The 12th Japan ITS Promotion Forum

Automated Driving Systems

Pedestrian Traffic Accident Reduction

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<Translated Version>

SIP Cabinet Office

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SIP-adus' 3 Strategies for Reducing Accidents

◆ Reduce pedestrian accidents with automated driving and IoT

(1) Survey and analysis of accident circumstances (Institute for Traffic Accident Research and Data Analysis [ITARDA])

・Classification of all accident patterns and trend analysis

→ Ascertainment of the actual circumstances of pedestrian accidents and study of countermeasures

(2) R&D on technologies for estimating accident reduction effects (Japan Automobile Research Institute [JARI])

・Simulation technologies that recreate traffic environments based on a multi-agent system

→ Prediction of accident-reduction effects according to system performance

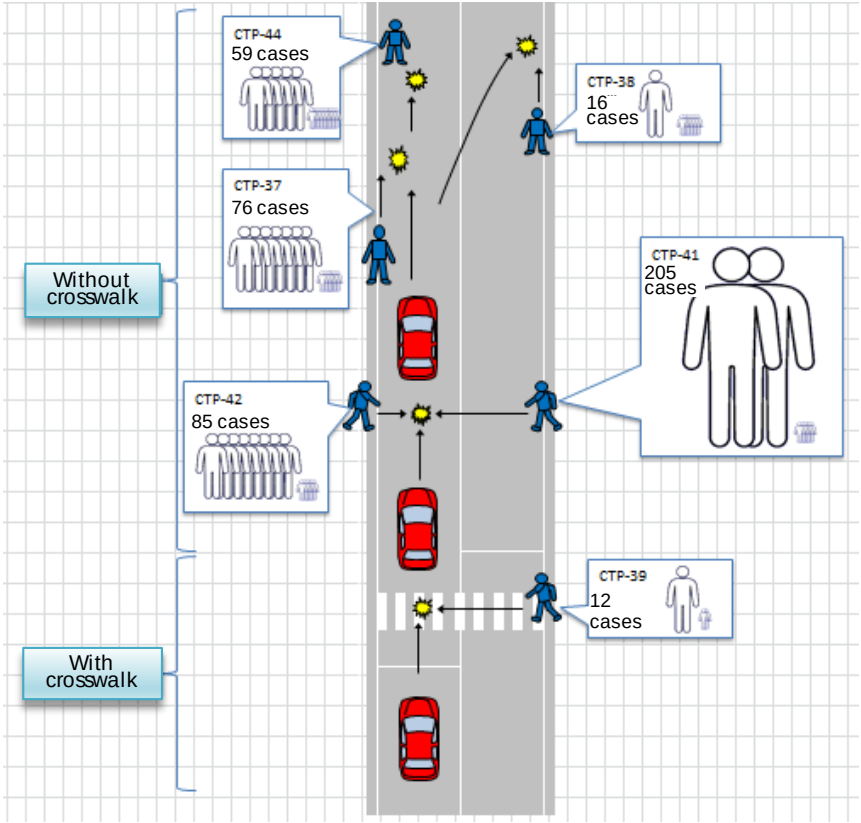
(3) R&D on vehicle-to-pedestrian communication systems (Panasonic)

・Mutual cognizance of other's presence by pedestrians and vehicles through intercommunication

→ Reduction of accidents caused by cognitive errors, which account for a large portion of pedestrian accidents

Survey and Analysis of Accident Circumstances

◆ Classification of accidents into patterns (3 or more fatalities: 256 patterns)



- Extraction of pedestrian accidents and analysis of contributing factors
- Envisioning of possible countermeasures for each factor

