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Impact assessment with virtual simulation methodologies

Scope of SIP-adus

【Motivation】

Development of a simulation tool to evaluate traffic safety impact when ADAS/Automated Driving systems are deployed.

(I) Development and verification of automated driving system

Road Transport system

Traffic environment

Driver

Recognition | Judgment | Operation

(5) System Security

(4) Driver Model

Recognition | Judgment | Operation

(1) Dynamic Map

(2) Prediction based on ITS information

(3) Sensors

Area of Cooperation

Area of Competition

Vehicle

(II) Basic technologies to reduce traffic fatalities and congestion

(1) Traffic fatality reduction effect estimation method & national shared database
(2) Macro and micro data analysis and simulation technology
(3) Local traffic CO_2 emission visualization technology

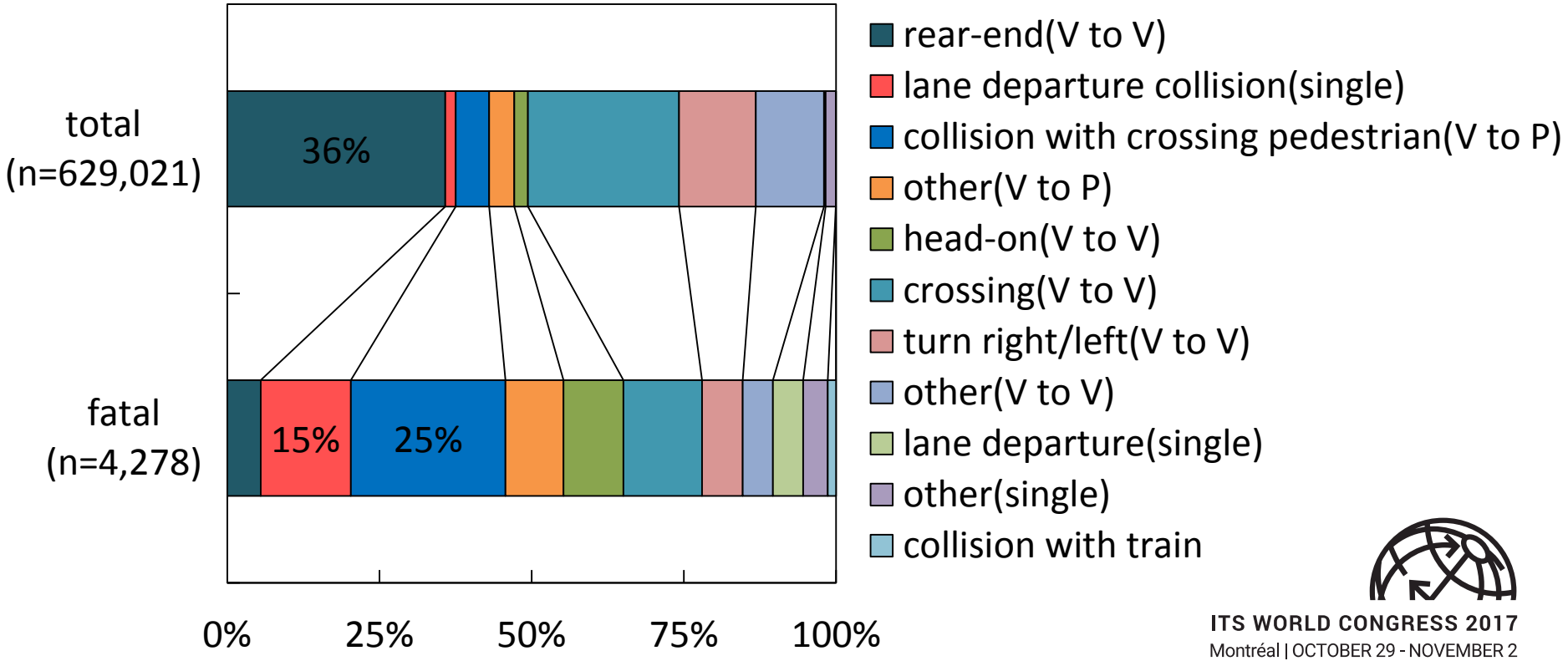
(III) International cooperation

(1) Open research facility
(2) Social acceptance
(3) Technology transfer

(1) Enhanced local traffic management
(2) Next generation transport system

