



Development of “Driving Intelligence Validation Platform”
for ADS safety assurance
-SIP-adus activity in Japan-

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Strategic Innovation promotion Program

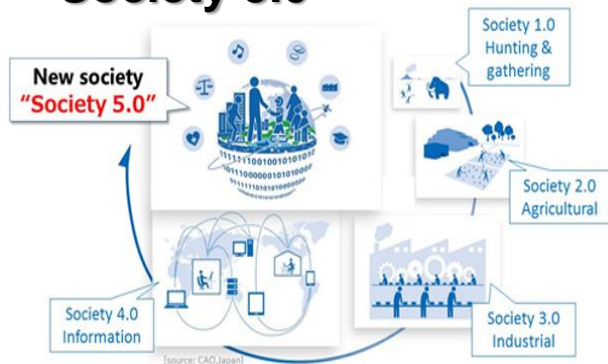
SIP 2nd FY2018~FY2022



12 themes on going (SIP-adus is one of them)

adus ; Automated driving system for universal service

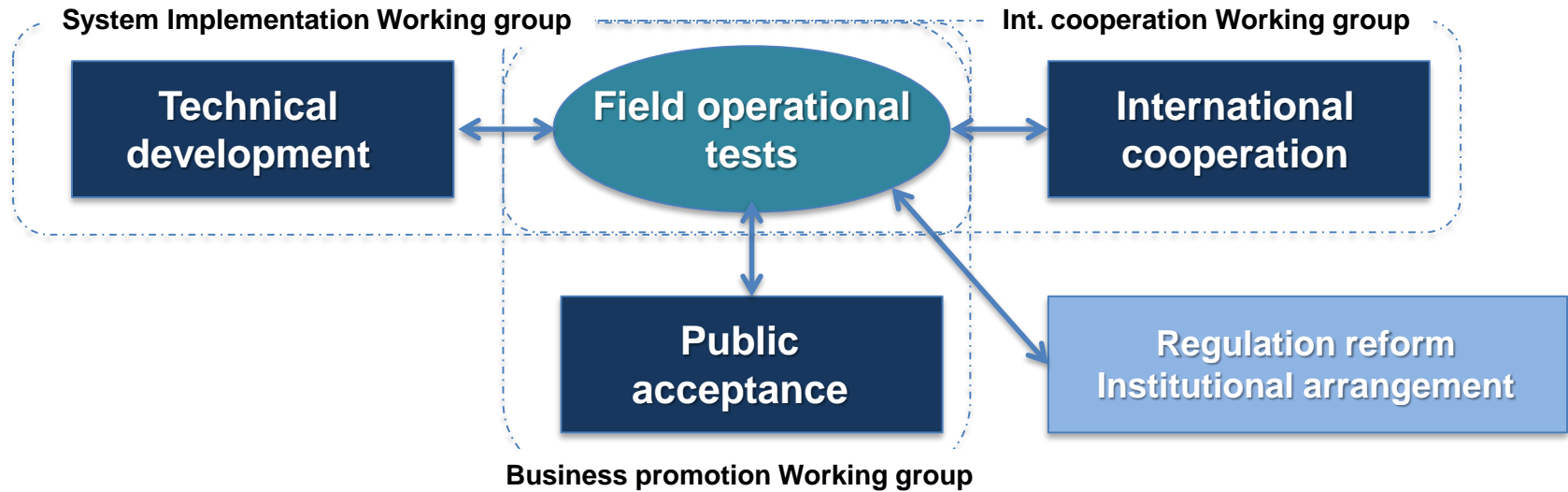
Society 5.0



- Promote cross-sector and **industry-academia-government collaboration**
- Intensive R&D program from **fundamental research to practical and commercialization**
- Promote Regulatory reform

Focus themes

【4 pillars】



【Focus themes】

- (I) Traffic environmental information (Dynamic map)
- (II) Traffic environmental data portal
- (III) Virtual validation platform for ADS safety assurance
- (IV) Evaluation methodology of Intrusion detection system

Evaluation in virtual space

Project focus ; Precisely Duplication from Real to Virtual, and Verification of highly consistency between sensor model and real testing.

