NISSAN

Driver Assist System Considerations

First Human Factors Symposium:
Naturalistic Driving Methods & Analyses
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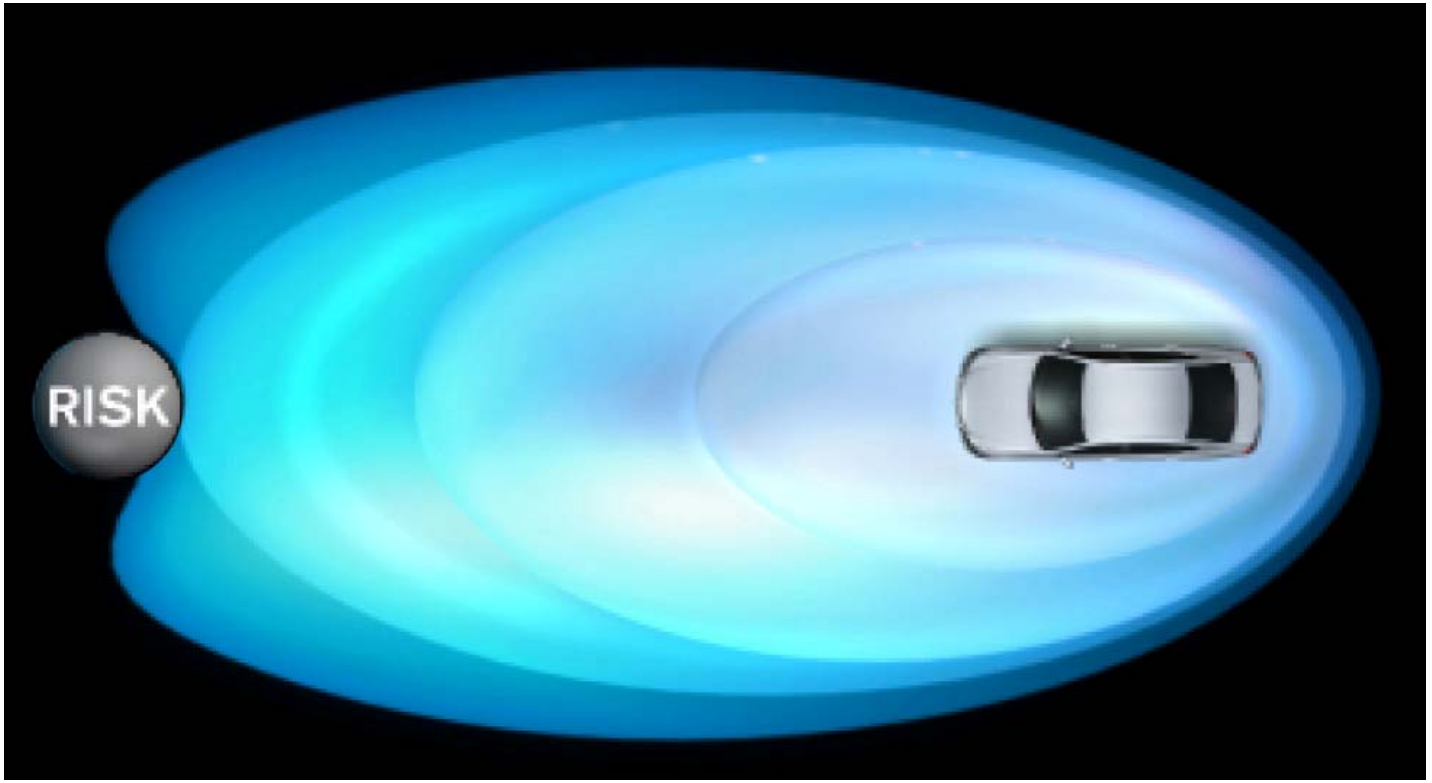
Overview

1. Nissan's Safety Shield and Driver Assist Systems
    - Distance Control Assist
    - Lane Departure Prevention
2. Naturalistic driving study for development of DAS
3. Examples of studies
    - Risk Quantification
    - Lane Departure

Safety Shield Concept

- ***"The Vehicle That Helps Protect People"***

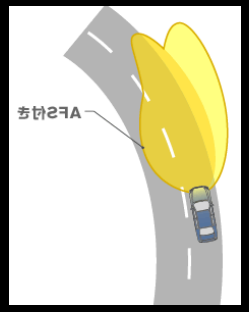
The vehicle activates various barriers to help the driver, passengers and other road users to avoid danger from normal driving conditions through post accident conditions.