(IV) Development for next generation urban transport

Major Crash Types in Japan

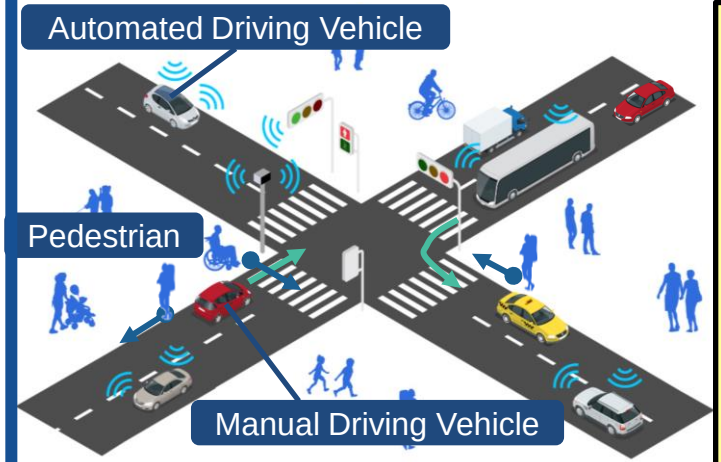


Safety Impact Assessment

Quantitative analysis of accident reduction

1. Traffic flow simulation → 2. Traffic accident analysis → 3. Estimation

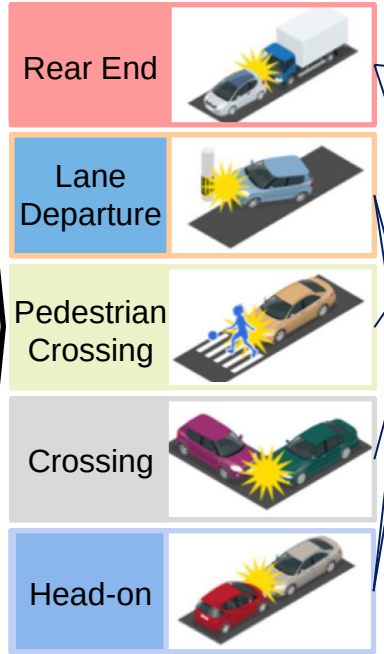
Traffic accidents reduction simulation “Multi Agents”



[Simulation Parameters]
- Levels of Automation
- Diffusion of Automated Driving Vehicles
- Error Action (driver/pedestrian)

etc.

Major crash types in Japan



Contributions by ADVs

- Collision Warning
- Advanced Emergency Braking
- Lane Departure Warning
- Lane Keeping Assistance

Simulation result

	W/	W/o
ADV	60%	40%
Man.DV	50%	10%
Ped.	30%	25%
…	…	…

Traffic Accident Reduction

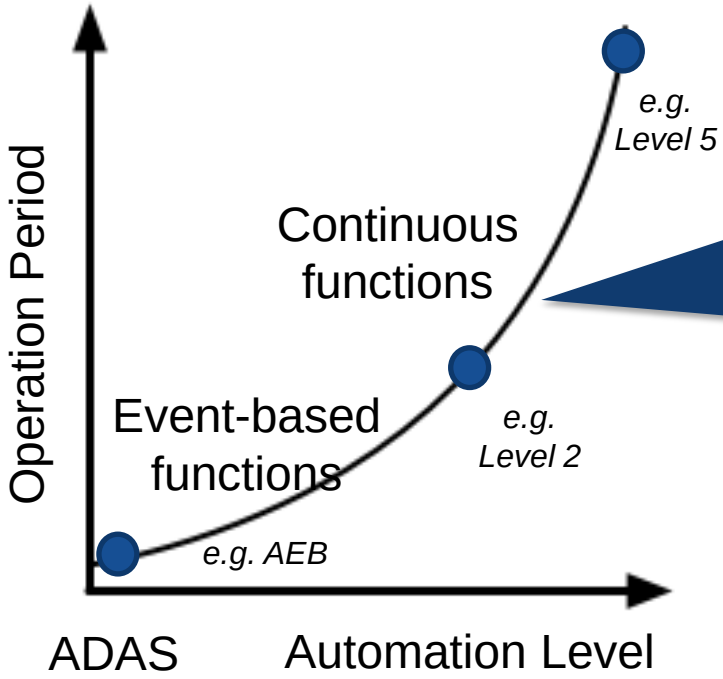
Number of:
- Fatalities
- Traffic jams due to accidents,

etc.

Safety Impact Assessment

Type of functions in ADAS/Automated driving systems

"Event-based functions" and "Continuous functions"



Traffic simulation with virtual road environments and multi agent traffic participants is needed for assessment of both Event-based and Continuous functions.

