

Research on HMI

Homework item 1 (ACSF-01-13)

Toshiya Hirose, Toru Kojima

Vehicle Safety Research Department

National Traffic Safety and Environment Laboratory, Japan

2nd Meeting of ACSF Informal Group, 15-17 June 2015



Contents of the presentation

- 1. Report on experiment on behaviors of drowsy drivers during transition from system control to manual driving**
- 2. Research plan for ACSF in 2015**

1. Report on experiment on behaviors of drowsy drivers during transition from system control to manual driving

Purpose of the experiment

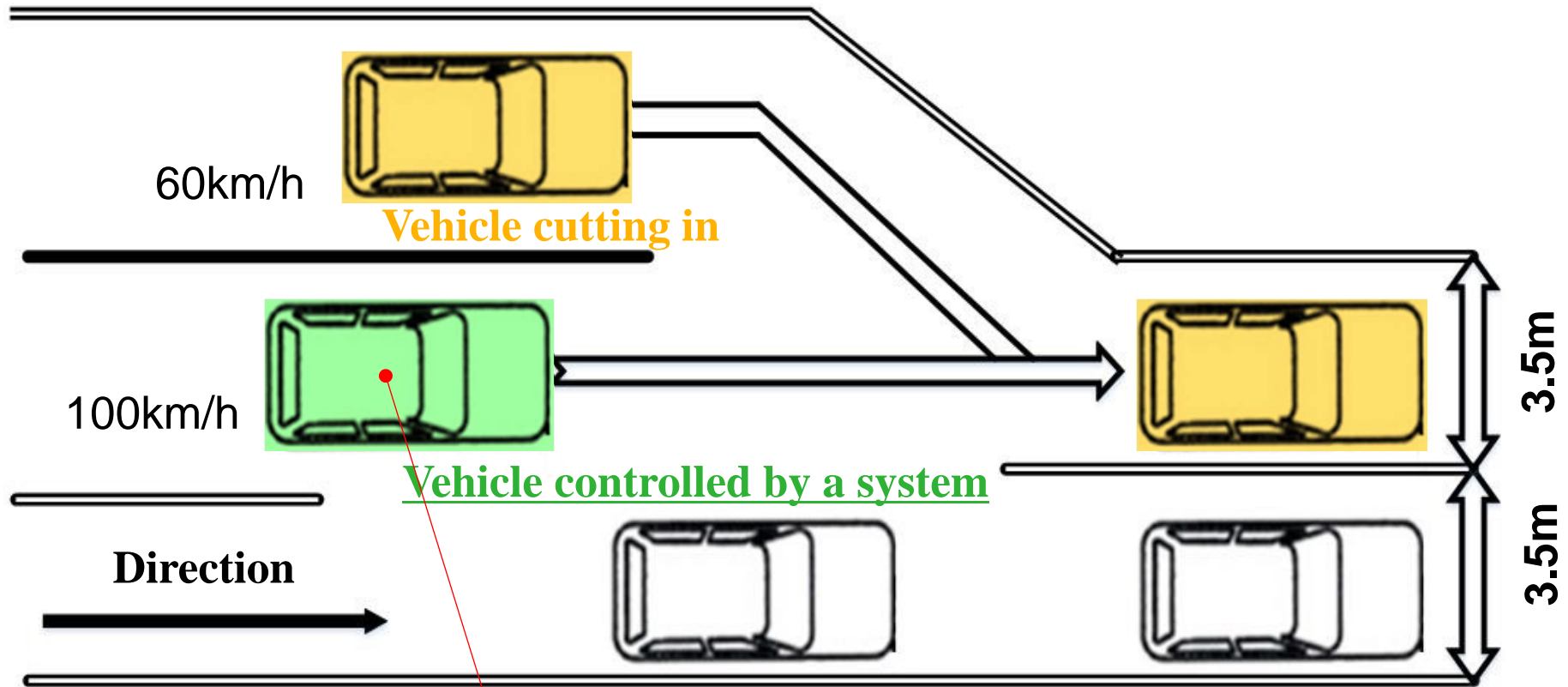
By using driving simulator,

