

Driving Intelligence Validation Platform with ASAM

Prof. Hideo Inoue, Kanagawa Institute of Technology

Weather Forecast



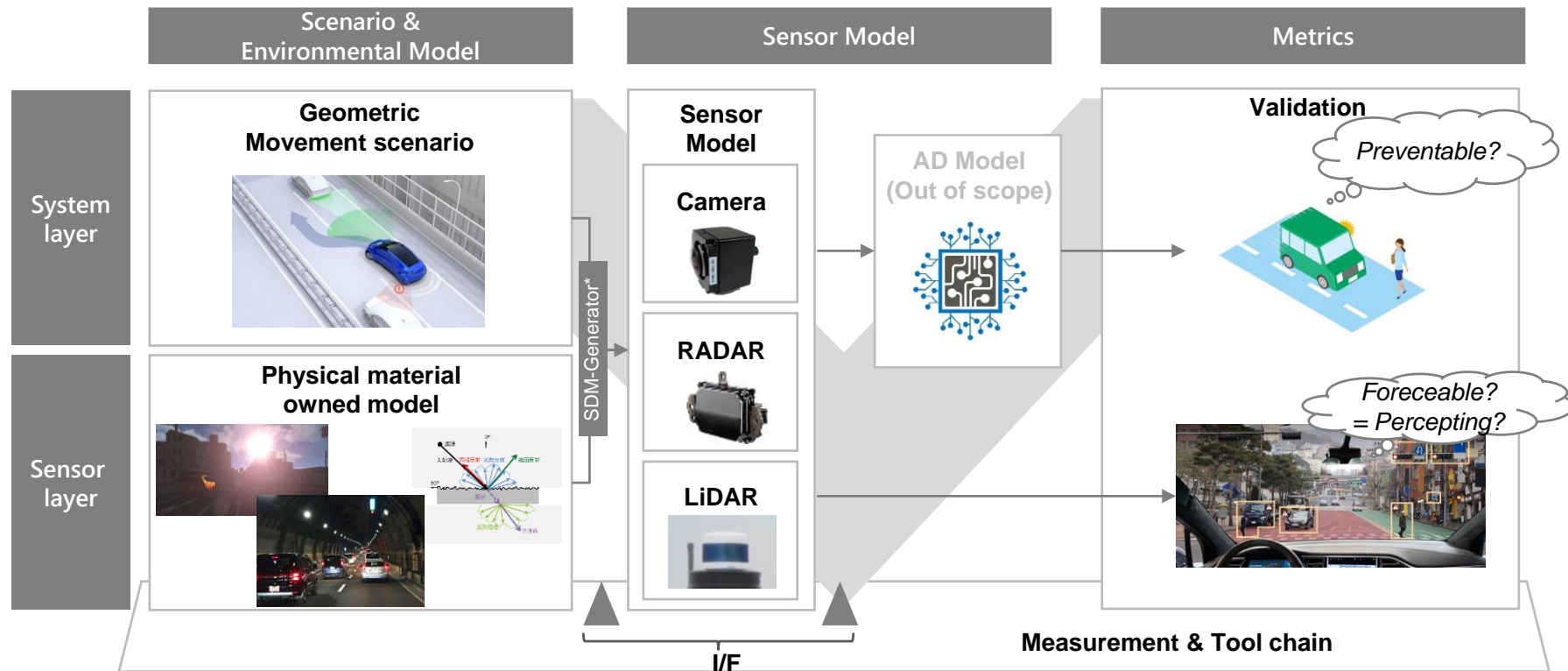
AD safety Assurance*



For Validation & Verification Methodology

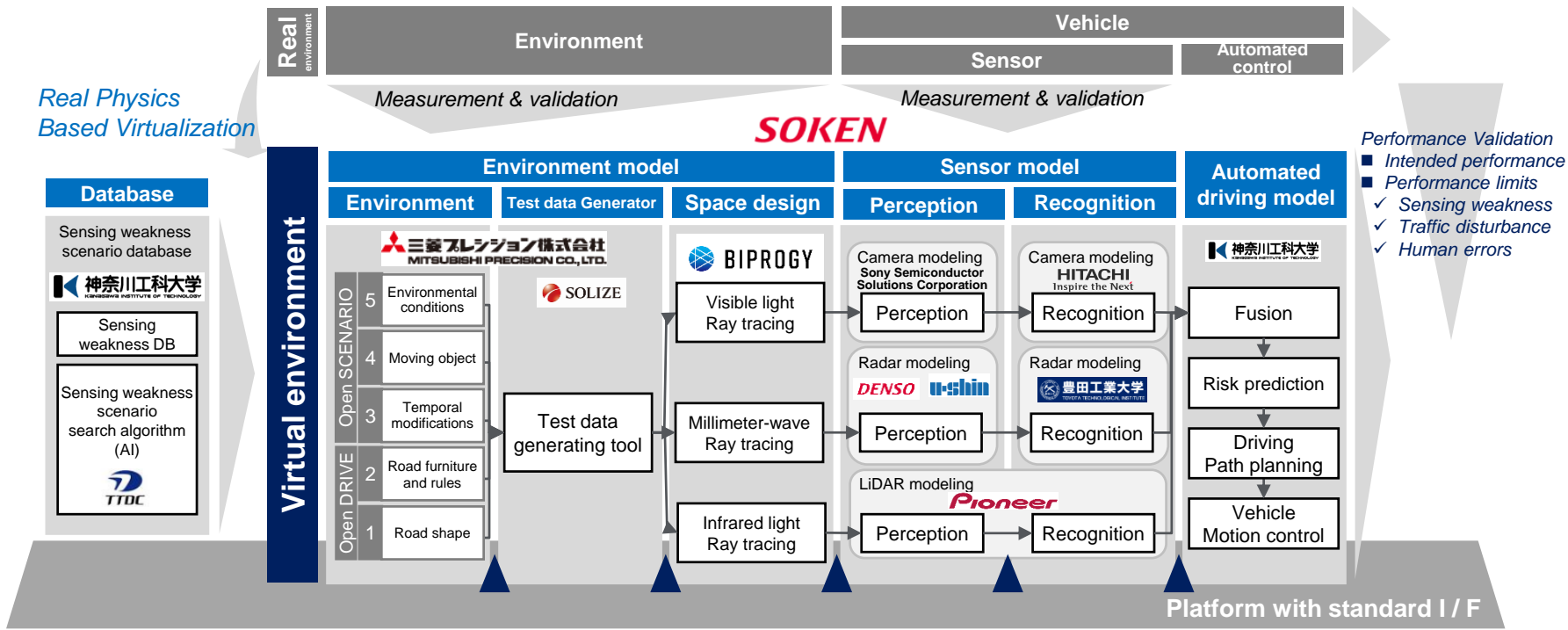
for AD safety assurance, Geometrical input for system layer & Physical materials input for sensor layer are needed as total validation framework

Total validation framework for AD-safety assurance