Impact Assessment Methodology

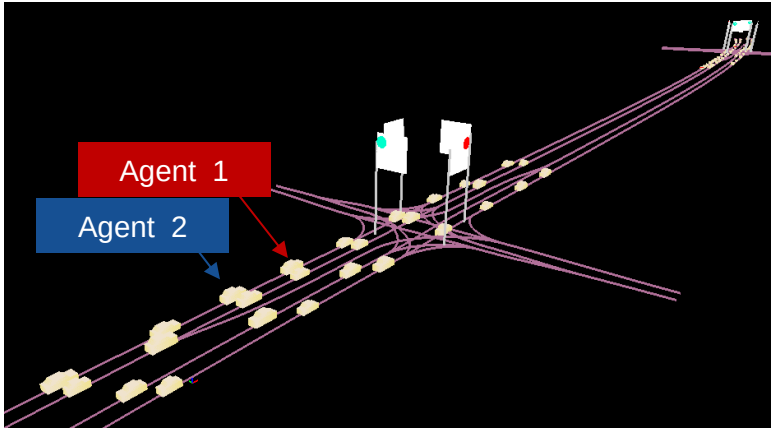
Assessment Methods for "Continuous Functions"（Long Operational Period）

Field Operational Test

Implementation challenges

Cost
Acceptance
.....
Data
(Accident)

