The 10th ITS Informal Meeting

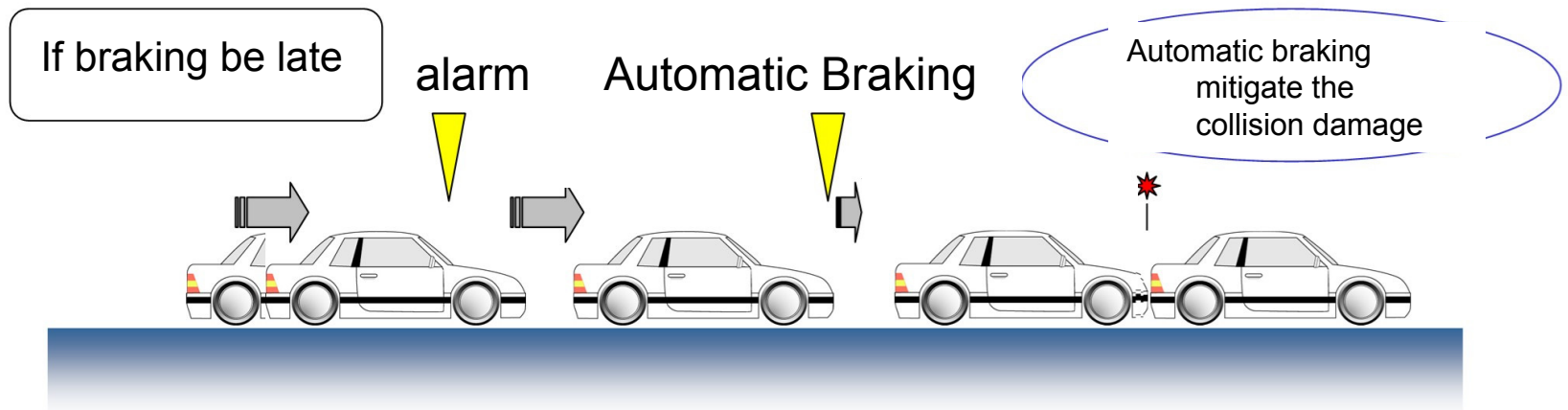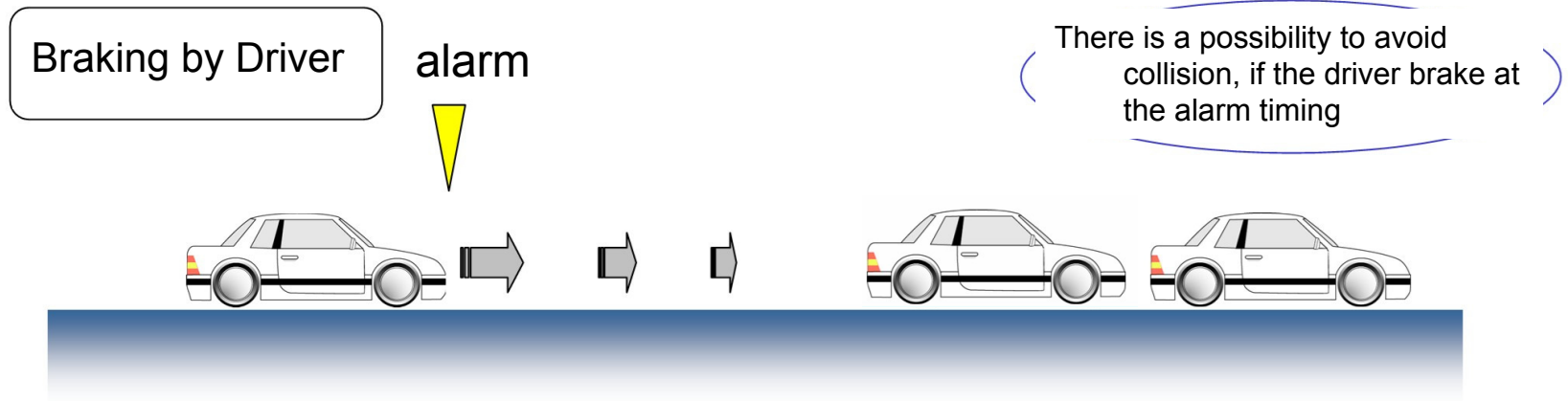# *Forward Collision Damage Mitigation Braking Systems on ASV*

ASV Projects

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1. What is Forward Collision Damage Mitigation Braking Systems？

- Forward Collision Damage Mitigation Braking Systems is a driving assistance system to mitigate damage caused by collision with a forward obstacle

Braking by Driver　alarm

There is a possibility to avoid collision, if the driver brake at the alarm timing