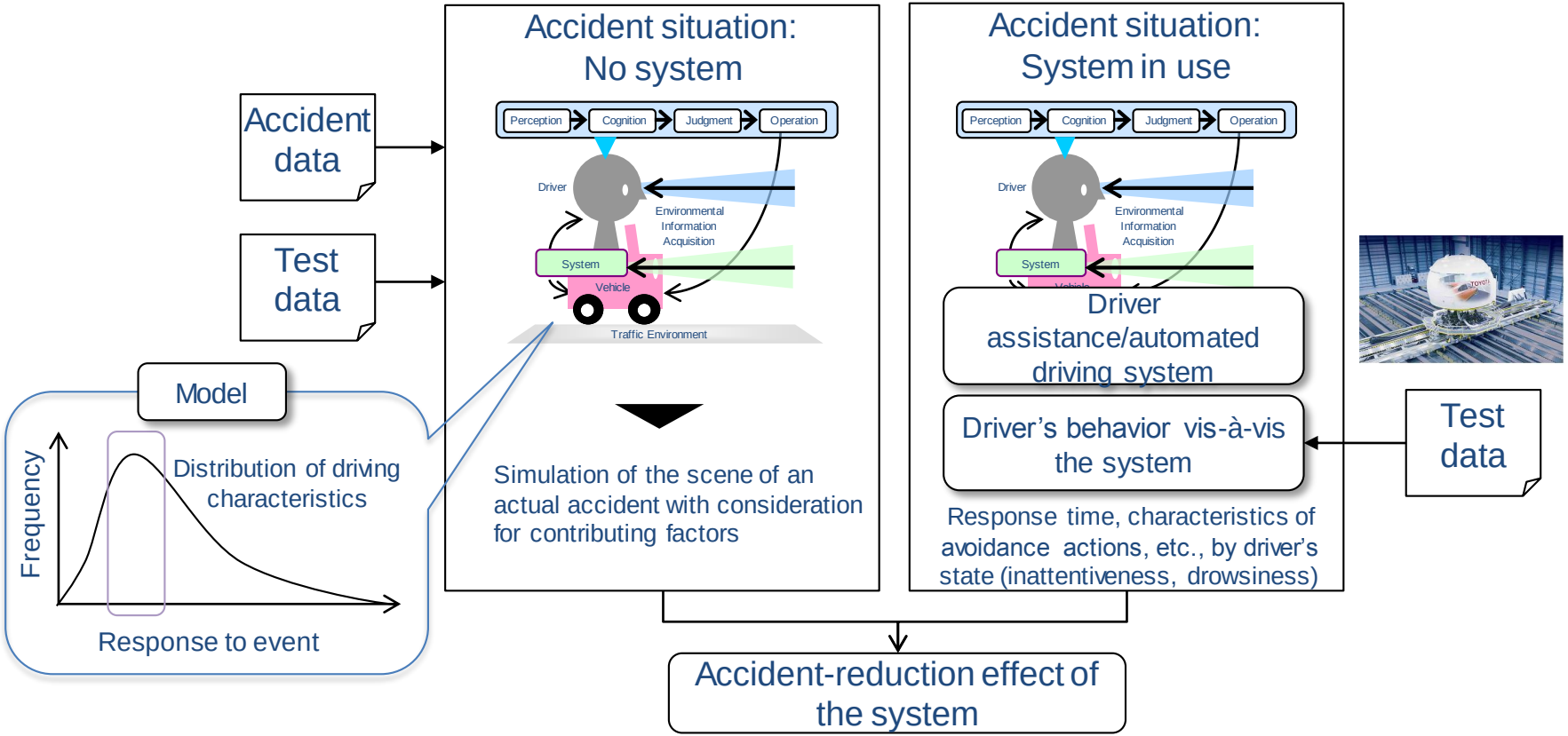
  Example: Ignoring of traffic lights while walking → Awareness activities
- "Possible that accident could have been avoided with awareness" (e.g., inattention ahead, failure to confirm safety, etc.)

  64 patterns, 1,043 out of 1,305 cases (80%)