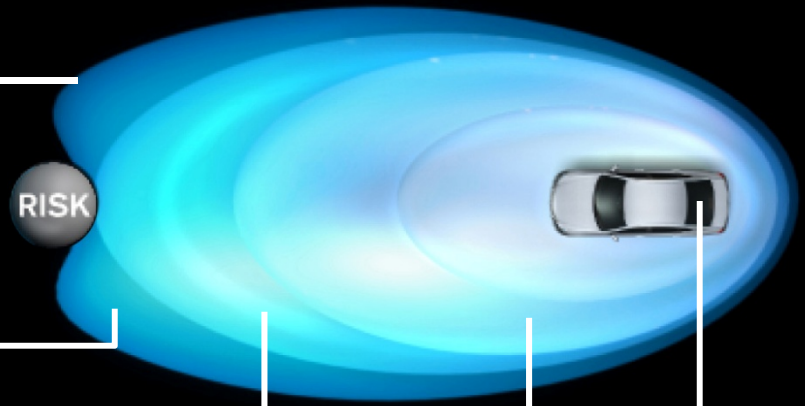
Safety Shield

"The Vehicle That Helps Protect People"

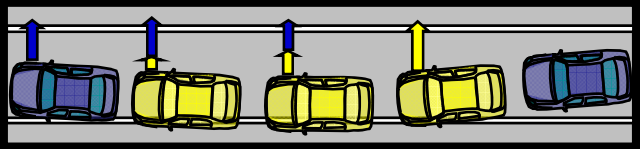
Risk has not yet appeared



e.g.:
Adaptive Front Lighting System (AFS)



Risk has appeared

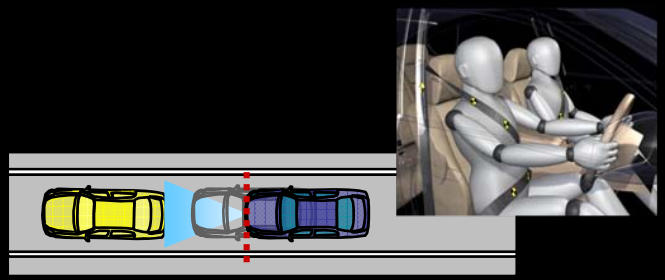


e.g.:
Lane Departure Prevention (LDP)

Crash may occur

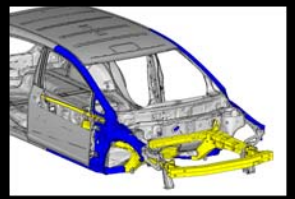
e.g.: Vehicle Dynamics Control (ESP)

Crash is unavoidable



e.g.: Intelligent Brake Assist
Pre-Crash Seatbelt

Crash/ Post-crash



e.g.: Zone body structure

Distance Control Assist

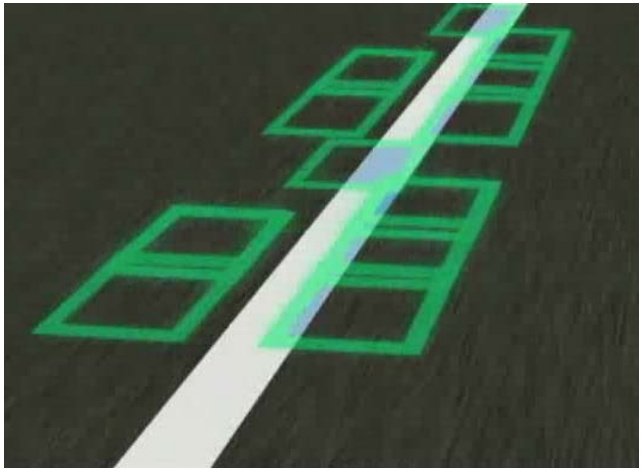
- Support the driver to help maintain appropriate distance by moving gas pedal upwards to assist to switch to the brake
- Applied on FUGA in Japan, and on FX in US in June/08