The project architecture designed by DIVP® precisely duplicates Virtual from Real, and verifies consistency with real testing by 12 experts as DIVP® Consortium

DIVP® project design



*1 Ritsumeikan finished Feb-2021, DENSO finished June-2021, Hitachi finished Sept-2021

*2 TTDC, U-shin, Toyota-univ joined Mar-2021

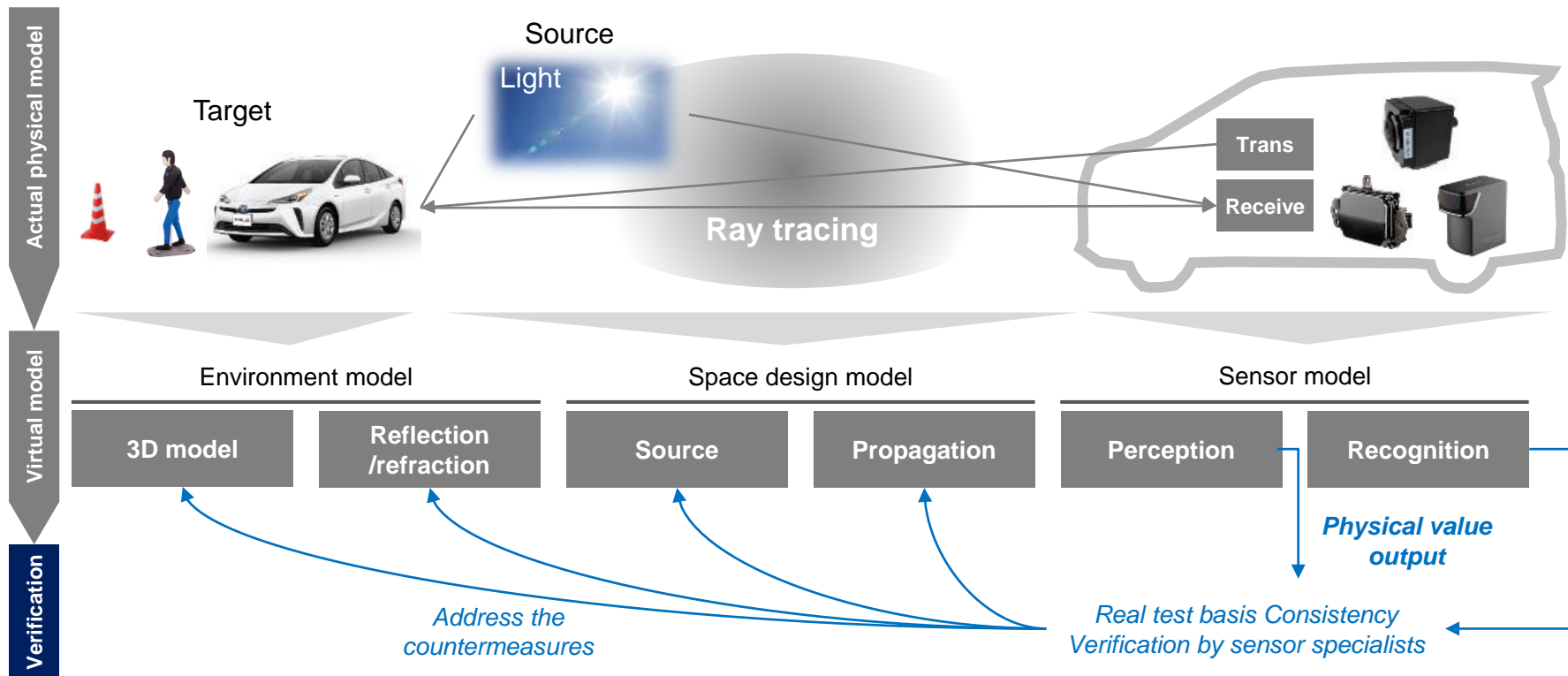
Verifying consistency between Real vs Virtual, sensor supplier as a sensor specialist validates sensor output and addresses the countermeasures