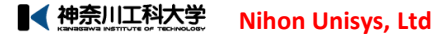
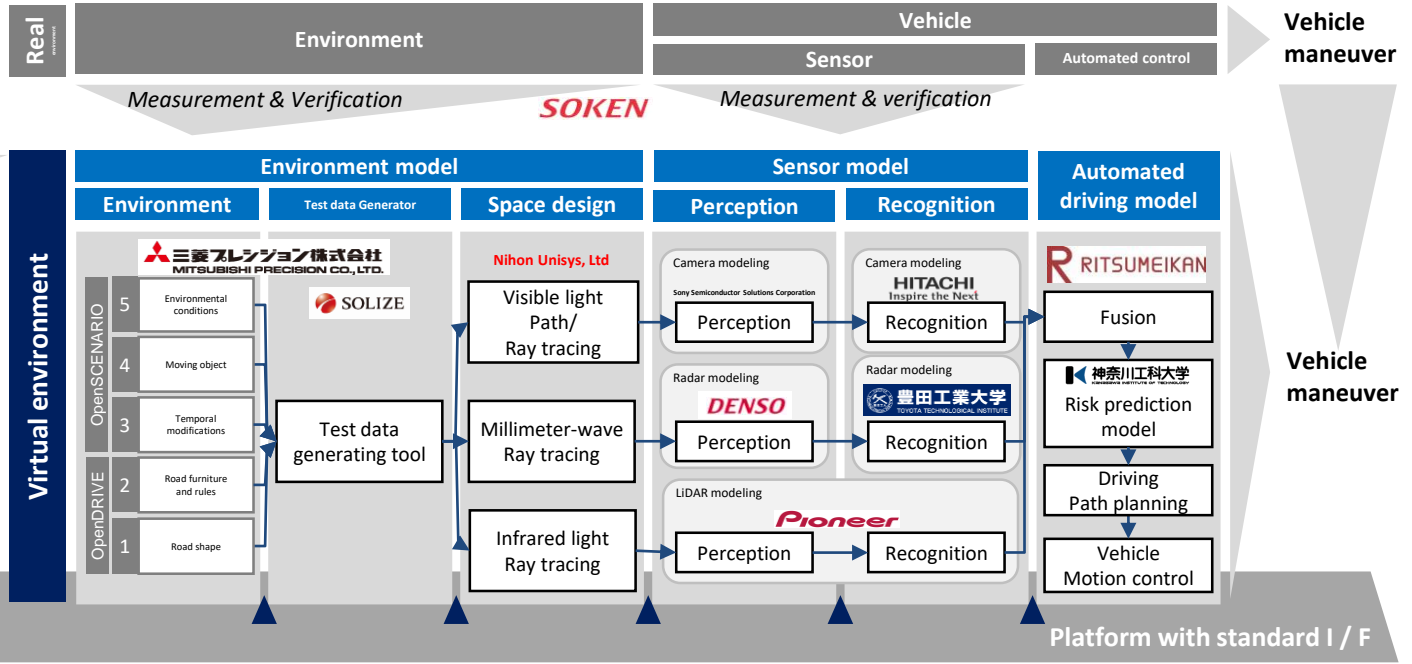


Project design

DIVP™ Consortium is established by 12 organization from industry and academia, and collaborating with the SAKURA project promoted by JAMA and JARI.



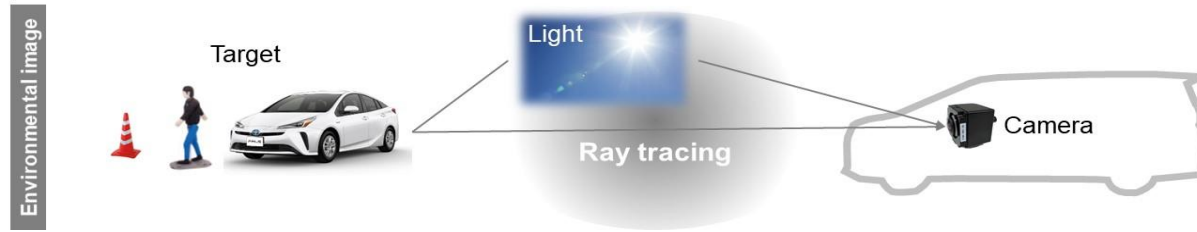
Real Physics based Virtualization



SAKURA project ; Safety Assurance KUDos for Reliable Autonomous Vehicle project
 JAMA; Japan Automobile Manufacturer Association JARI; Japan Automobile Research Institute