Detect by laser sensor

Move gas-pedal and apply brakes

Lane Departure Prevention

- Detect unintentional lane departure and helps to return
  to lane by generating yaw moment
- Applied on INFINITI M, EX35, FX in June/08



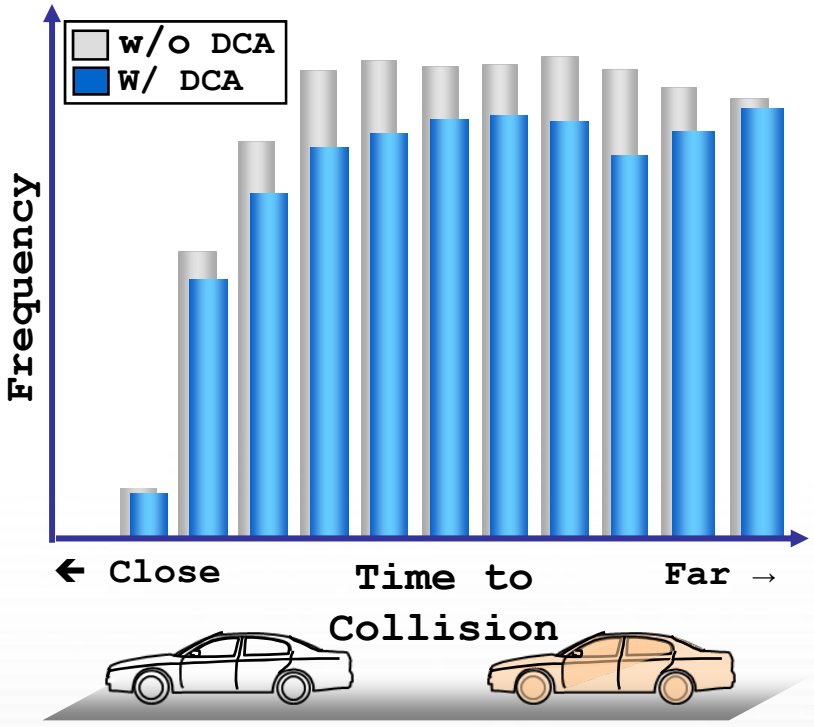
Detection by camera

Assist return to lane with yaw moment
by brake control

System Effectiveness

DCA (Distance Control Assist)