Support for mutual cognizance using vehicle-to-pedestrian communication

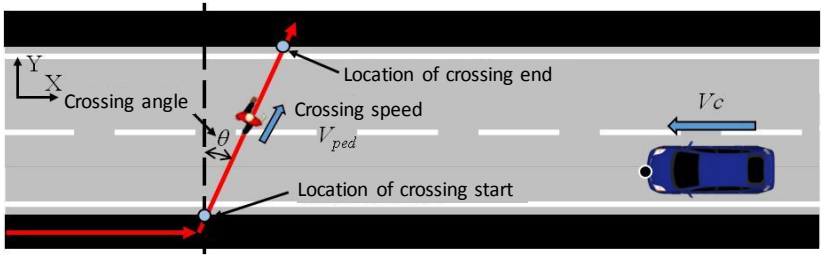
Estimating Accident Reduction Effects

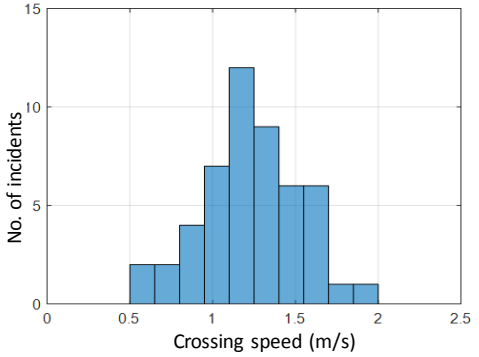
- Recreation of traffic environments and accidents through multi-agent simulation



Model Construction

- Construction of a pedestrian crossing model using fixed-point observations and experiments



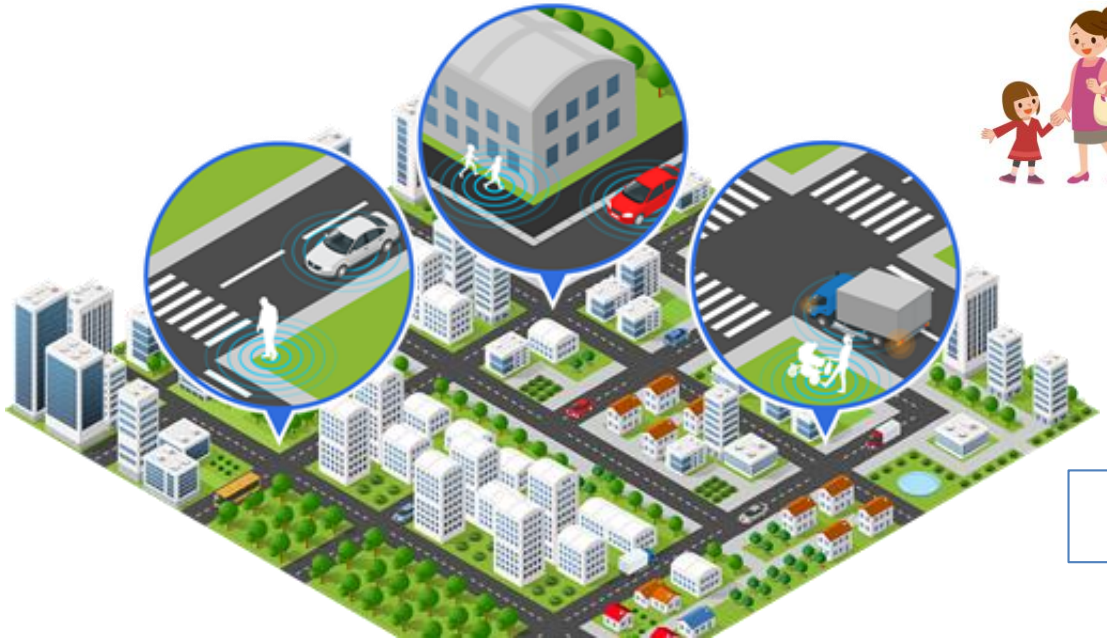


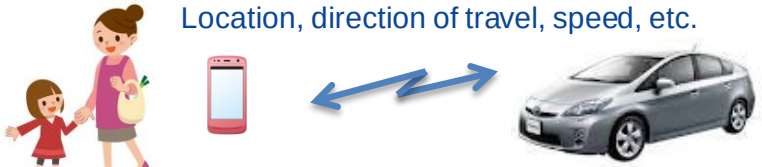
- Using simulation makes it possible to replicate accidents that involved pedestrians.

Validity studies are currently underway.

The Vehicle-to-Pedestrian Communication System

- The system supports mutual cognizance of presence through direct communication at a dedicated ITS frequency (760 MHz) between pedestrians' terminals and vehicles.





Supply of information and alerts

Technical Challenges of Vehicle-to-Pedestrian Communication

- Alerts should be issued only in cases where there is a strong possibility of contact between a vehicle and pedestrians.