Validation & Verification procedure

HITACHI
Inspire the Next

Sony Semiconductor
Solutions Corporation

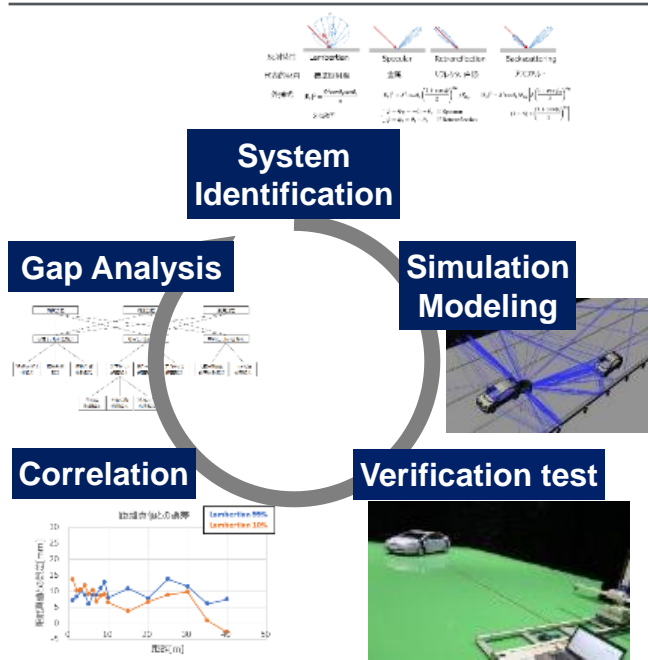
DENSO SOKEN Pioneer



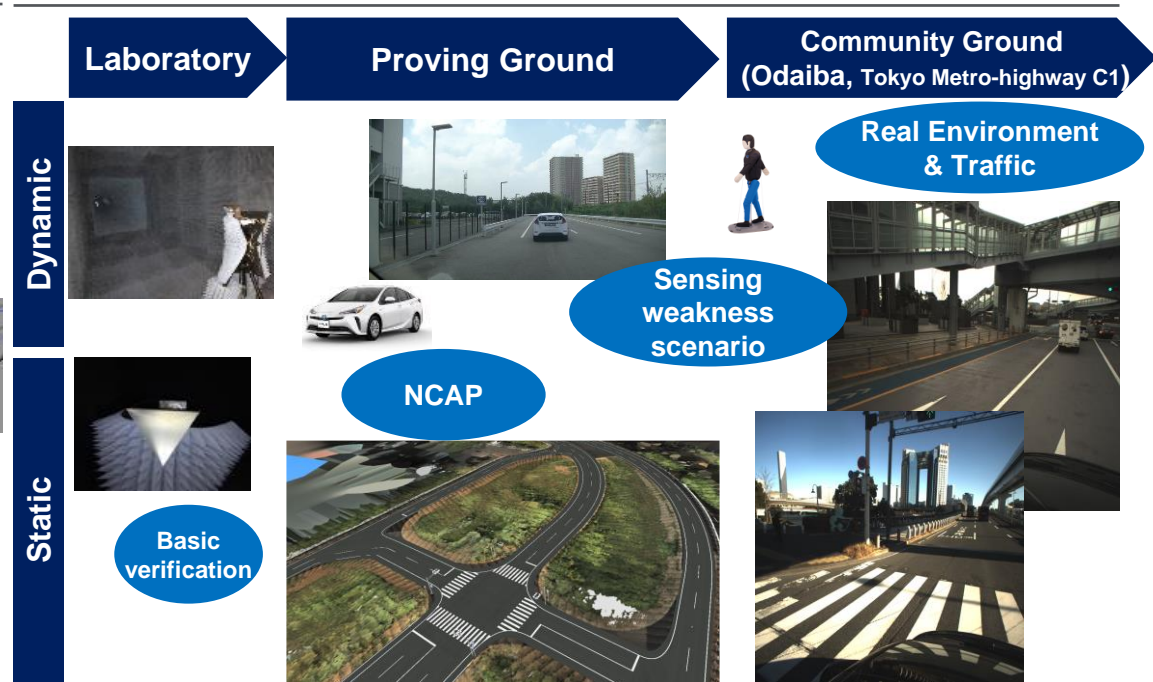
Measuring based modeling framework, DIVP® has developed Assessment scenario packages as Virtual-PG*1 & sensing weakness scenario packages in Odaiba as Virtual-CG*2

Measuring based Modeling framework

Measurement based approach



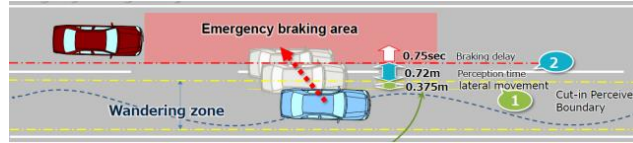
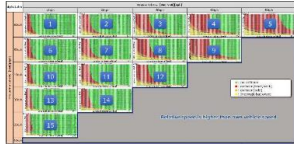
Virtual space enhancement roadmap



*1 Virtual-PG : Virtual Proving Ground, *2 Virtual-CG : Virtual community Ground