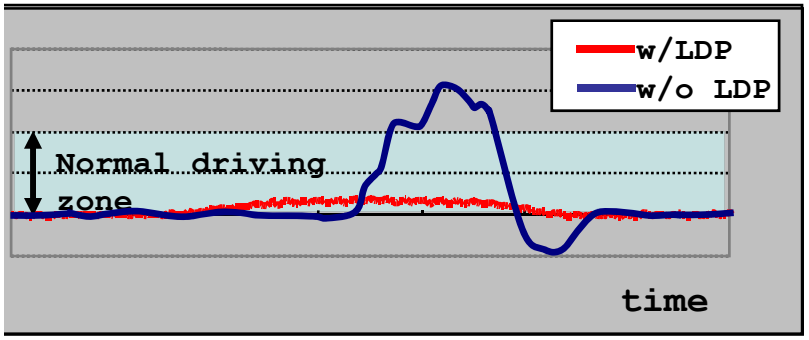
Less frequency in closer approach



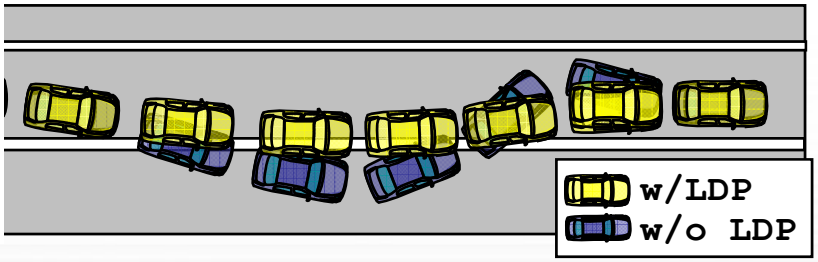
LDP (Lane Departure Prevention)

Smooth maneuver to return inside

Lateral acceleration



Vehicle maneuver



NDS for development of DAS

- Necessary to understand ‘driving behaviors’ in the real world to develop Driver Assist Systems
- Data from Naturalistic Driving Study are very useful
  - large volume
  - includes both of normal and unsafe driving data
- Typical usages of NDS are;
  1. quantitative analyses of driving behaviors
  2. driving behaviors in risky situations
  3. direct use of data for system function simulations
  4. system FOT

Examples of studies : Approach

- **Using 100-Car naturalistic driving study data**

Risk quantification

- tried to quantify frequencies of various Time-to-collisions in car- following

Lane departure

- tried to understand how drivers return to the lane in the case of lane departure

Risk Quantification : Analysis

- **Processes of data reduction**

- Vehicles used more than 90% by the main drivers : 16 subjects
  Younger group (18 – 24 years old) : 11 subjects
  Older group (56 – 68 years old) : 5 subjects

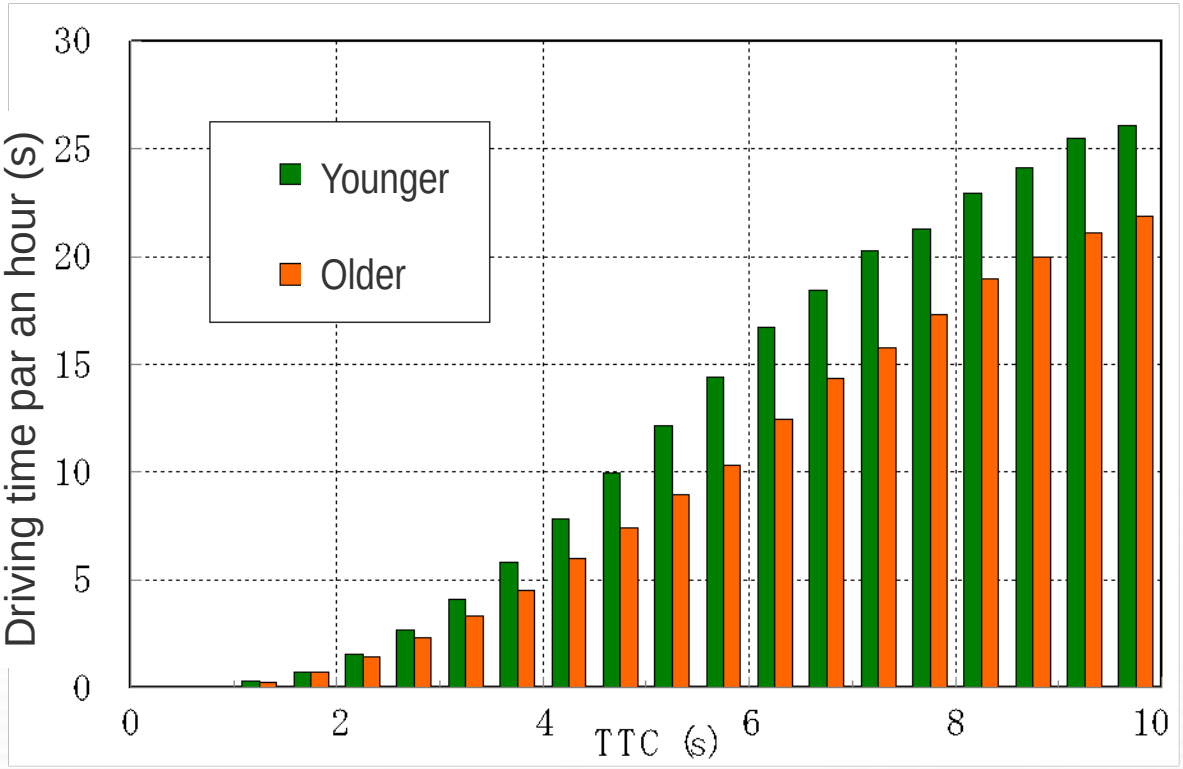
- Automatically selected the scenes can be assumed as car-following