・The system says “Be careful,” but the pedestrian is way over in the opposite lane.

→ Pedestrian locations must be ascertained with high precision.

High-precision positioning technology

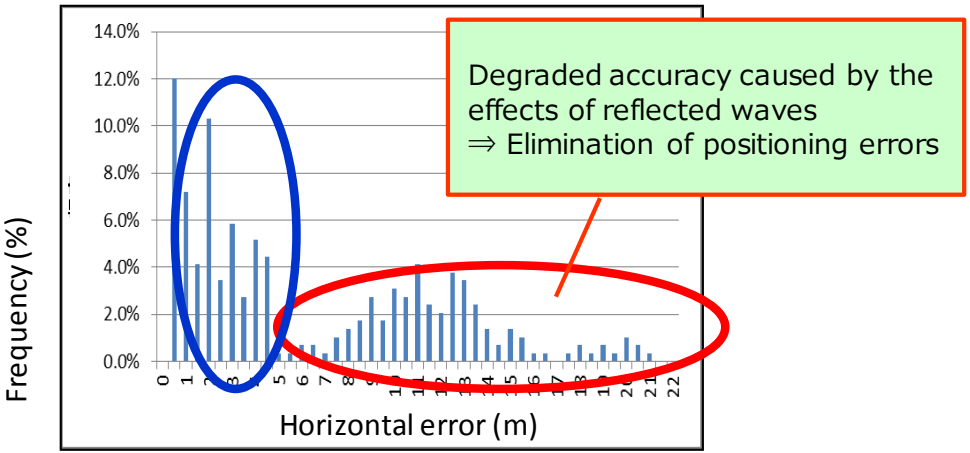
・The pedestrians are safe on the sidewalk. I wish the system would stop saying “be careful” all the time.

→ Ascertaining danger to pedestrians and the vehicle is required.

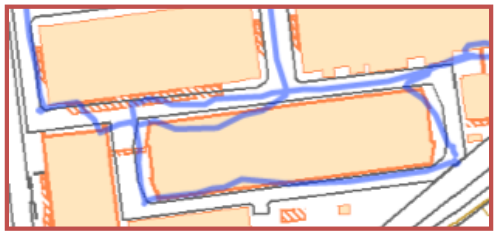
Technology for estimating cross-over probability

◆ Ensuring a certain degree of accuracy even in adverse environments by combining numerous technologies

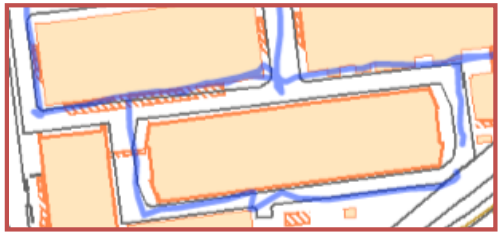
(1) Eliminating positioning errors caused by reflected satellite waves
(2) Pedestrian dead reckoning (PDR)
(3) Correction by Doppler velocity



(±20m → ±5m)



Elimination of satellite positioning error only



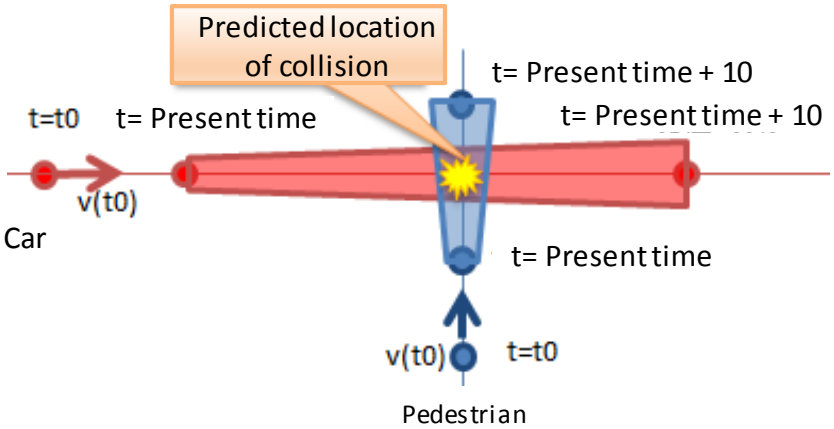
Corrective additions with PDR, etc.