DIVP®'s virtual ALKS cut-in scenario is capable for Camera, Radar & LiDAR assessment test

ALKS Cut-in Scenario Simulation



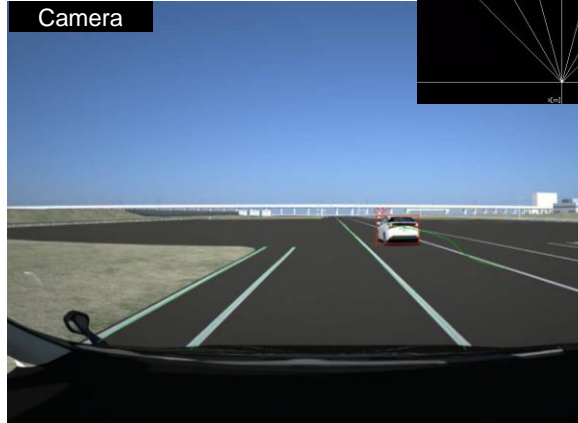
Concrete scenario (JARI/JAMA)

Scenario

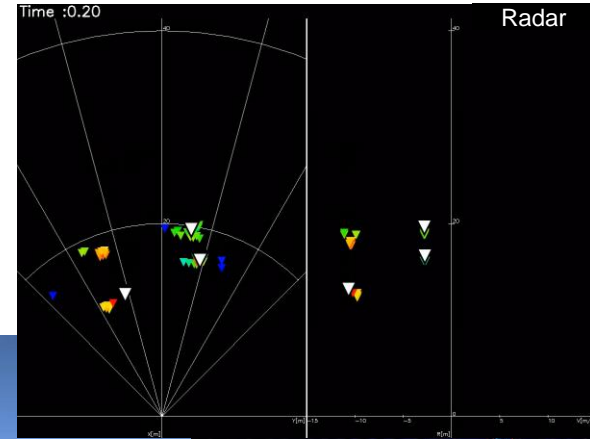


Scenario Simulation (Geometry)

Camera



Sensor simulations (Physical Property)



Assessment scenario packages as Virtual-PG has realized some of Euro-NCAP protocols, and 80% of current Euro-NCAP protocol will be constructed in FY2021 as expansion plan

Euro-NCAP ; Pedestrian darting out scenario

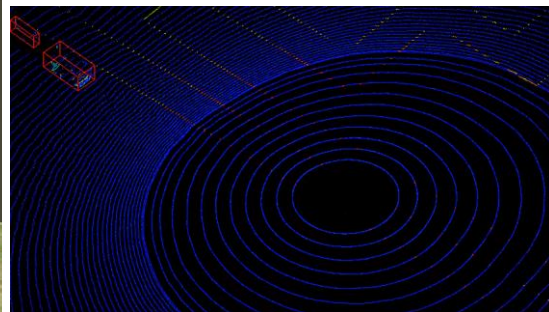
Pedestrian darting out scenario sim.