1. Correcting data on driver's behaviors during transition from system control to manual driving

2. Comparison of drivers' behaviors under different level of drowsiness

Condition and scenario of the experiment

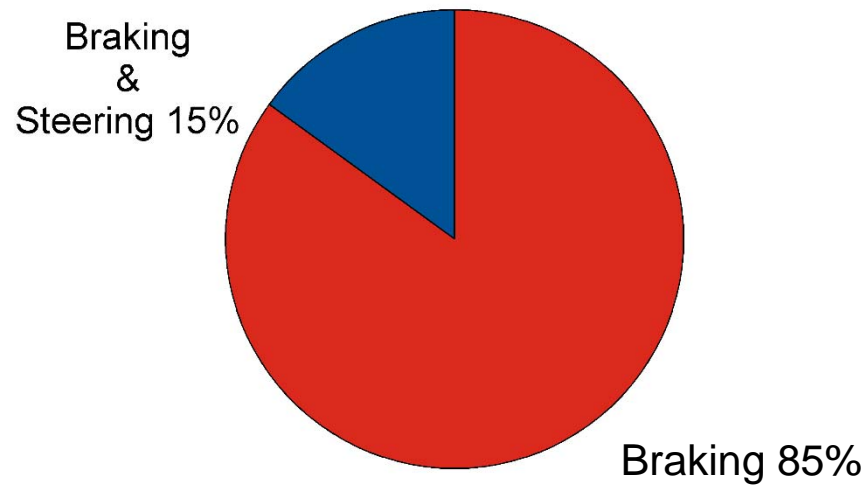
- Subject : 40 test drivers (20-30 years old)
- Scenario: The driver is sitting on the Driving Simulator which simulate driving at 100 km/h on a high way. Another vehicle cuts in at 60 km/h ahead of the vehicle.
- Status of the drivers: Normal and drowsy
- Data: Drivers' operation and their reaction time



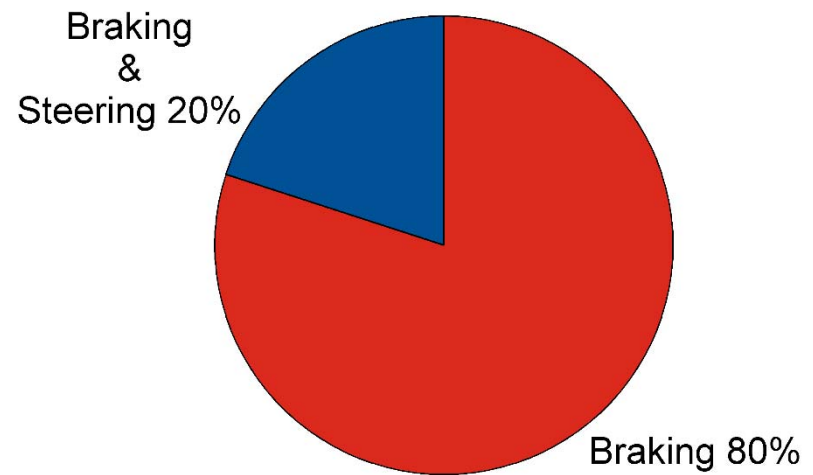
Audible warning is activated during transition from system control to manual driving