Scope & Objective

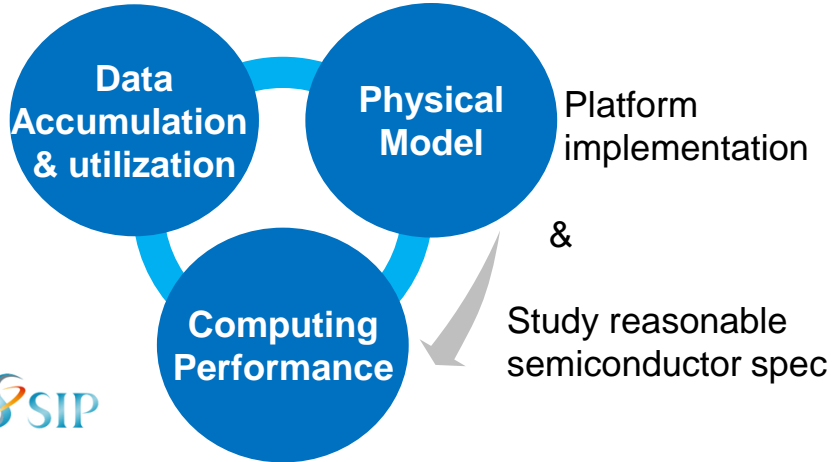
Camera (Example)



DIVP™ Driving Intelligence Validation Platform

DIVP™ scope

Trinitarian approach



DIVP™ Objectives

- *Open Standard Interface*
- *Reference platform with reasonable verification level*
- *E & S pair model based approach (E : Environmental model, S : Sensor model)*

Camera Simulation output

The camera model simulates spectral characteristics that are input to semiconductors such as CMOS, rather than the RGB is human eyes friendly.

Real movie



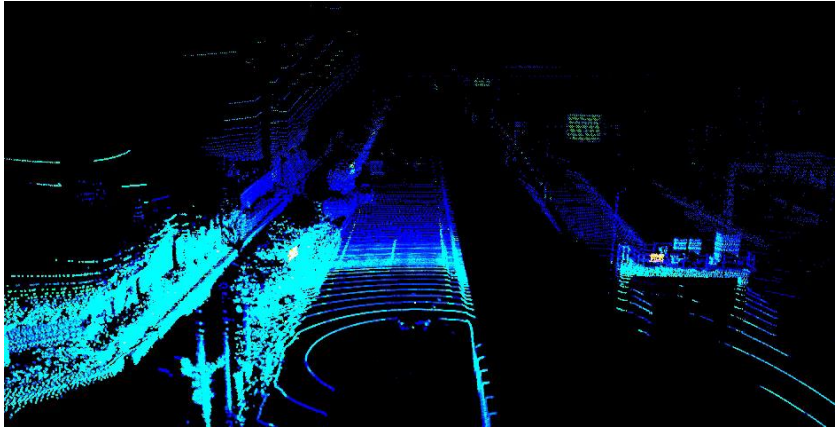
SIM output (Clear sky)



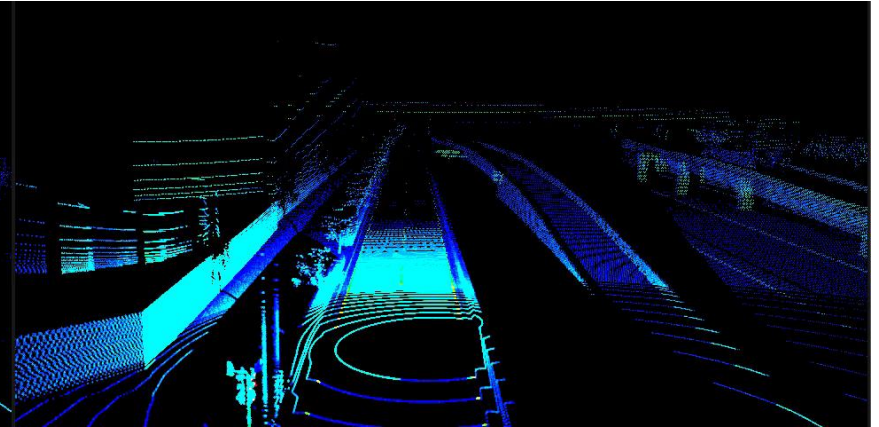
Lidar Simulation output

Lidar model simulation has a good coincidence with real Lidar output. It is possible to evaluate environmental disturbances such as background light.