Camera sim.



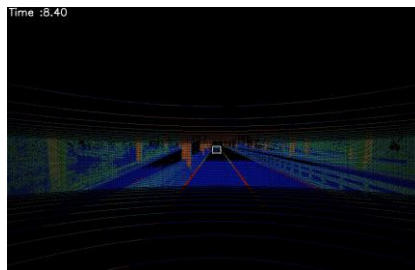
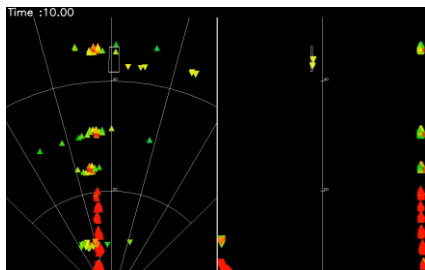
LiDAR sim.



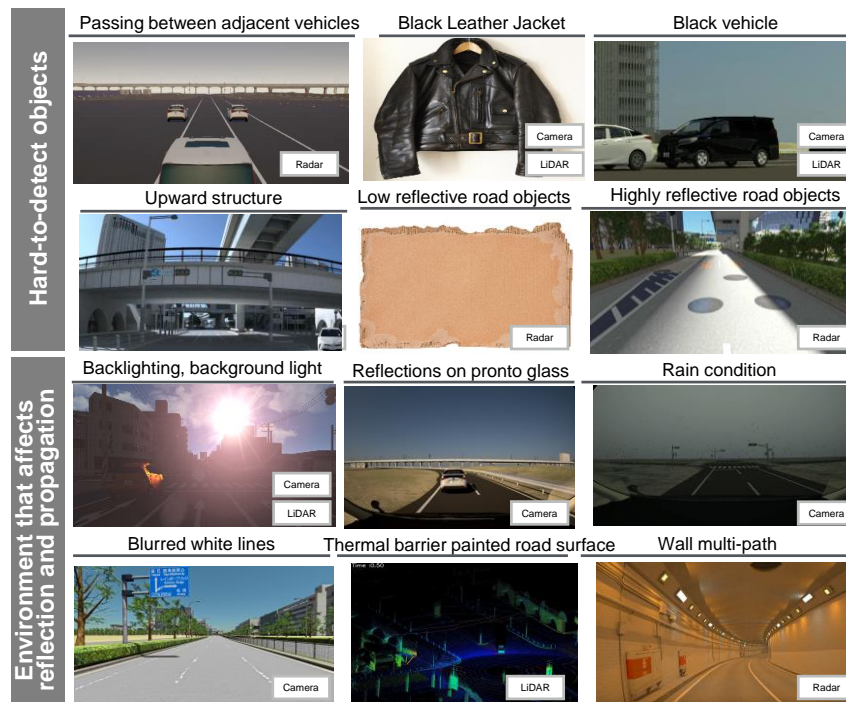
DIVP[®] simulation demonstration of AD virtual validation with sensing weakness scenario package on Odaiba & C1 expressway, is planned thru FOT in the Tokyo Waterfront Area

Simulation validation on scenario packages

Sensing Weakness Scenario Packages on Odaiba, C1



Various sensing weakness scenes



DIVP®'s space design model available for both traffic & sensing simulation

Total Space design model at Odaiba area



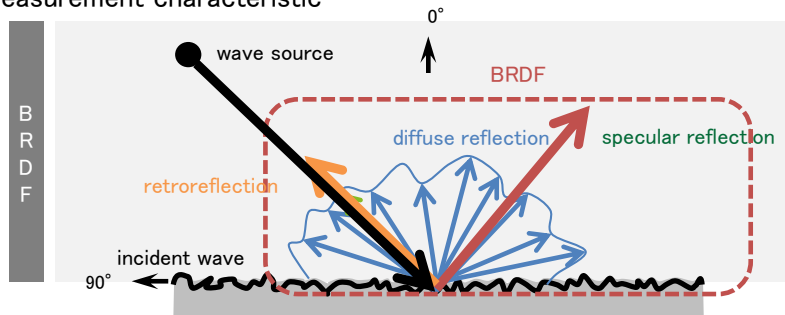
[Modeling of waterfront subcenter (Virtual-CG development)]Reflection characteristics were modeled based on experimental measurements, and detailed Virtual-CG was reproduced.