Result of the experiment

Drivers' operation for collision avoidance



Normal



Drowsy

Analysis of drivers' behaviors by their reaction time

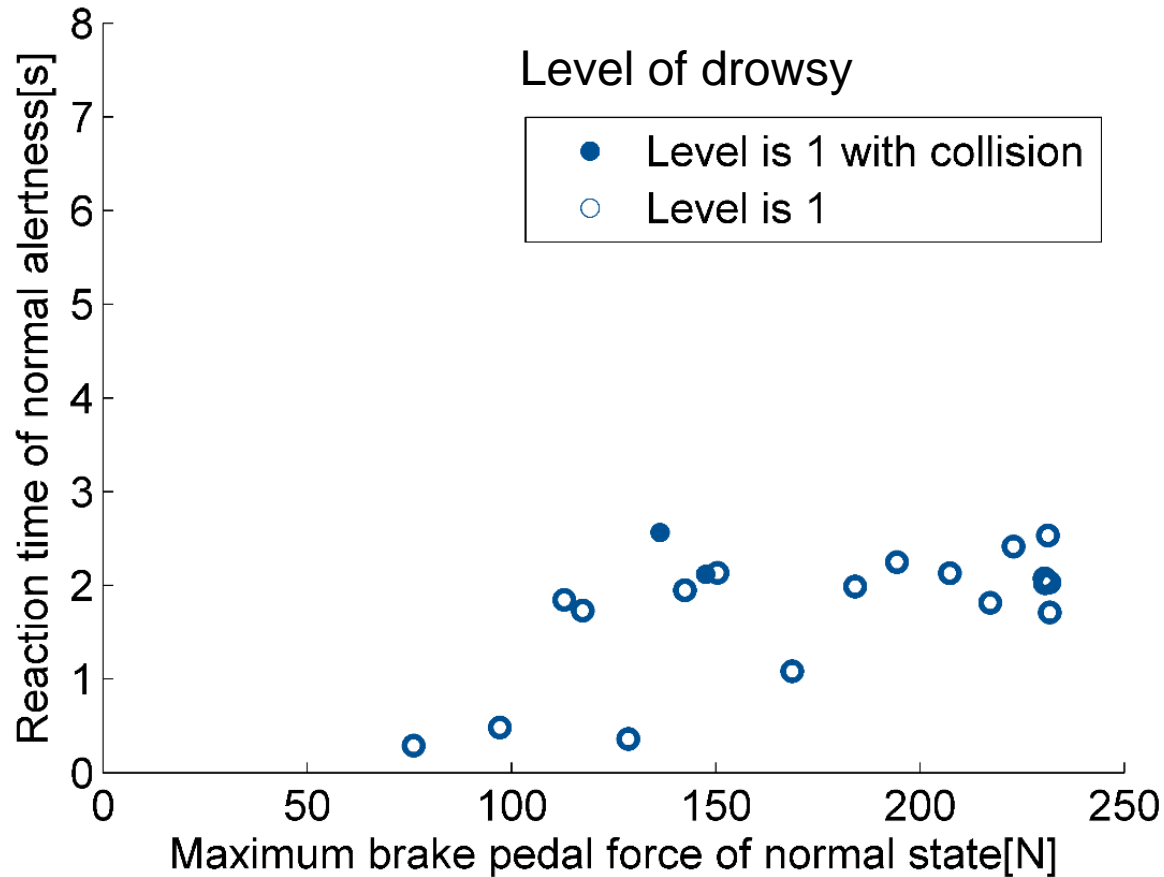
Level of drowsy

Level of drowsy	Status of drivers	Physical signs
1	Not sleepy at all	Blink a stable
2	Not sleepy	Yawn
3	Sleepy	Re-sit
4	Sleepy fairly	Shaking a head
5	Sleepy very	Close the eyelid

Definition of reaction time

The time from the moment the forward vehicle cutting in the same lane to the timing of braking operation by the driver

