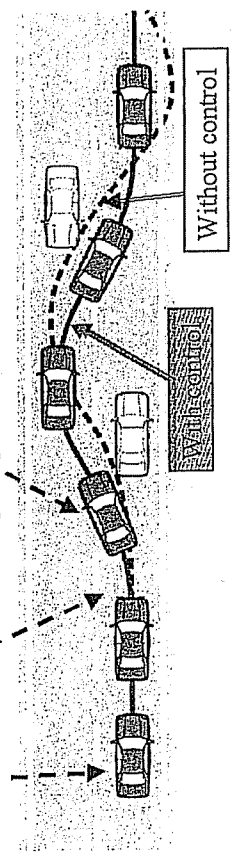


Fig. 3 Control Overview of Steering Assist System for Driver's Collision Avoidance Maneuvers

Pre-crash intelligent headrest
(E eliminates a space between the headrest and the back of an occupant's head immediately before a rear-end collision)

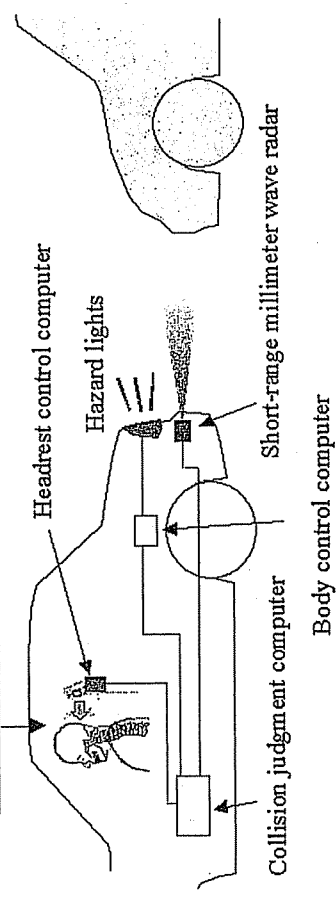


Fig. 4 Rear PCS System