Modeling based on experimental measurements

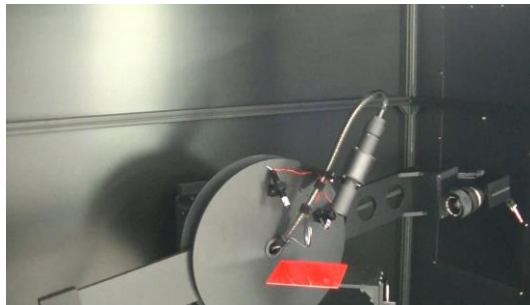
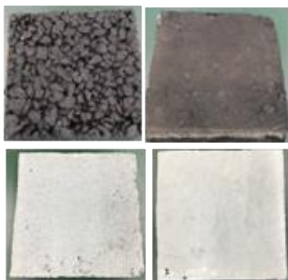


Modeling Reflection Characteristics

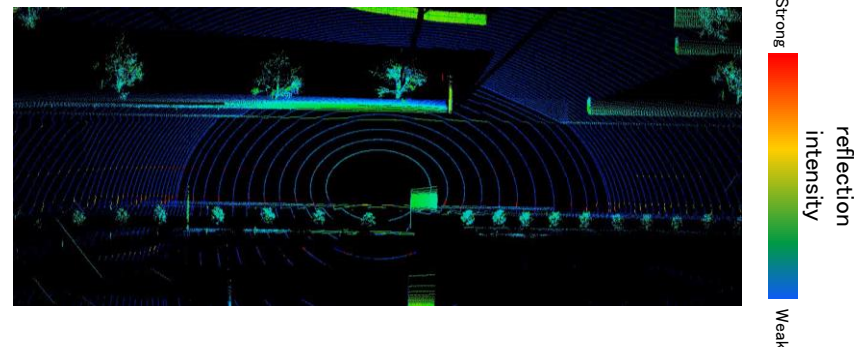
■ Measurement characteristic



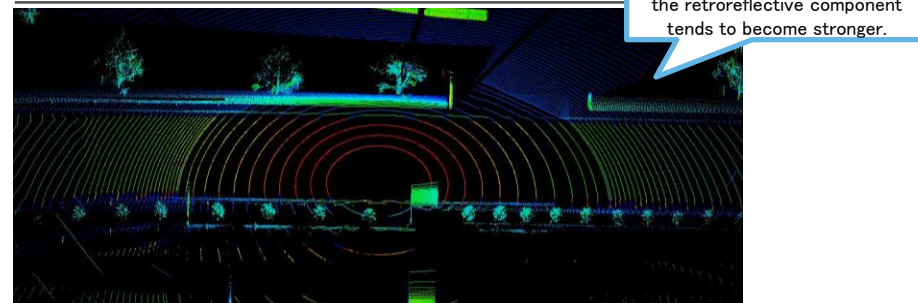
■ Measuring asphalt used locally



DIVP® Sim (usually asphalt)



DIVP® Sim (Thermal shielding painting)



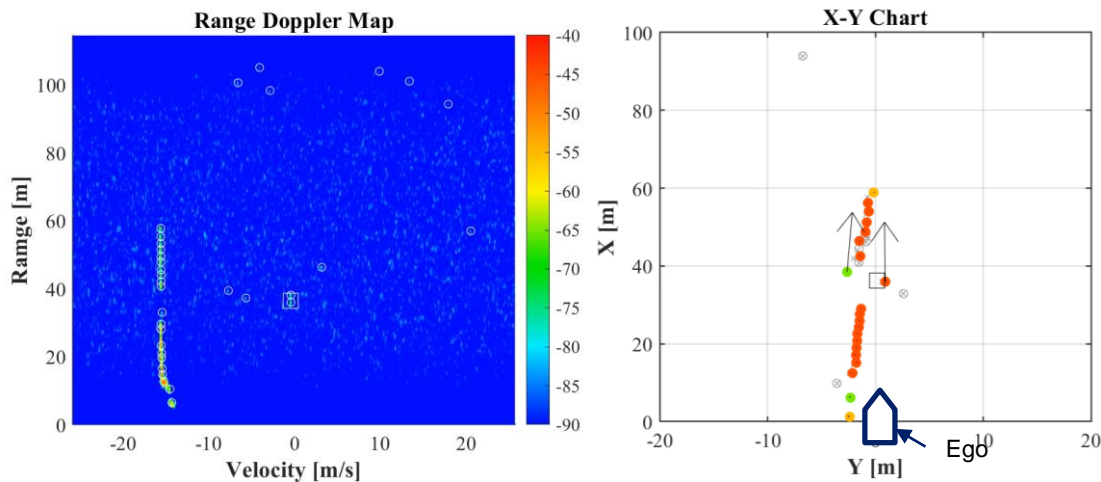
DIVP[®] can evaluate complex traffic environment scenarios in virtual proving ground