Real Lidar output

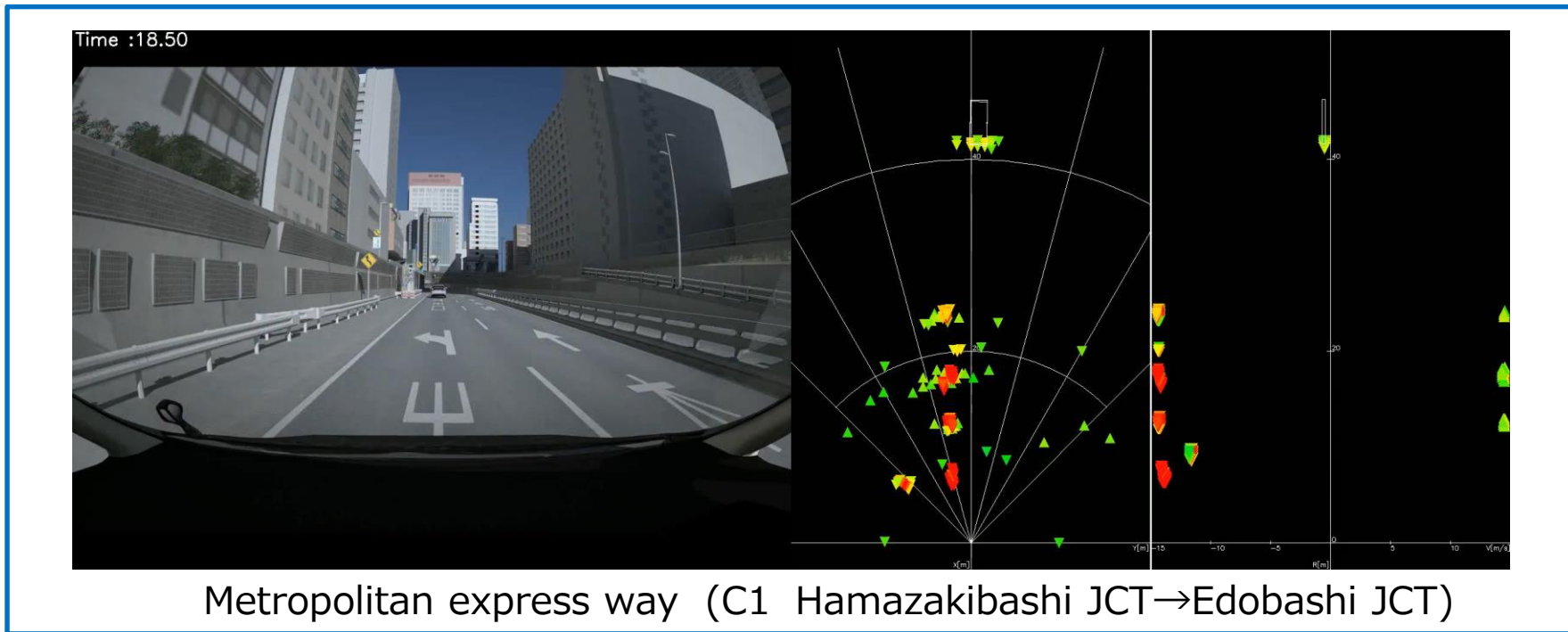


Lidar model simulation output



Millimeter wave radar Simulation output

Radar is the most difficult sensor for modeling. Three reflection models are defined and used according to the behavior of radio waves at reflective targets.



Environmental modeling (Camera)

HDR (High Dynamic Range) camera model can provide sufficient visibility for recognition even in the dark condition in the tunnel, weak visible light with intense backlight at the approaching exit.