Development of Technology for Estimating Cross-Over Probability

- Development of technology to estimate pedestrians' states for assessing the pedestrian environment

Example: Determination that a pedestrian is walking on a delineated sidewalk from map information and high-precision pedestrian positioning technology

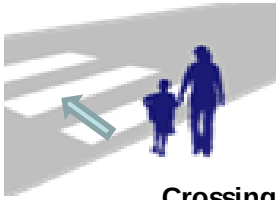
- Construction of an algorithm that predicts collisions



Estimation of cross-over probability

Situational Adaptation

Situations requiring assistance



Crossing

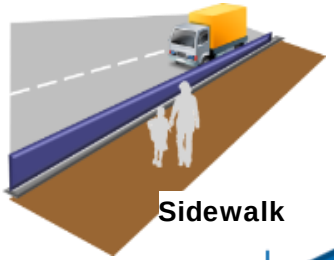
Right turn at intersection

Obstructed view

Walking on roadway

Left turn at intersection

Situations not requiring assistance



Sidewalk

Inside vehicle

Inside building

On pedestrian bridge

On or below elevate structure

Aggregation into five situations from the pattern analysis of accident circumstances

Establishment of five situations from the Report of the Survey on Time Use and Leisure Activities

Large-Scale Field Operational Test Plan

Oct. 2017	Jan. 2018	Apr.	Jul.	Oct.	Jan. 2019	Mar./E

Study of test location

Phase 1: System operation verification

☆ Checking of the system's operations in an actual traffic environment

- Does the system operate normally in the five situations requiring assistance?
  → Normal operation rate
- Do unnecessary operations occur in the five situations that do not require assistance?
  → Unnecessary operation rate

System improvement

Phase 2: System effects verification

☆ Checking of the system's effects in an actual traffic environment using numerous participants

- What changes in behavior appear when the system operates?
- Evaluation/consideration of happiness or annoyance with the system
- Evaluation/consideration of the HMI in terms of information comprehensibility, etc.

System Operation Verification

■ Situations requiring assistance

(1) Pedestrian road crossing

Odaiba

(3) Right turn at intersection

(2) Passing at intersection

(5) Road without sidewalk

(4) Left turn at intersection

■ Situations not requiring assistance

(6) In vehicle
- Vehicle

(7) In building
- Aqua City, etc.

(8) On pedestrian bridge

(9) Sidewalk

(10) Elevated crossing

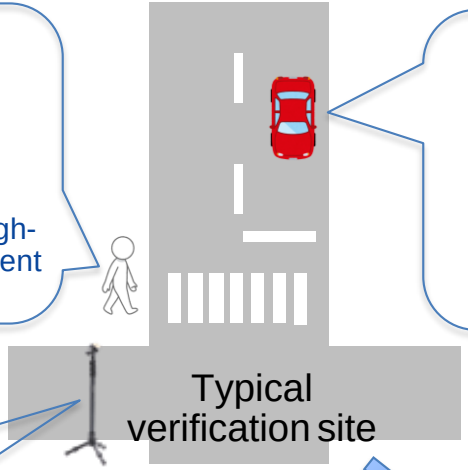
Test Tools

Pedestrian test terminal

Wireless communications device, battery, high-precision localizing device, and other equipment integrated into a backpack-like package

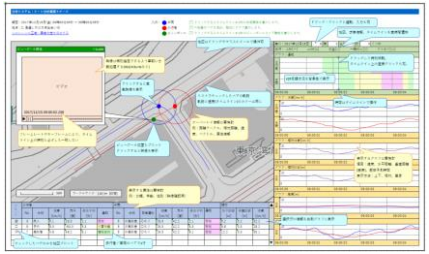
Vehicle test terminal

Vehicle installed with a wireless communications device, interior and exterior cameras, CAN logger, etc.