If braking be late　alarm　Automatic Braking

Automatic braking mitigate the collision damage

TOYOTA MAJESTA

NISSAN FUGA

HONDA INSPIRE

HONDA ELYSION

HONDA ODYSSEY

NISSAN CIMA

HONDA LEGEND
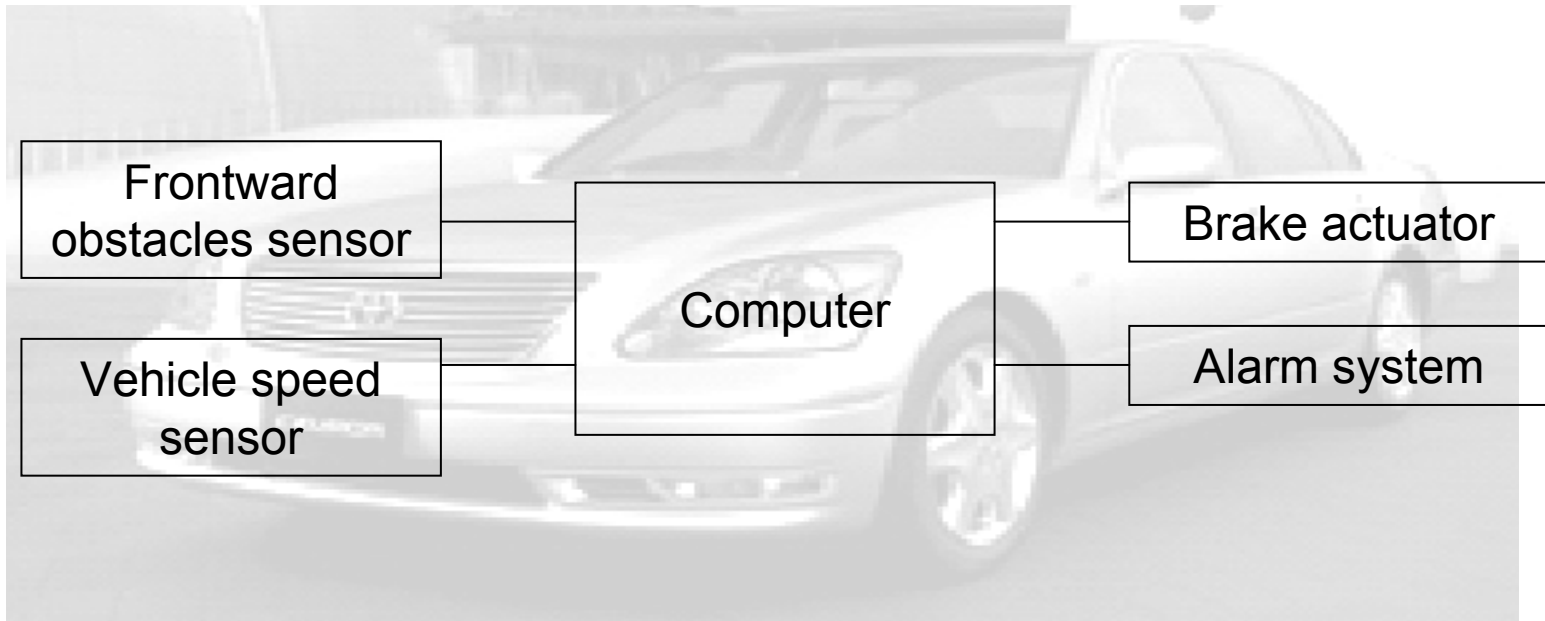

TOYOTA HARRIER

NISSAN ELGRAND

TOYOTA CELSIOR

HONDA STEP WGN

NISSAN PRESIDENT

2. Components and operations of System(1)

1.   Components

Frontward obstacles sensor

Vehicle speed sensor

Computer

Brake actuator

Alarm system

- Frontward obstacle sensors and speed sensor detect the distance between vehicles and relative vehicle velocity.

- Computer of the system gives the alarm, in case that the vehicle might crash with forward vehicle.

- Computer of the system applies the automatic braking, in case that the vehicle could not avoid crash.

2. Components and operations of System(2)

2. Operations:

1) Sensors of the system detect the relative location between the vehicles

2) The computer judges the possibility of the collision, through the relative distance and velocity data transferred by the sensors.

3) If the computer judges the possibility of the collision, the alarm system works on.

+ Alarm; sounds, visual display and touch feeling etc.

+The driver who is aware of the alarm could apply braking at this moment.
Operation of brake assist system is applicable under this situation.

4) If the computer judges the collision, automatic braking is applied.

+ Automatic braking works, in the case that the distance between vehicles becomes smaller than the both minimum braking distance and minimum steering distance to avoid collision.

- "Minimum braking distance to avoid collision" means distance which could not avoid collision even in using the vehicles' maximum braking capability.