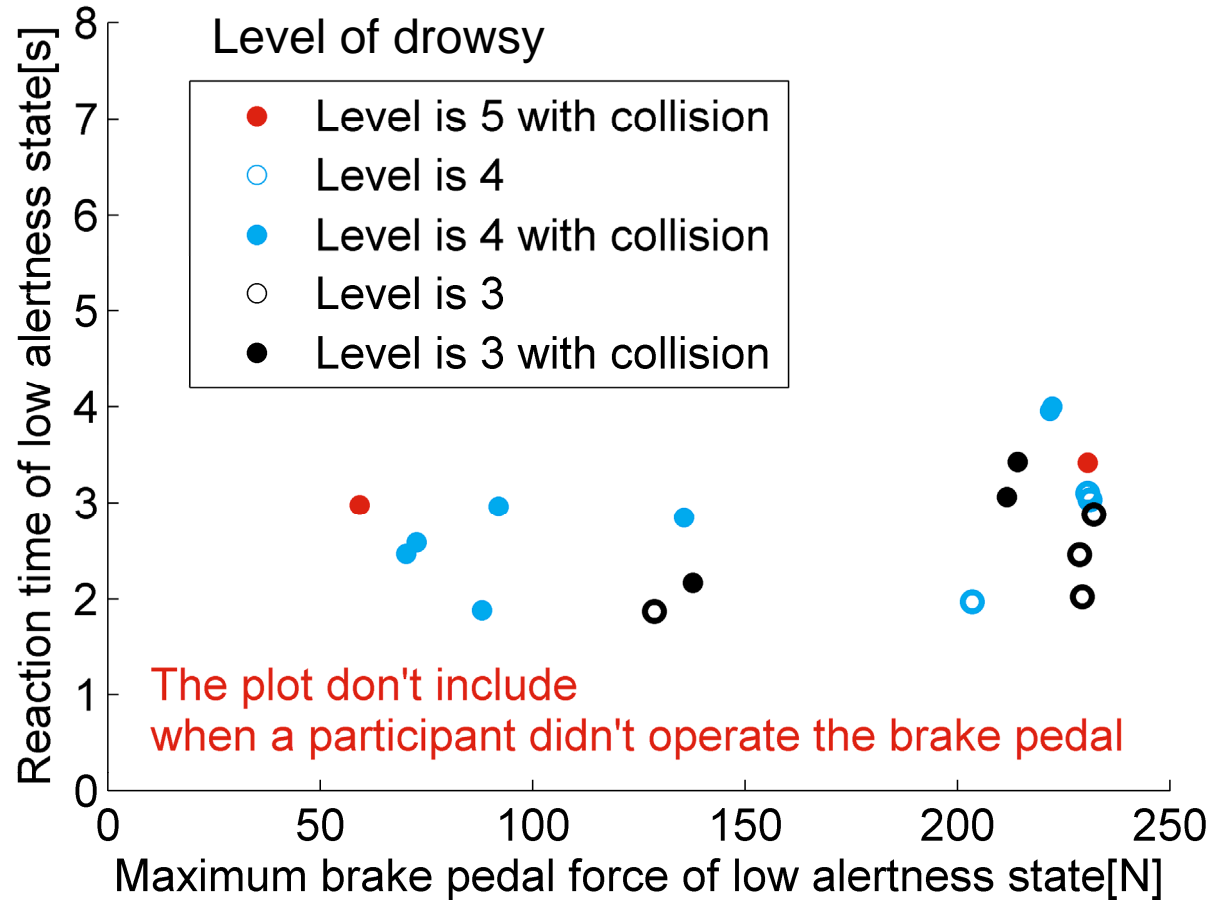
Reaction time and brake pedal force by normal drivers