Traffic Simulation

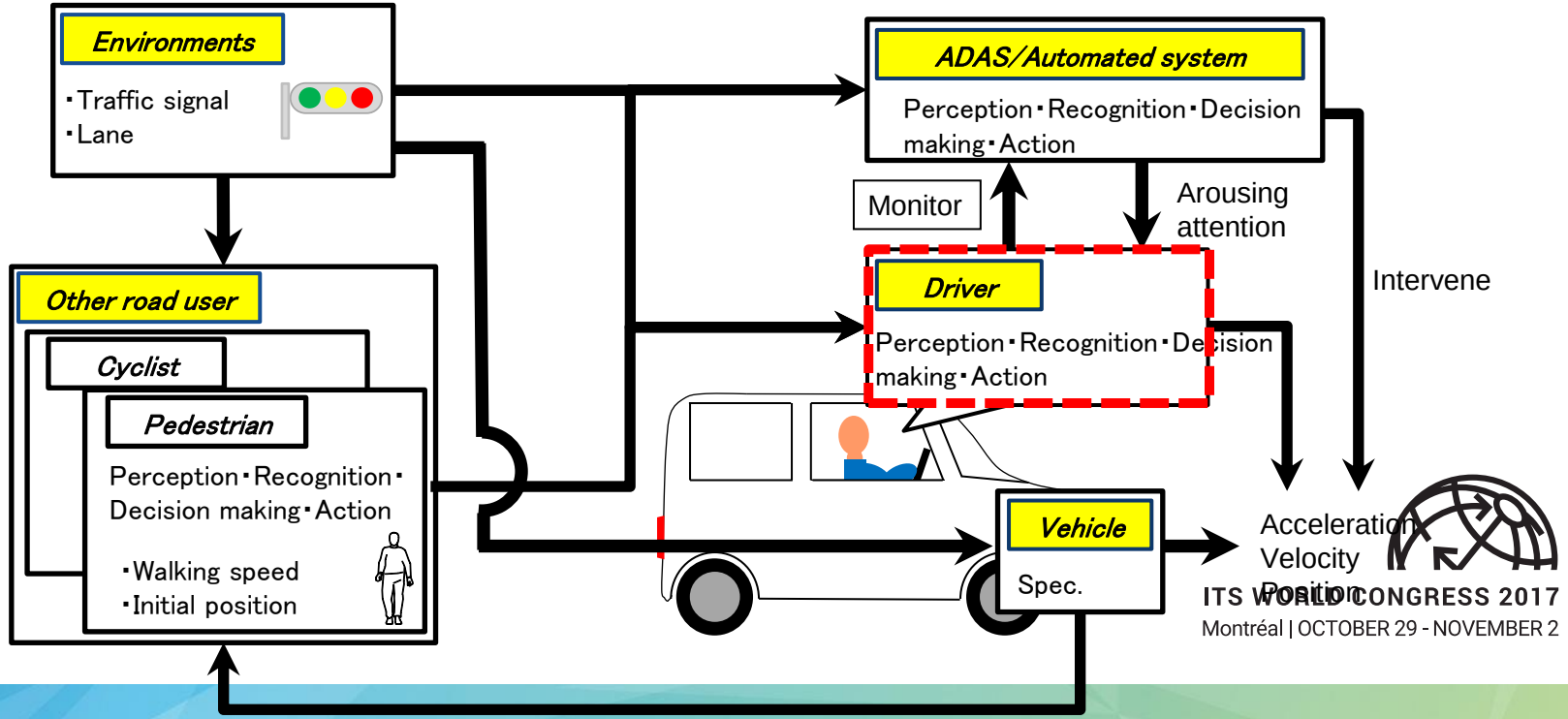


Real traffic flow

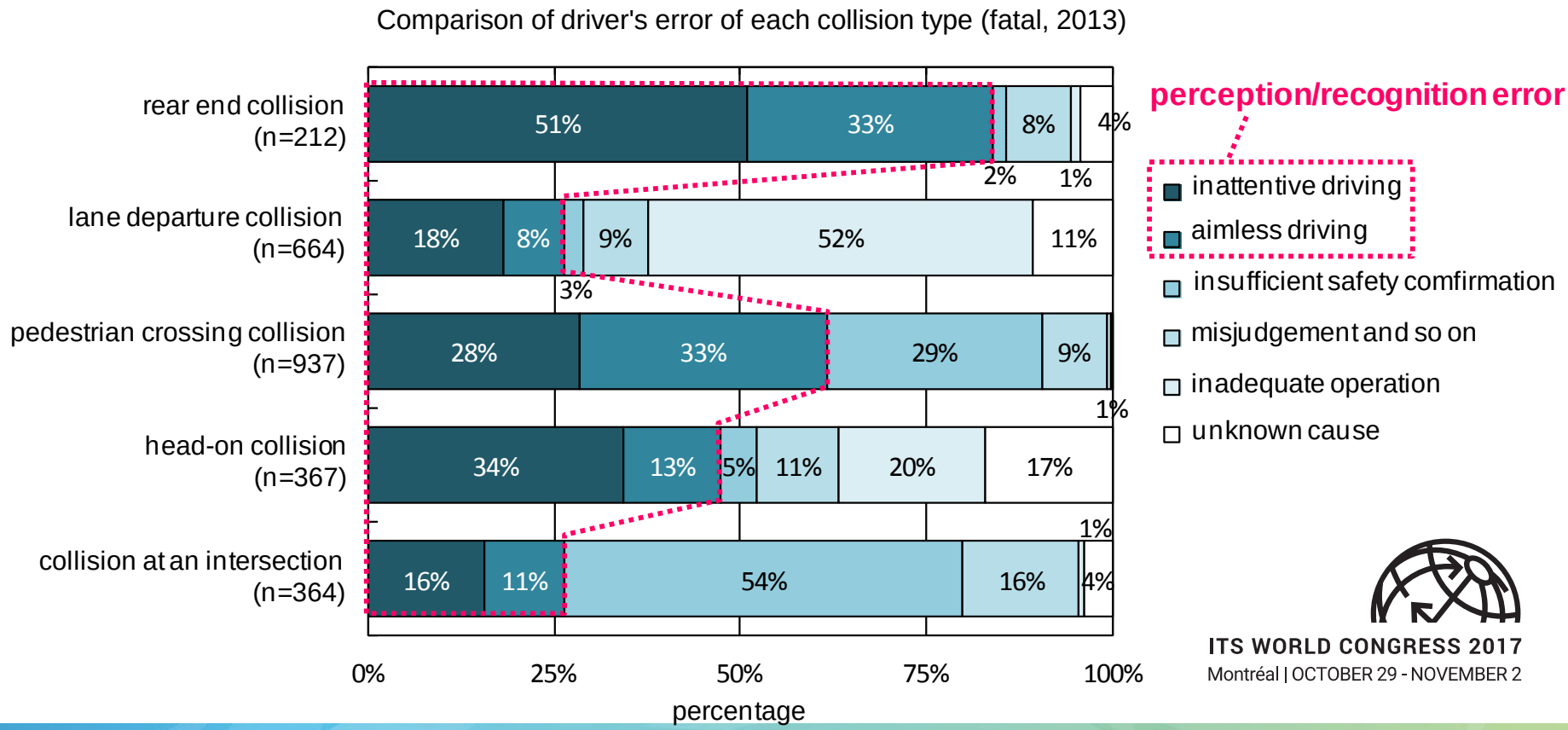
Virtual traffic flow

Composition of models

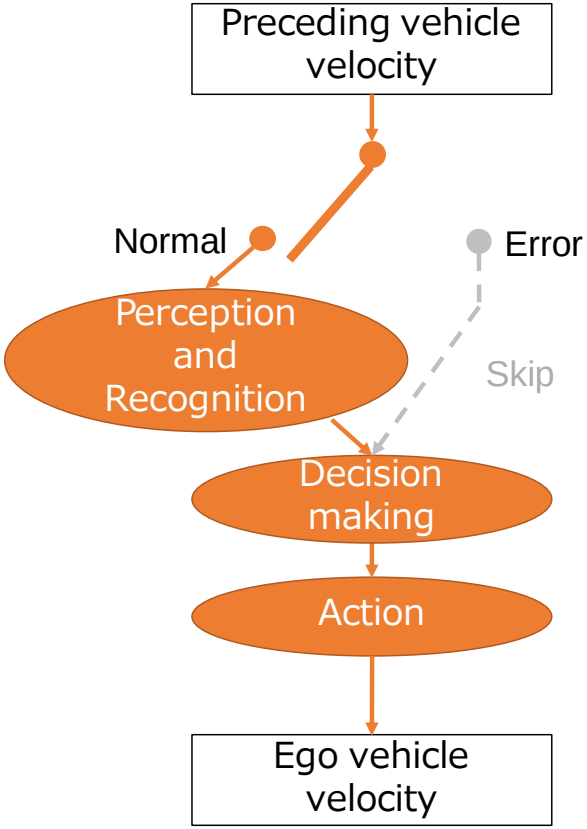
To evaluate ADAS/Automated vehicles, it is necessary to have at least 5 components.



Driver errors in major crash types in Japan

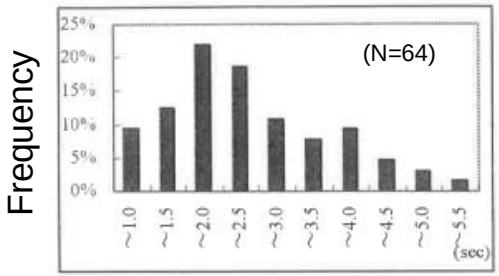


Simulated driver inattentive error (Vehicle speed control)



Normal state
Driver agent recognizes a current preceding velocity and react to changing it.

Perception & Recognition error state
Driver agent DOES NOT recognize a current preceding velocity. And, Continue error state in few seconds.