- "Minimum steering distance to avoid collision" means distance which could not avoid collision even in using the vehicles' maximum steering capability.

2. Components and operations of system(3)

3. Collision judgment：

● Collision judgment is made in the case that the vehicle distance becomes lower than the minimum braking and steering distance to avoid collision
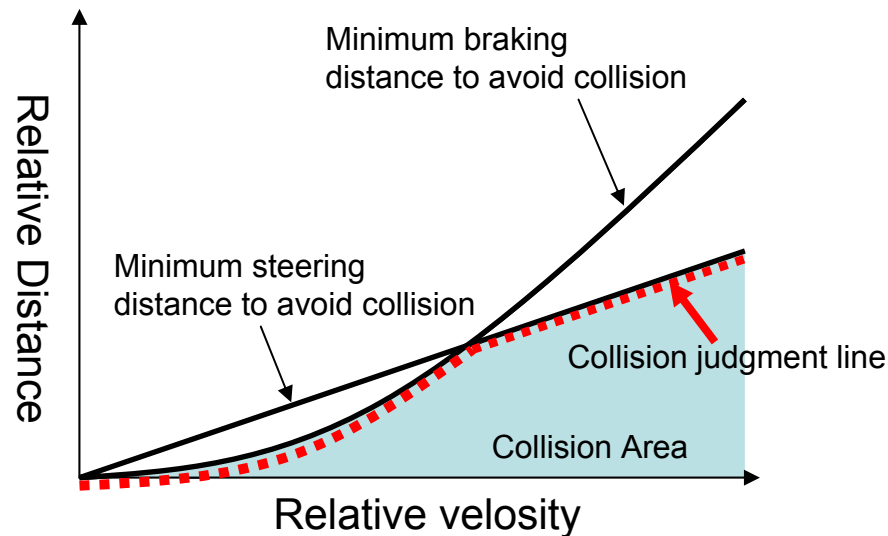
- Many experiments show the advantages of braking than steering in the condition of lower relative velocity and show the advantage of steering than braking in the condition of higher relative velocity.
- Collision area is defined in the lower area which are made by the minimum braking distance line and the minimum steering distance line.

3. Concepts of ASV(1)

- ## Design Principles of ASV

  Design Principles of ASV are decided to clarify what ASV should be in Phase 2 ASV (1996-2000).

  ・Driver Assistance:
    ASV technologies should understand driver's wills and support their safe driving based on the concept of driver responsibility.
  ・Driver Acceptance:
    ASV technologies should be easy to use and be trusted by drivers. This means that a human-machine interface design should be appropriately implemented.
  ・Social Acceptance:
    ASV technology-equipped vehicle must operate with unequipped vehicles and pedestrians. Therefore, we must consider how to obtain proper understanding of the public.

3. Concepts of ASV(2)

・Concept of Driver Assistance

Following the Design Principles, Concept of Driver Assistance for ASV technologies are decided.

1. The system should act according to the will of the driver or what the driver normally expects in terms of safety
2. The system should assist driver in safety
3. The system should be checked by the driver at any time
4. The system should inspire a proper amount of confidence in the driver, not causing him to place too much confidence nor distrust in the system.
5. The system should be overridden by the driver in the case that the driver operates for more safety.
6. The system's control should be smoothly passed over to the driver when the situation goes beyond the range of assistance of the system and if a room for operation by the driver is left
7. The system should not make a negative impact to the traffic environment.
8. There should be mature society to accept the system.

4. Justification of Forward Collision Damage Mitigation Braking Systems (main points)

1. The system should act according to the will of the driver or what the driver normally expects in terms of safety
    ・To apply the braking in the case that the vehicle might get collision is normal action for the driver and vehicle in the safety aspect. Automatic braking in the collision condition of the Forward Collision Damage Mitigation Braking Systems therefore reflects drivers' will.

4. The system should inspire a proper amount of confidence in the driver, not causing him to place too much confidence nor distrust in the system.
    ・There is few possibility for drivers to have too much confidence in the system as they might not depend on automatic braking for crash mitigation at the minimum braking and steering distance.
    ・Drivers can have proper confidence in the system by understanding of at what condition the automatic braking works.

5. The system should be overridden by the driver in the case that the driver operates for more safety.
    ・Though automatic braking at the minimum braking and steering distance should not be cancelled, system should accept some action by driver when such action can make the situation safer.
    ・According to it, the system can accept the drivers' steering also.

5. Summary

- Forward Collision Damage Mitigation Braking Systems of ASV and Concept of Driver Assistance systems are introduced.

- In case to develop any technologies related to Driver Assistant Systems, the concept of Driver assistance of ASV are fundamentally referred and applied.

- The discussion to maximize the effects of Forward Collision Damage Mitigation Braking Systems by adjusting the automatic brake timing has started and used the concept of driver assistance system.