- Calibrated the frequencies of the scenes by video inspection

Risk Quantification : Results

Driving time frequency in each TTC bin

- Younger group stays more frequent than older group in all bins.



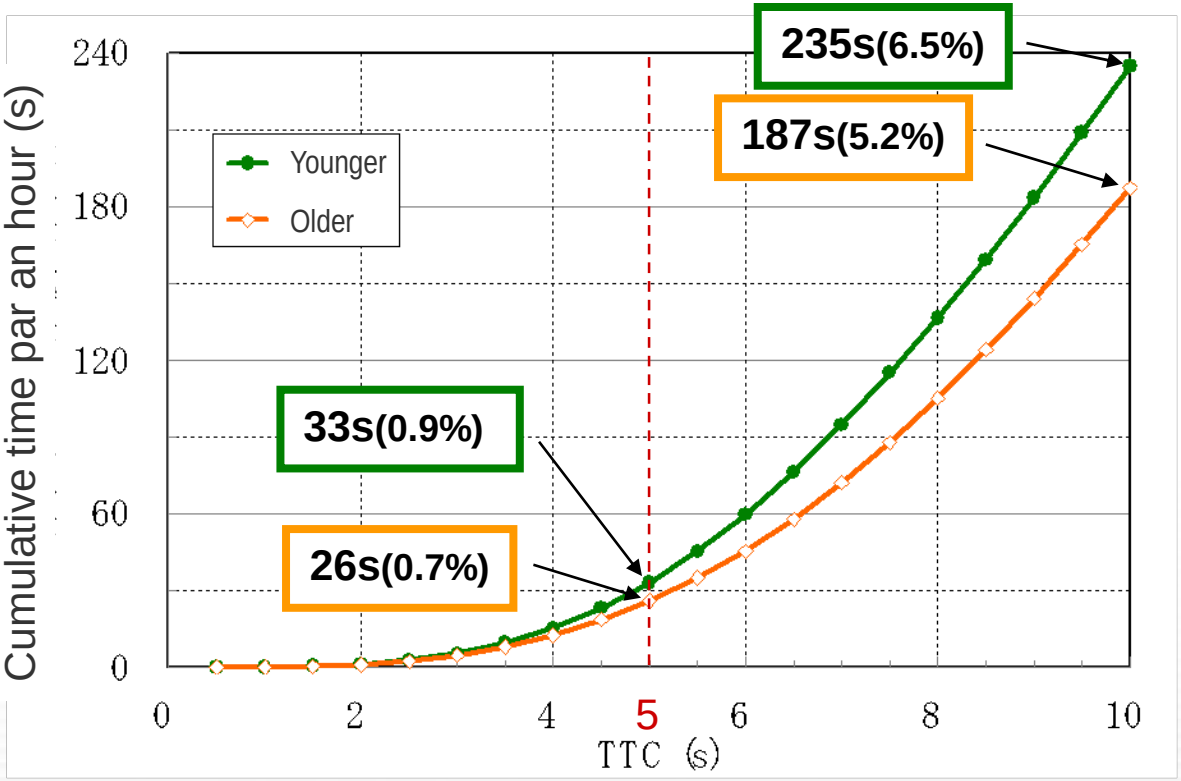
- More frequent in longer TTC bin
- Younger group stay more frequent than older in all bins