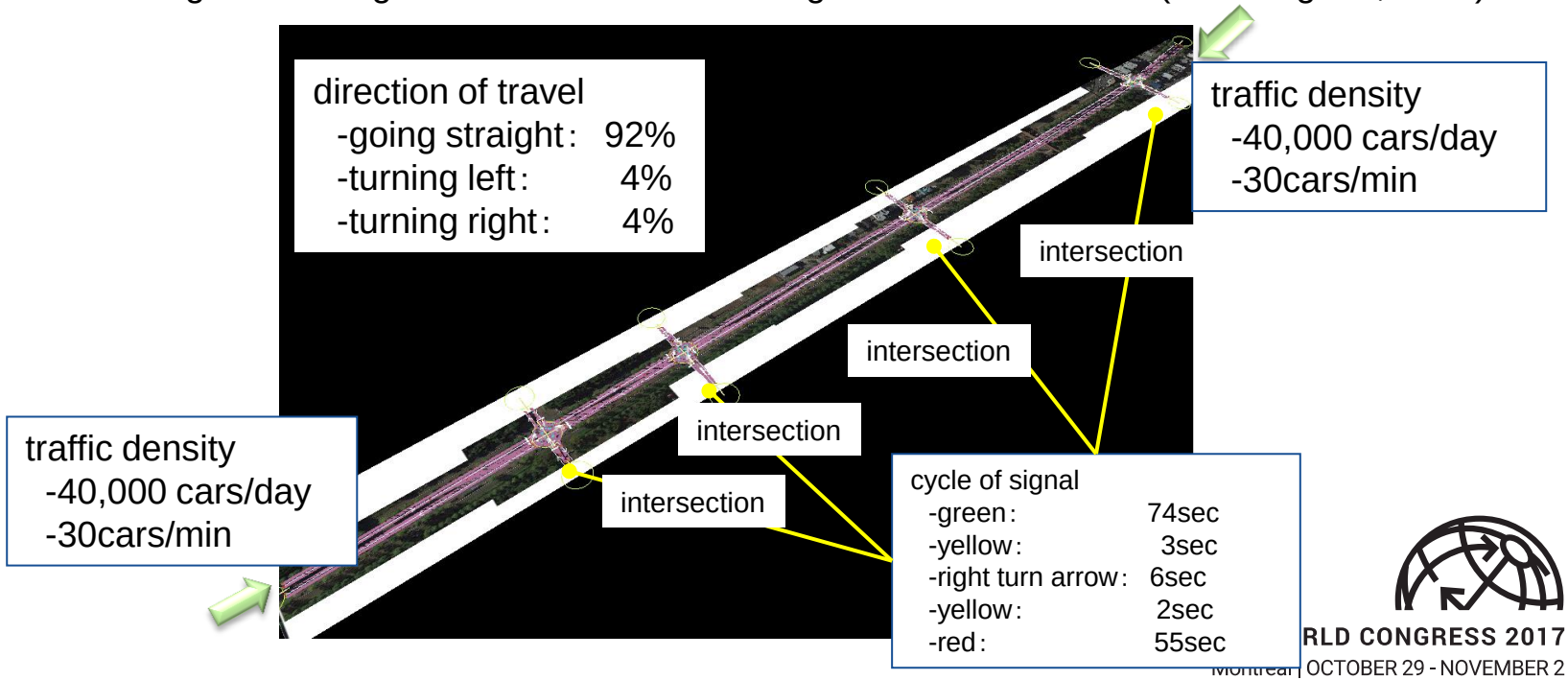


(Takubo, 2001)

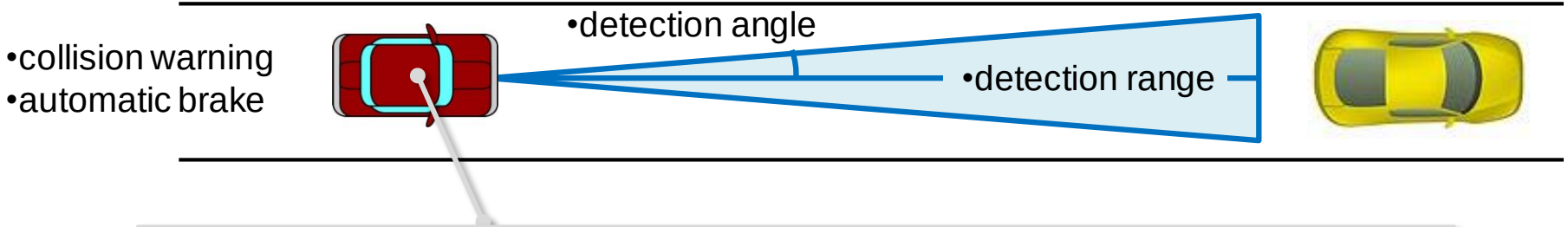
Safety impact assessment via traffic simulation software

Simulation setup

Road segment: straight road section with four signalized intersections (total length:1,400m)