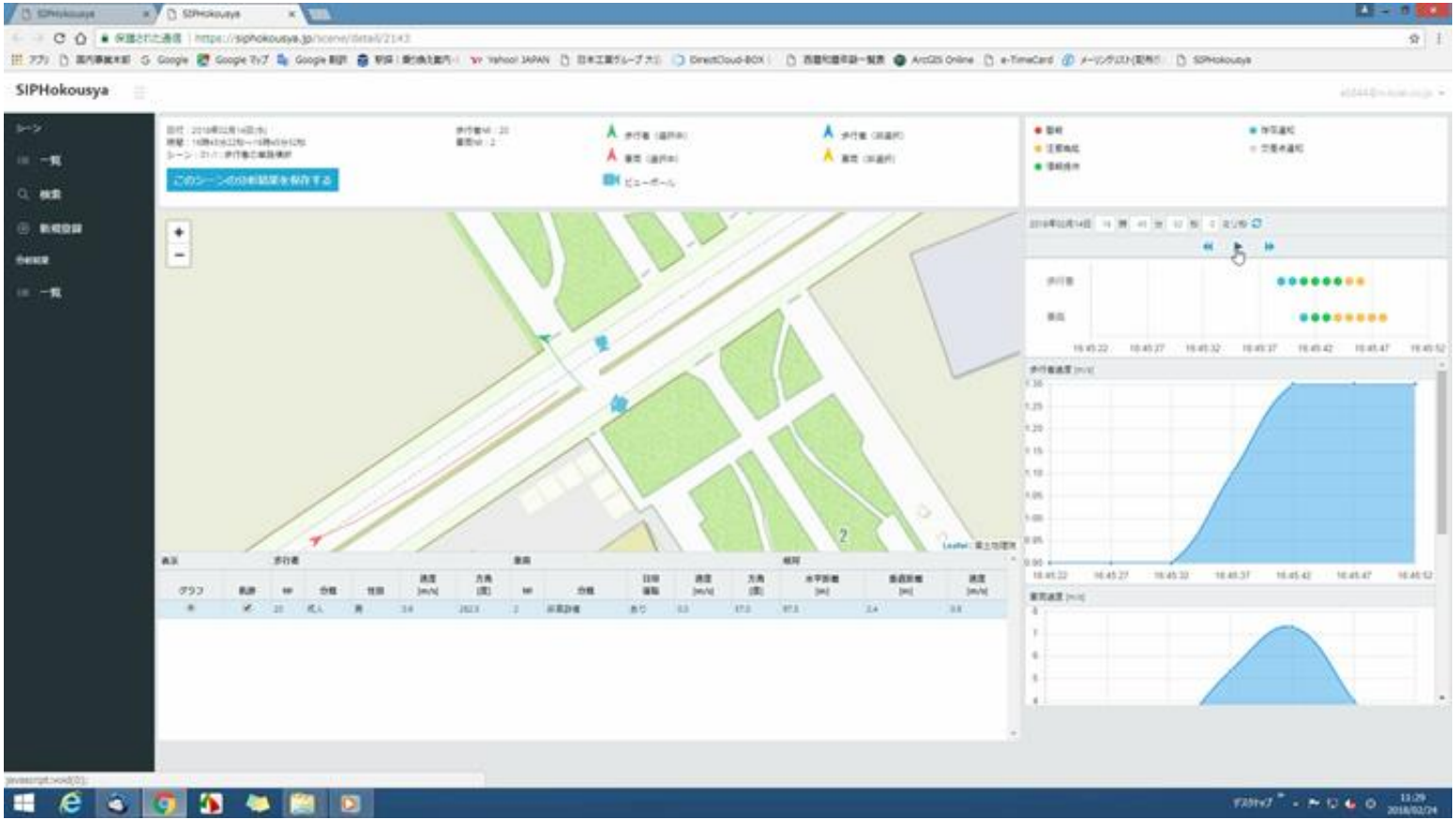
Typical verification site

Image from a View Pole camera



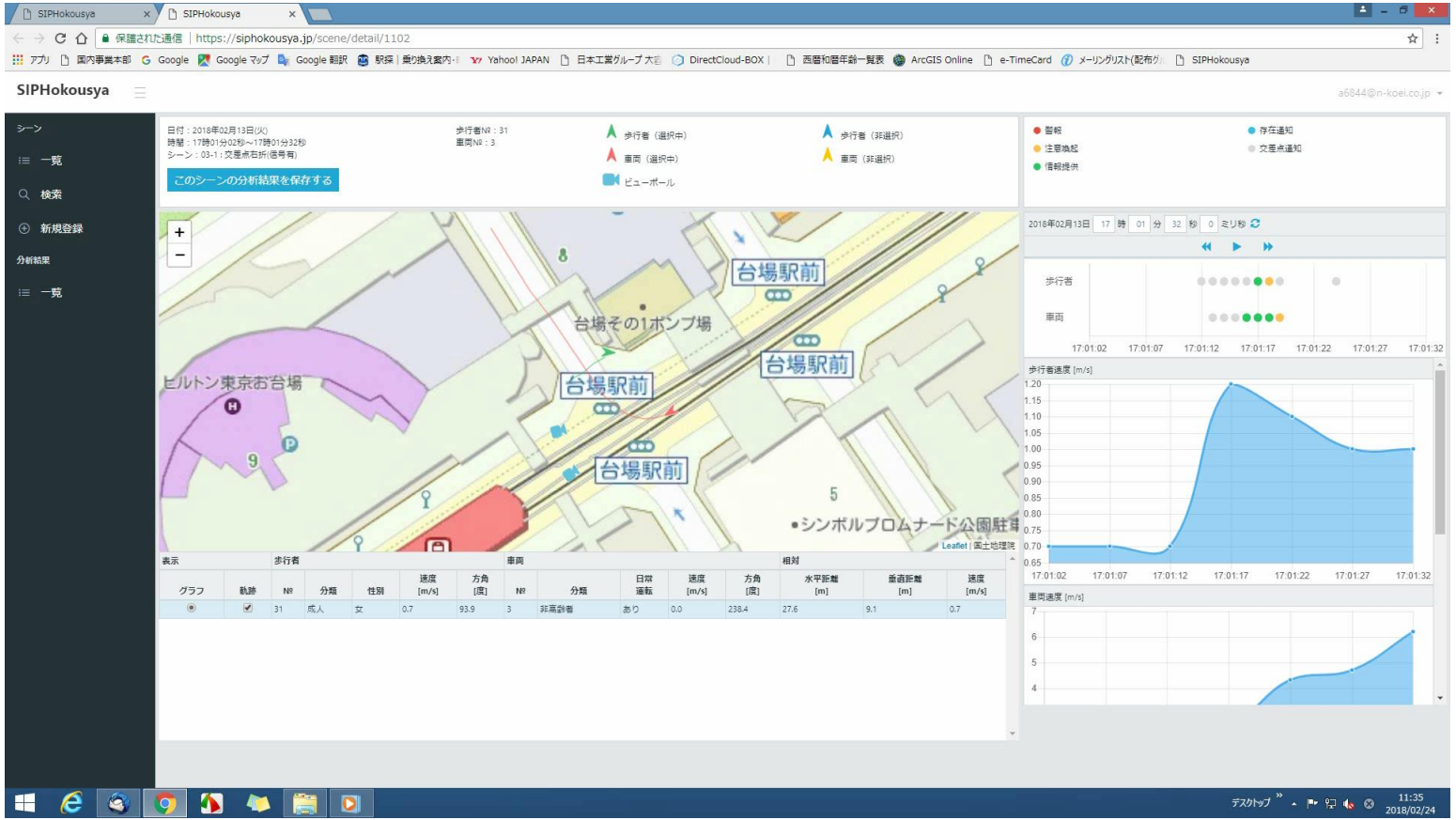
Data analysis tool

Example of Data Analysis (1)



Example Image (1)

Example of Data Analysis (2)



Example Image (2)

Upcoming Schedule

- End of this fiscal year
  - Analysis of test data and derivation/consideration of results
  - Arrangement of issues identified in the test and consideration of ways to deal with them
  - Identification of points for system improvement

- Next fiscal year
  - System improvements for Phase 2
  - Study of details concerning Phase 2 field operational test methods and preparation of a test plan
  - Phase 2 test
  - Summary


Thank you