Driving time frequency in each TTC bin

Risk Quantification : Results

Driving time frequency in each TTC bin

- Larger difference at 5 – 10 s of TTC



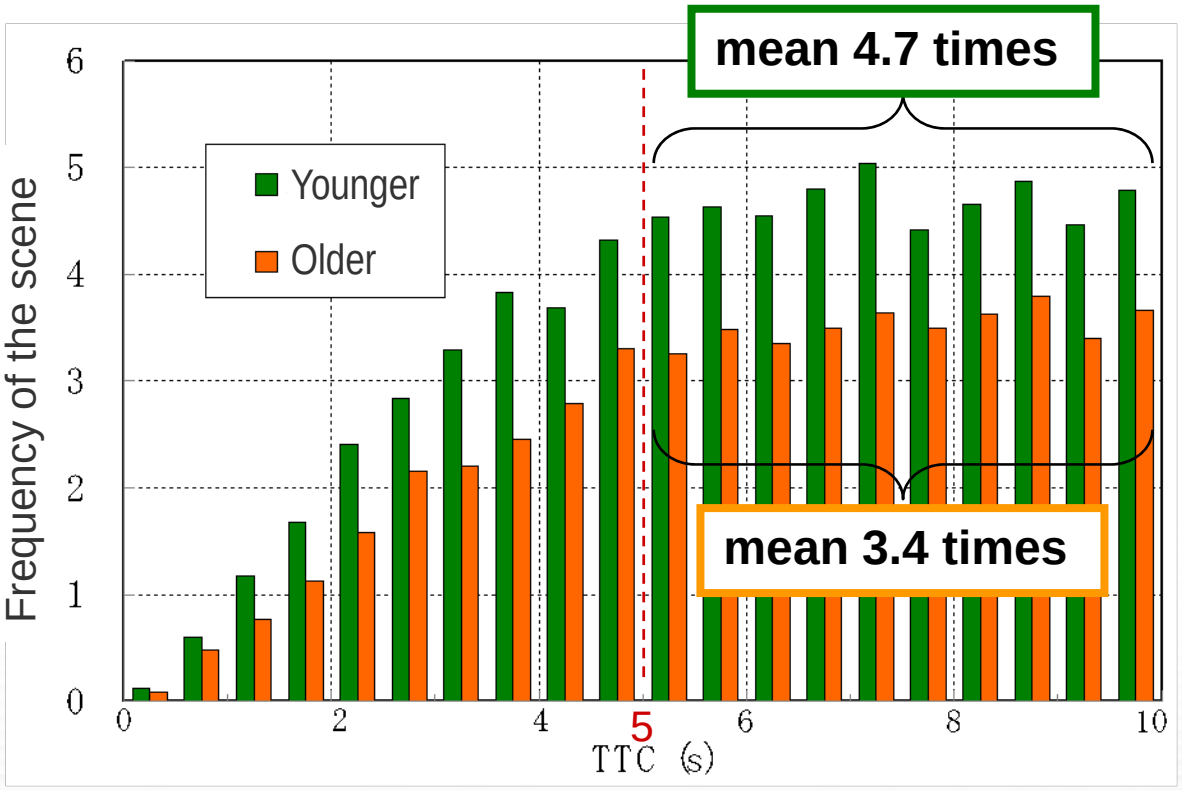
Driving time cumulative frequency

- Time less than 5s is 1/7 of less than 10s
- Difference in times less than 5s is relatively small
- Larger difference at 5-10s of TTC

Risk Quantification : Results

Frequency of the scene in each TTC

- Younger group experiences more frequent than older group in all bins.