Reaction time: 0.3-2.5 sec

Brake Pedal force: 70-240 N

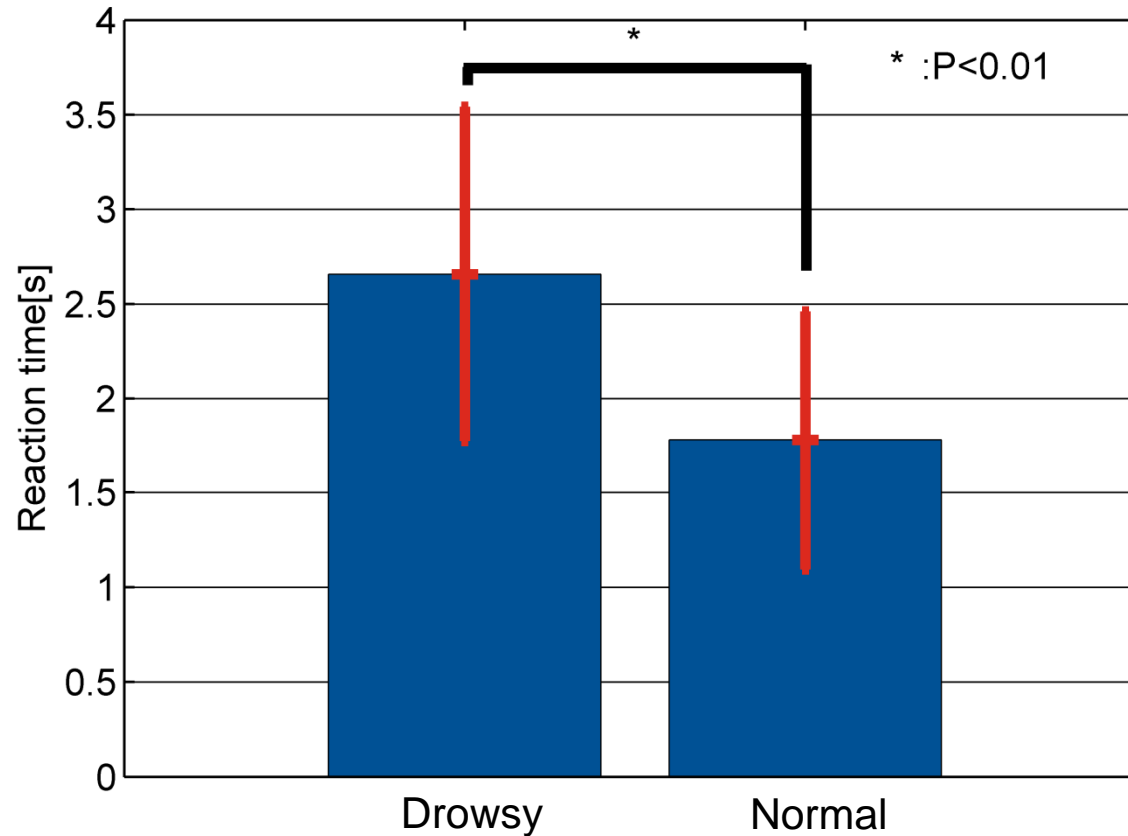
Reaction time and brake pedal force by drowsy drivers



Reaction time: 2.0-4.0 sec

Brake Pedal force: 50-230 N

Comparison of reaction time (normal vs drowsy drivers)



Normal: 1.78sec, Drowsy: 2.66sec

Reaction of drowsy drivers is longer by 0.9 seconds, or 50% than that of normal drivers