Millimeter wave radar simulation example (multipath ghost)

Camera Simulation



Radar Simulation



DIVP[®] simulation able to reproduce the precise multipath due to tunnel walls of the millimeter-wave radar and the ghosting of the vehicle ahead.

Traffic signal recognition in rainy weather; verification of recognition limit performance is possible with virtual space simulation

Contribution to safety assessment for AD-system evaluation using virtual space model

Difficult to catch signal recognition limit conditions in public road due to lack of control over rainfall condition levels



DIVP® simulation allows for intense rainfall settings
→ Signal recognition limit verification is possible



By extrapolation
evaluation is
possible

Public road tests

	Normal weather	Rainy weather (a few mm/h)
Recognition rate	0.982	0.984

DIVP® simulation

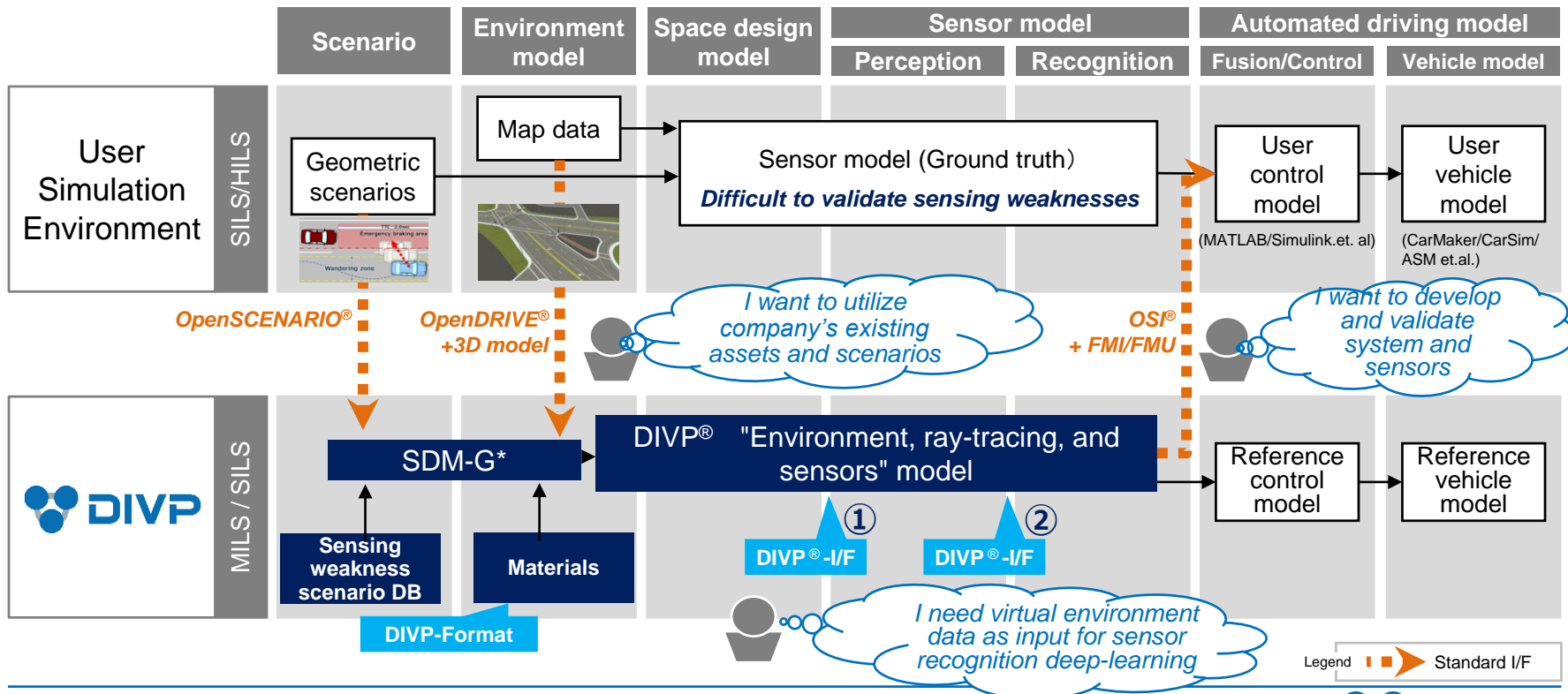
	Normal weather	Intense rainy weather
Recognition rate	0.989	0.868

The overall recognition rate deteriorated with increasing rainfall in DIVP® simulation.