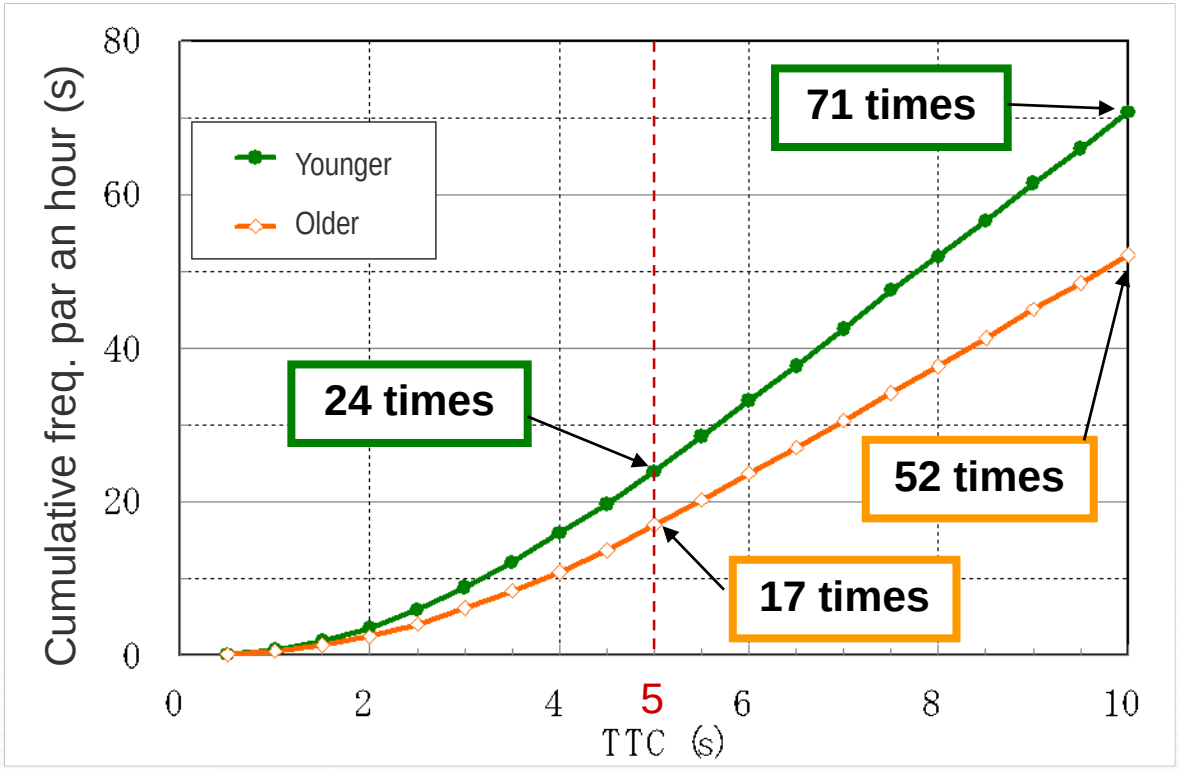
Frequency of the scene in each TTC bin

- Almost constant in 5-10s TTC
- Less frequent in smaller TTC less than 5s
- More frequent for younger group than older group in all bins

Risk Quantification : Results

Frequency of the scene in each TTC

- Frequencies of older group are less than younger group by about 30%.