Light model of Metropolitan
Expressway tunnel

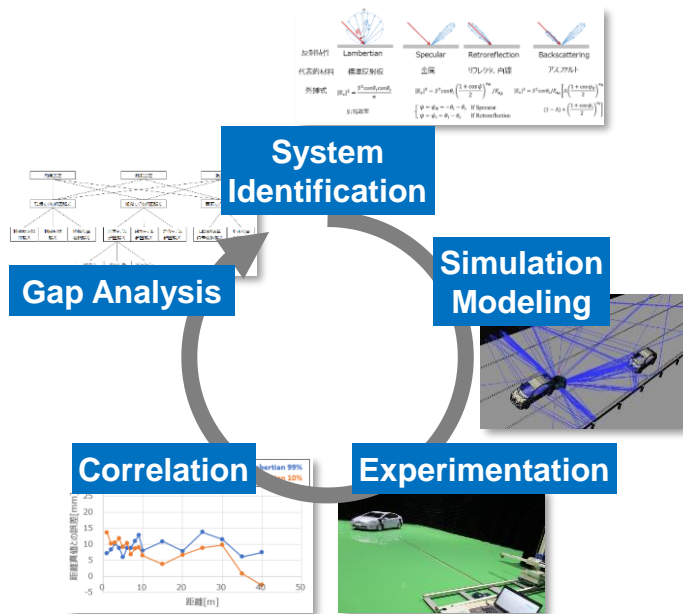


Rain adhesion model on windshield

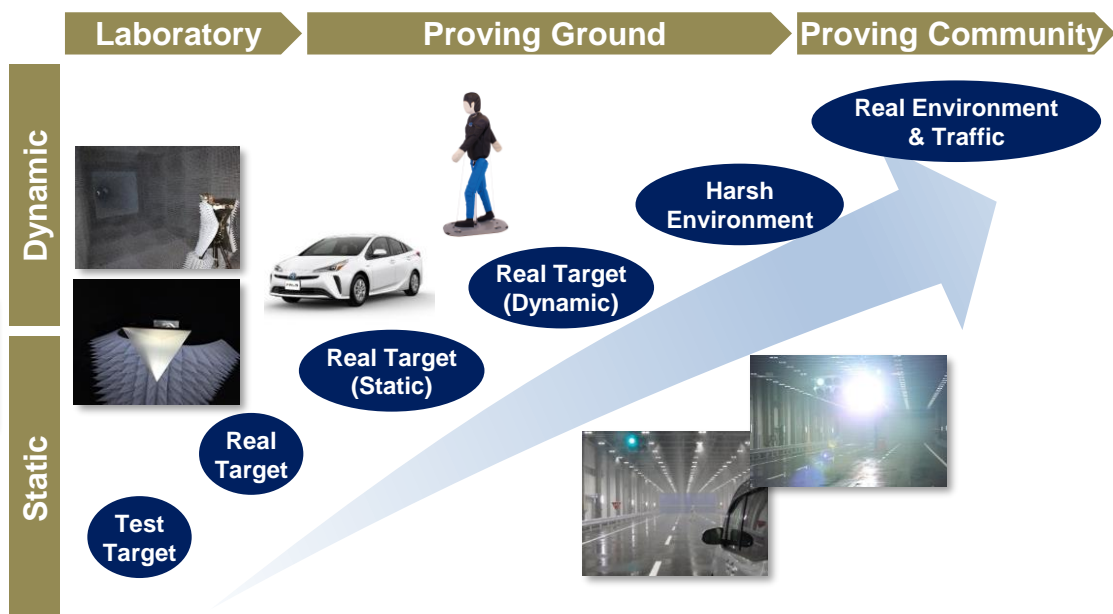


Approach & Roadmap

Real physics based approach



Enhancement roadmap



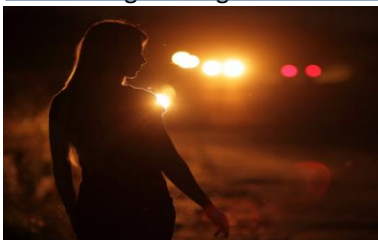
DIVP™ propose to model enhancement roadmap to meet user needs

Sensing weakness scenario

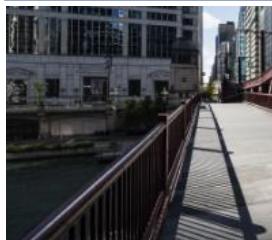
Reflection of wet road surfaces



Lost pedestrians due by backlight in night scene



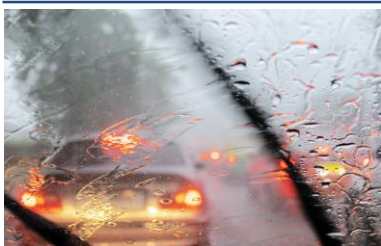
Multi-path by bridge pier structure



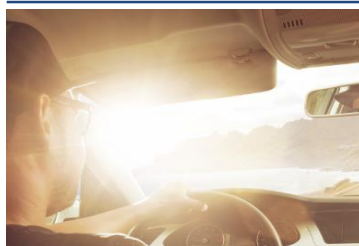
Multivehicle multipath



Attenuation of light and radio waves due to rainfall



Lost objects due by backlight



False recognition due to high reflection paint



Underpass multipath



Motorcycles



Source : SOKEN, INC

FOT2021 in Tokyo water front area

To create sensor simulation virtual proving ground by measuring real proving ground using MMS^(*)

MMS: mobile Mapping System



International Cooperation

DIVP® and VIVALDI (German consortium) launched joint project named VIVID from Nov-2020, Targeting to simulation-based ADS safety assurance

Key objectives

- Simulation and test chains: Fidelity metrics
- Complementary methods from simple to realistic: SiL, HiL, ViL, FoT
- Multi-sensor platforms: Radar, lidar, camera
- Open interfaces: Scenario generation, sensor and environmental models, co-simulation
- Building a reference architecture => creating a knowledge base

Jointly study toward,,

■ How safe is safe enough?

■ How realistic is realistic enough?



Key contributors



SIP-adus Workshop 2021



- **Plenary Sessions :**
November 09-10, 2021 (Virtual conference)
- **Breakout workshops :**
schedule to be announced for each theme

For further information, please visit our website

<https://en.sip-adus.go.jp/evt/workshop2021/>