- Undetected due to shielding by raindrops
- Misrecognition due to color change, etc.

For sensing performance validation, DIVP® approaching to initiate “Materials” on Envi-model and “Intermediate I/F” in Sensor models for ASAM standards

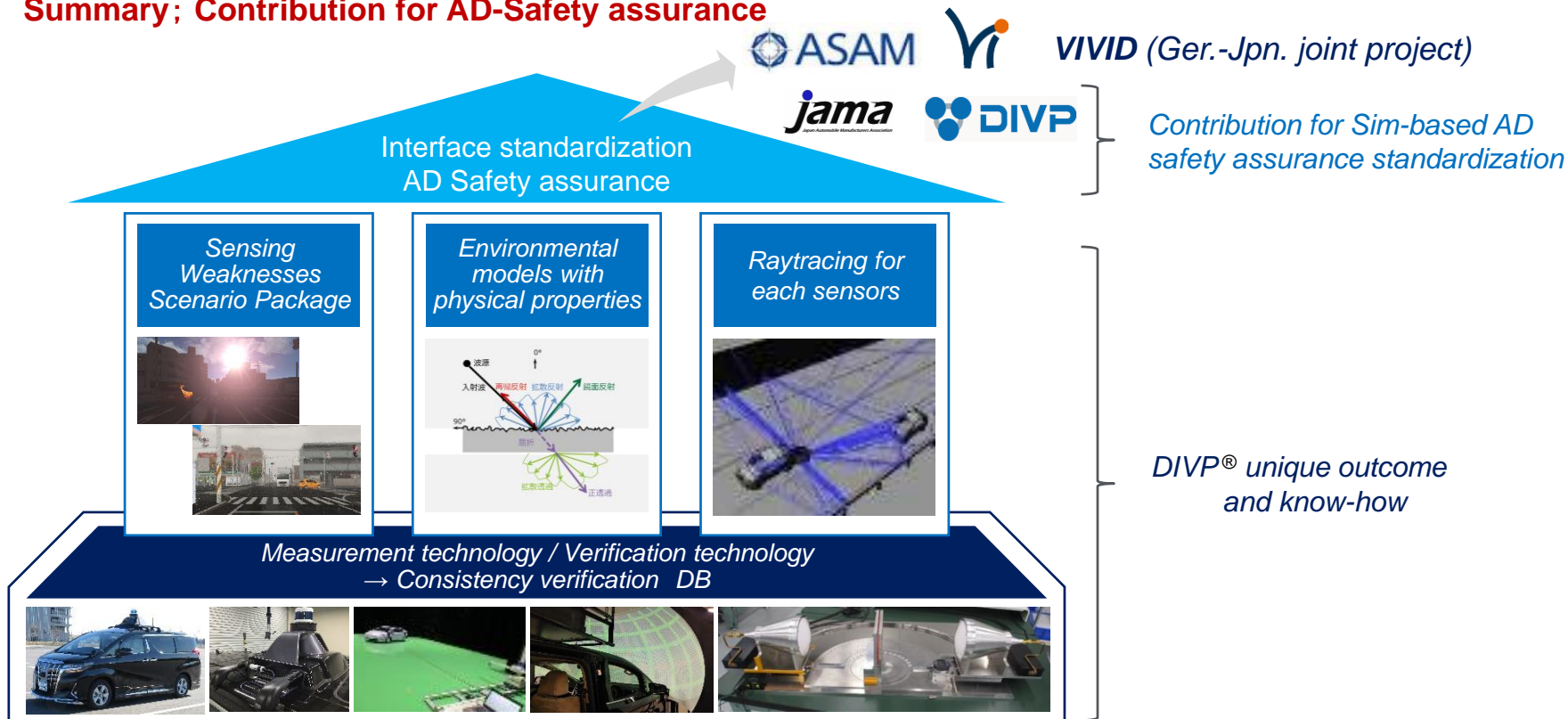
DIVP uniqueness



* SDM-G : Space Design Model Generator

DIVP® contribute to Simulation based AD-safety assurance with international collaboration

Summary; Contribution for AD-Safety assurance



Thank you for your kind attention!



END

Tokyo Odaiba → Virtual Community Ground