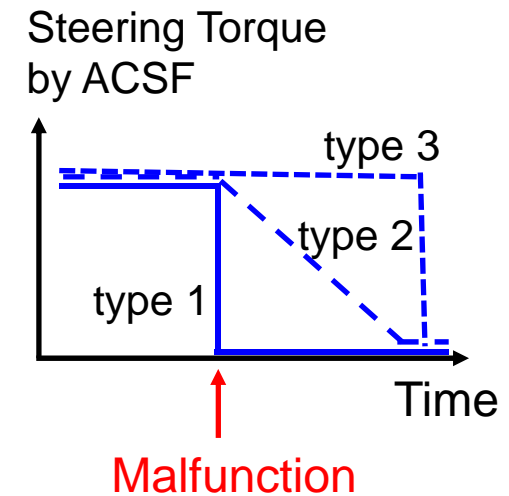
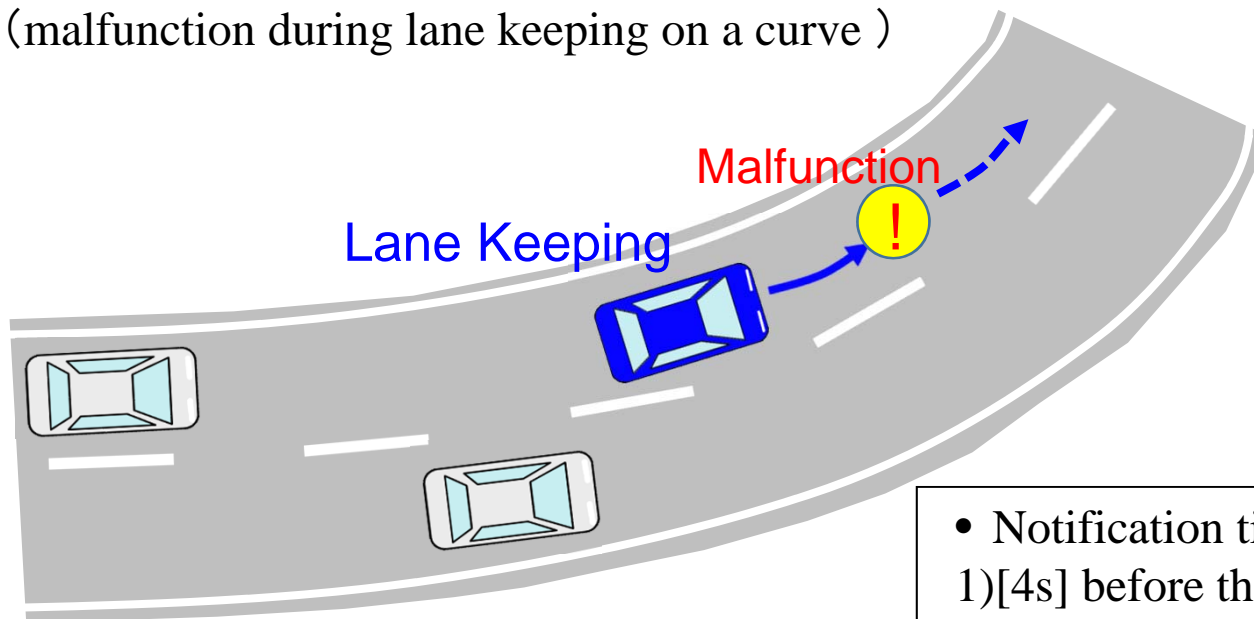
2. Research plan for ACSF in 2015

Drivers' behaviors during the transition from ACSF to manual driving under several scenarios

- Assessment of the drivers' behaviors during transition from ACSF to manual driving. (drivers' operation, reaction time, etc.)
- Several scenarios (e.g. malfunction) are considered in the test.

Examples of the traffic scene (1)

(malfunction during lane keeping on a curve)

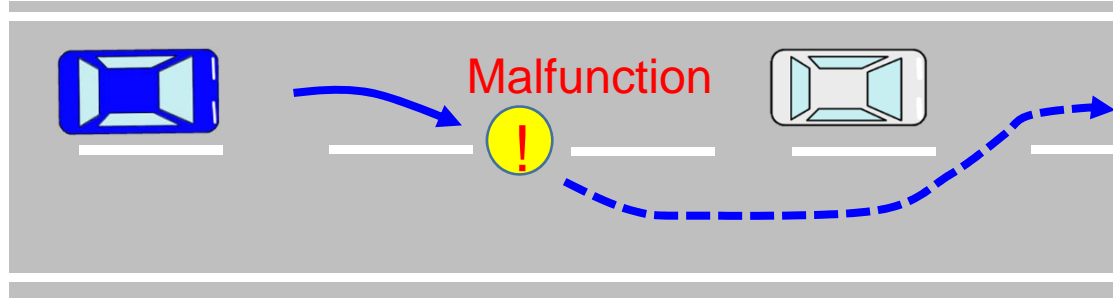


- Notification timing from HMI to the driver
 - 1)[4s] before the malfunction
 - 2)[2s] before the malfunction]
 - 3)Same timing as the malfunction

Examples of the traffic scene (2)

(Malfunction during a lane change)