Specification of AEB

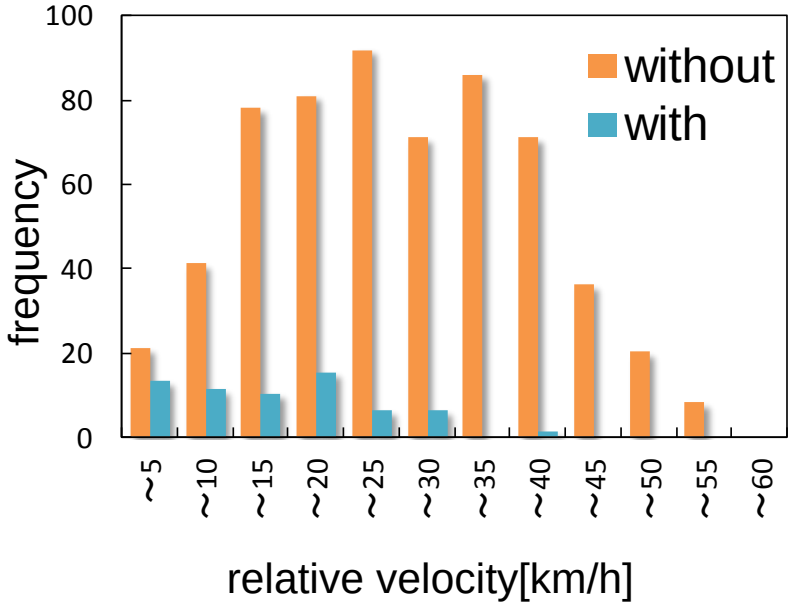


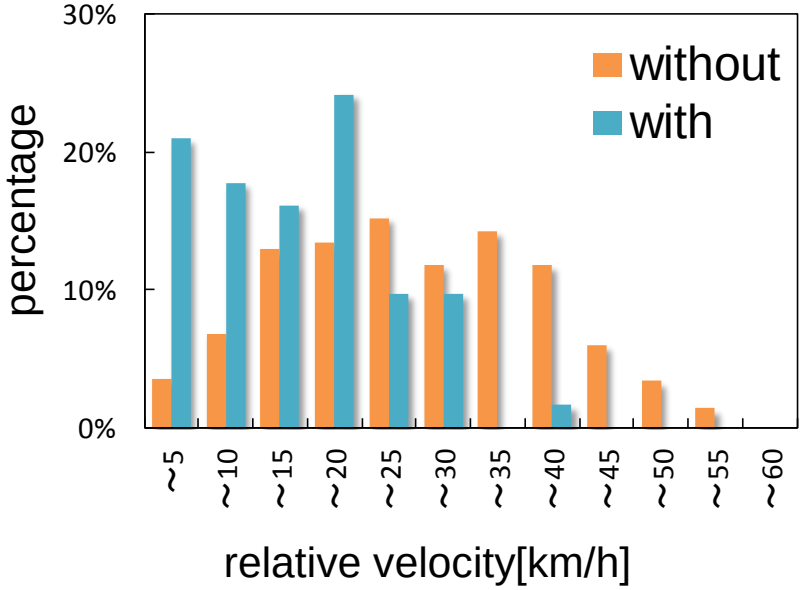
- time-to-collision for actuation of collision warning: 1.8sec
- time-to-collision for actuation of emergency braking: 0.6sec
- brake jerk: 2.0G/s [19.6m/s^3]
- maximum deceleration: 0.8G [7.8m/s^2]

Homma et al.(2012)