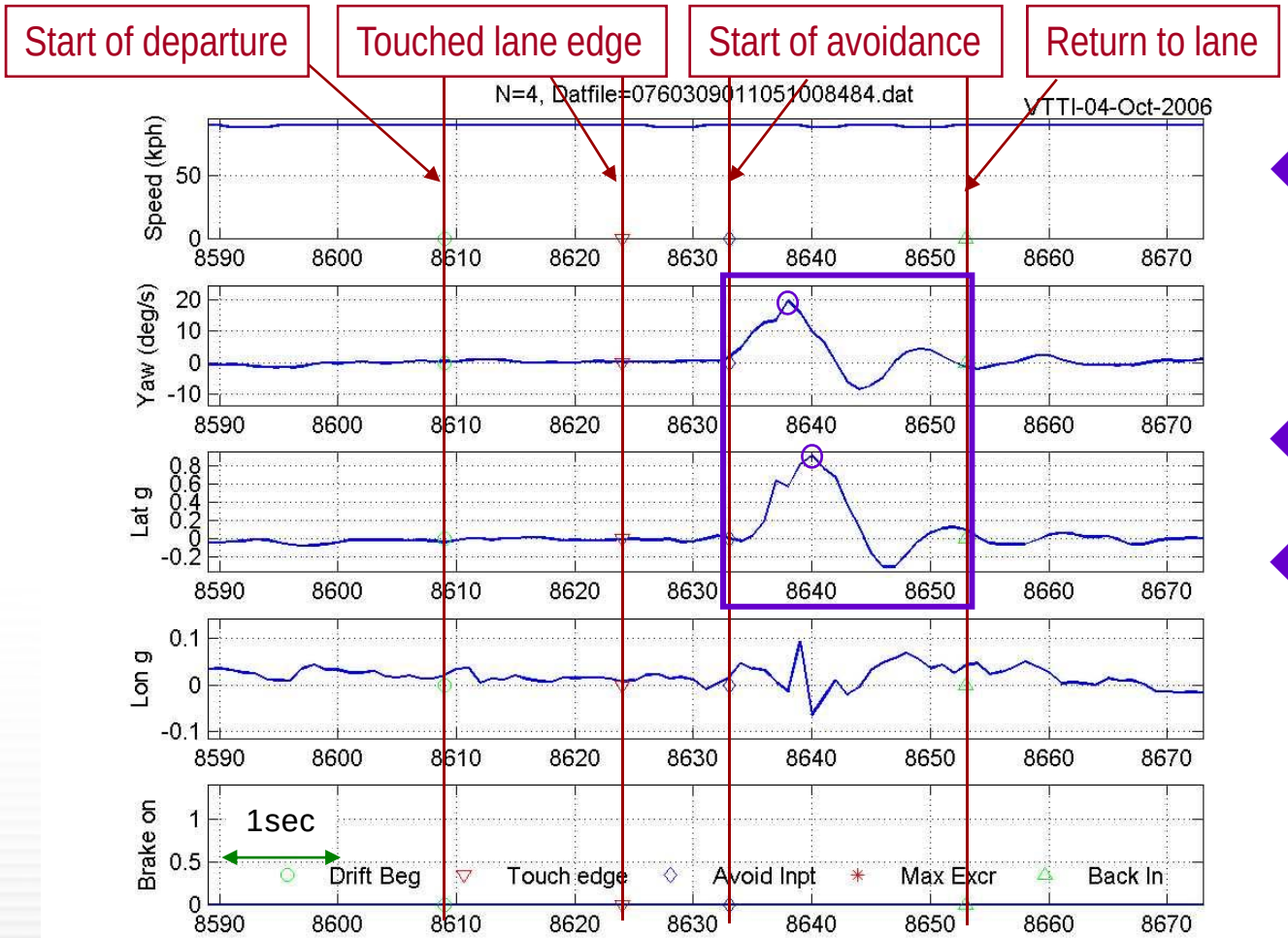


Cumulative frequency of the scene

- Scenes less than 5s are 1/3 of 10s
- Frequencies of older group are about 70% of younger group

Lane Departure : Analysis

- Analyzed 26 cases from 71 crash / near crash cases by video analysis



- Analyzed avoidance behavior
- Maximum yaw rate
- Maximum lat G

Example: Lane departure at freeway in 55mph, tried to insert CD disk to audio

Summary

- It is necessary to understand ‘driving behaviors’ in the real world to develop Driver Assist Systems. Then, data from Naturalistic Driving Study are very useful.

- Typical usages of NDS are;

1. quantitative analyses of driving behaviors

   Example: Risk Quantification Study

2. driving behaviors in risky situations

   Example: Lane Departure Study

3. direct use of data for system function simulations

4. system FOT

Thank you for your attention