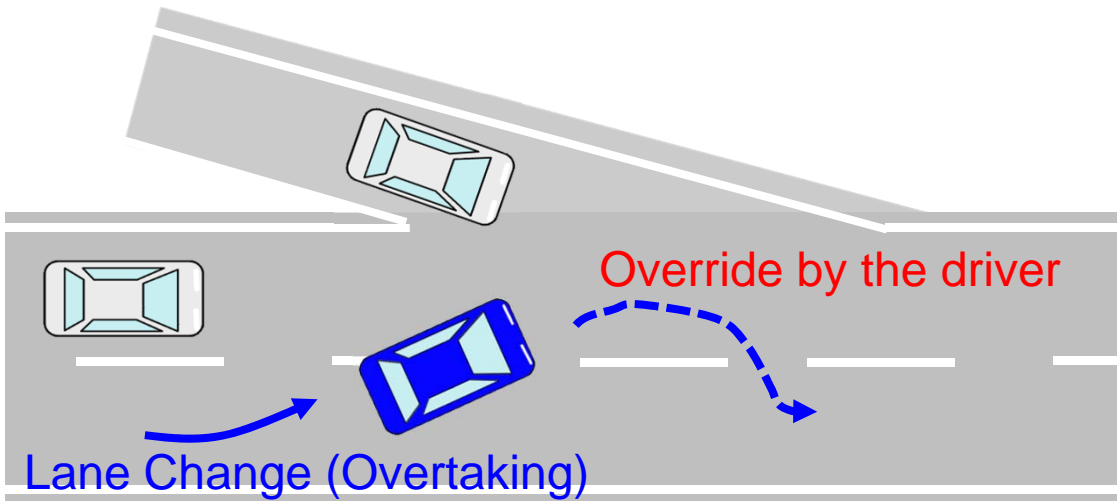
Lane Change (Overtaking)



- Lateral velocity during lane change
 - 1)[0.2~0.4] m/s
 - 2)[0.6~0.8] m/s
 - 3)[1.0~1.2] m/s
- Notification timing from HMI to the driver
 - 1)[4s] before the malfunction
 - 2)[2s] before the malfunction
 - 3)Same timing as the malfunction

Examples of the traffic scene (3)

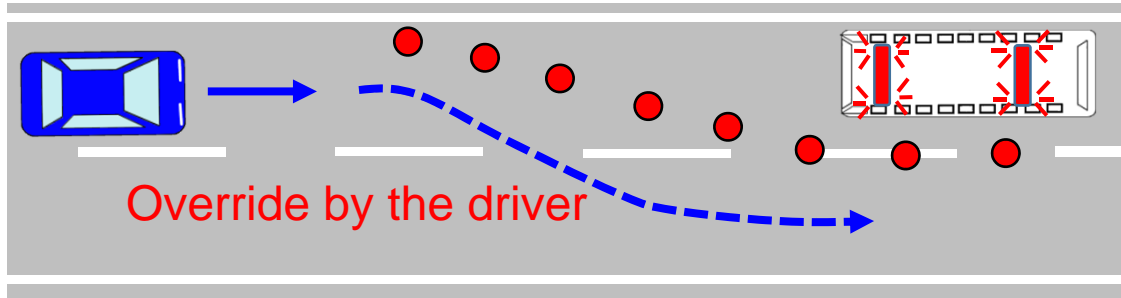
(Collision avoidance with other vehicle at the junction)



- Lateral velocity during lane change
 - 1)[0.2~0.4] m/s
- Notification timing from HMI to the driver
 - 1)[TTC 4s]
 - 2)No notification

Examples of the traffic scene (4) (reduction of the lanes)

Lane Keep



- Notification timing from HMI to the driver
 - 1) [TTC 4s]
 - 2) No notification

Sub-task for the driver during using ACSF (applied to all experimental traffic scenes)

- 1) Mental calculation (the driver sees the front, but his/her attentiveness will be decreased)
- 2) Operation of a smart phone or drinking coffee etc. (the driver doesn't see the front sufficiently)
- 3) No sub-task (the driver always sees the front)

Research schedules for ACSF in 2015

- By the end of August
 - To modify the driving simulator.
 - To make experimental scenarios
- By the end of September
 - To conduct experiment
- By the end of October
 - To analyse data