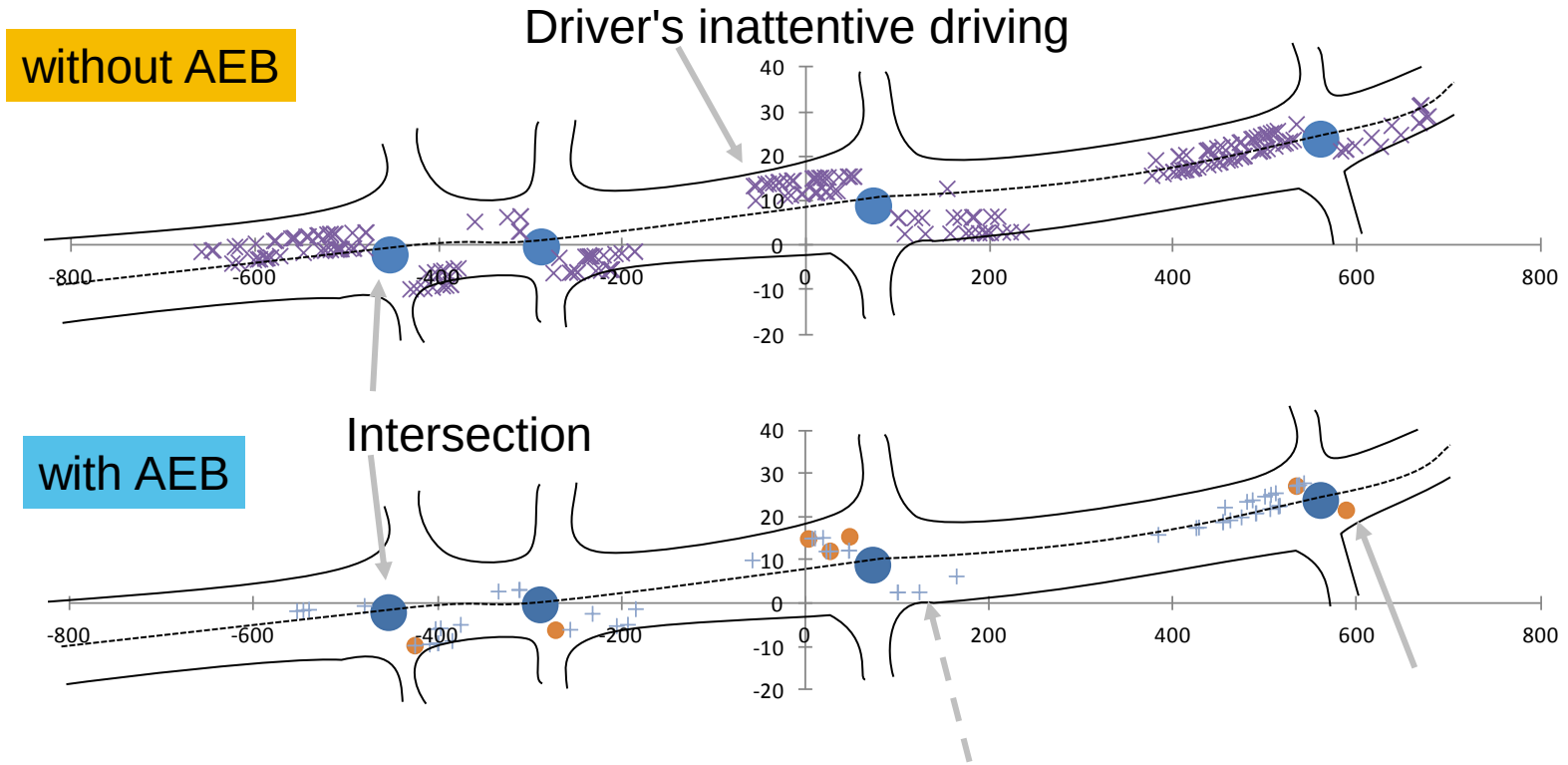
Relative velocity of rear-end collision

Comparison between with AEB and without AEB

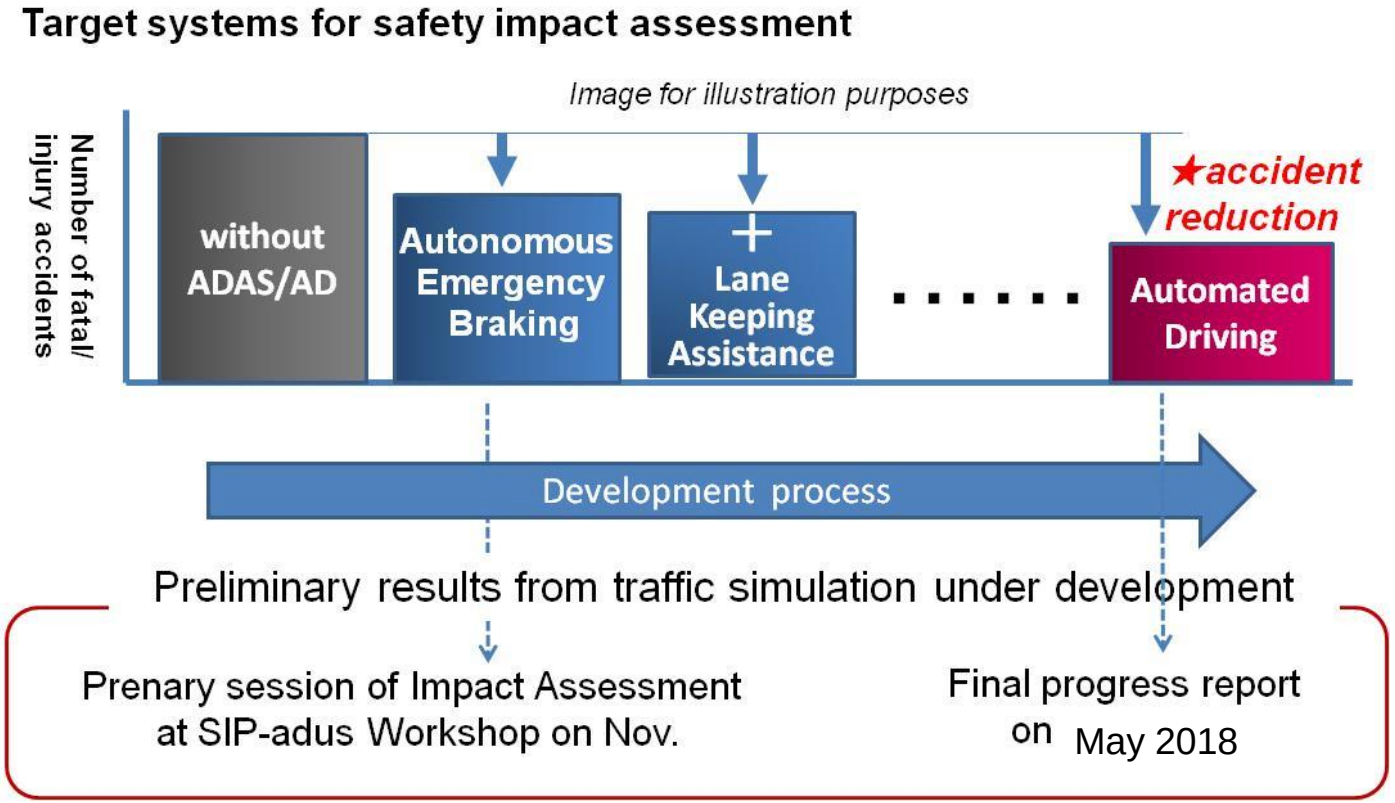




Locations of simulated accidents



Verification steps of the simulation



Summary

- We aim at developing a simulation which can contribute to accurate impact assessment when an automated vehicle / ADAS is deployed.

- Agent based simulation is necessary to reproduce realistic traffic environments.

- Making driver models that replicate driver errors is necessary for accurate impact assessment of automated vehicles / ADAS.