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Correct AI on Embedded Systems: the Role of Compiler Qualification

Presentation · March 2025

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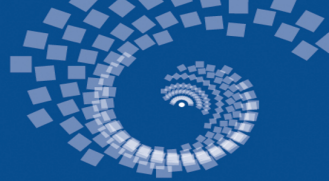


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Correct AI on embedded Systems: the role of Compiler Qualification

Prof. Dr. rer. nat. Stefan-Alexander Schneider

March 6th, 2025, Automotive SafeAI Day, Munich, Germany

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- University of applied sciences in Kempten
- Master course advanced driver assistance systems
- Guest lecturer at Shibaura Institute of Technology
- Curator of the Deutsches Museum, Munich, Germany

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- Curator of the Deutsches Museum, Munich, Germany

3 Motivation

Prof. Dr. rer.-nat. Stefan-Alexander Schneider

• University of Applied Sciences Kempten

- Professor of Autonomous Driving and Advanced Driver Assistance Systems
- Head of Masters Course Advanced Driver Assistance Systems
- Guest Lecturer at Shibaura Institute of Technology, Tokyo, Japan
- Member of the Board of Trustees of the Deutsches Museum in Munich, Germany

• BMW AG

- Functional Integration for Full Vehicle Simulation with FMI
- Automated Codegeneration and Validation Suite for Codegenerators
- Internal Trainer of the BMW Group Education Academy for Embedded Software Development

• Axxom Software AG

- Logistic and Distribution Optimization

• Infineon Technologies AG

- Layout Correction of Masks for Semiconductors

• Technische Universität München

- Numerical Solution of Partial Differential Equations
- Doctorate at Prof. Dr. Christoph Zenger [1]

• Career, LinkedIn and email to me



University of applied sciences in Kempten



Source: [University of applied sciences in Kempten](#)

Master course advanced driver assistance systems



Masters course advanced driver assistance systems

Source: privat

Guest lecturer at Shibaura Institute of Technology

Shibaura Insitute of Technology, Tokyo, Japan

Source: privat



Shibaura Institute of Technology

■Toyoku Campus 3-7-5 Toyosu, Koto-ku, Tokyo 135-8585, Japan
□Omiga Campus 307 Fukusaku, Minamiku, Saitama-shi, Saitama 337-8570, Japan

March 12, 2024

Address :
Hochschule Kempten University of Applied Sciences
Bahnhofstrasse 61 87435 Kempten

Dear President Prof. Dr. Wolfgang Hauke

Appointment of A Visiting Faculty Member
Based on the Agreement on Educational Research Partnership between University of Applied
Sciences, Kempten and SIT in the Academic Year of 2024

We are pleased to appoint you to be a Visiting Faculty Member of Shibaura Institute of Technology, based on our agreement on Educational Research Partnership with University of Applied Sciences, Kempten. The details of appointment are as follows:

Name:	Stefan Schneider
Job title:	Visiting Professor for Educational Research Partnership
Affiliation:	Graduate School of Engineering and Science
Duration:	From April 1, 2024 to March 31, 2025

Sincerely,

Dr. Jun Yamada, President
Shibaura Institute of Technology

Curator of the Deutsches Museum, Munich, Germany

Deutsches Museum



I am very pleased to have been appointed to the [board of trustees](#) of the [Deutsches Museum](#) in Munich.

Motivation

2 Introduction

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- Table of contents for this section
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4 Domains requiring confidence

26262 Club's mission

The **26262 Club** is a **community platform** founded by ISO 26262 experts and functional safety professionals. **Our mission** is to

- share **best practices**,
- foster **collaboration**, and
- support industry growth by **engaging with academia** and broader industry.

We **encourage discussions** at all levels to enhance the safety of electronic systems.

Here is a reference to the response to the announcement of this lecture on LinkedIn: [AI & Functional Safety – A Challenge for Embedded Systems!](#).

Note: The **abbreviation AI** is interpreted as **Advanced Statistical Inference**.



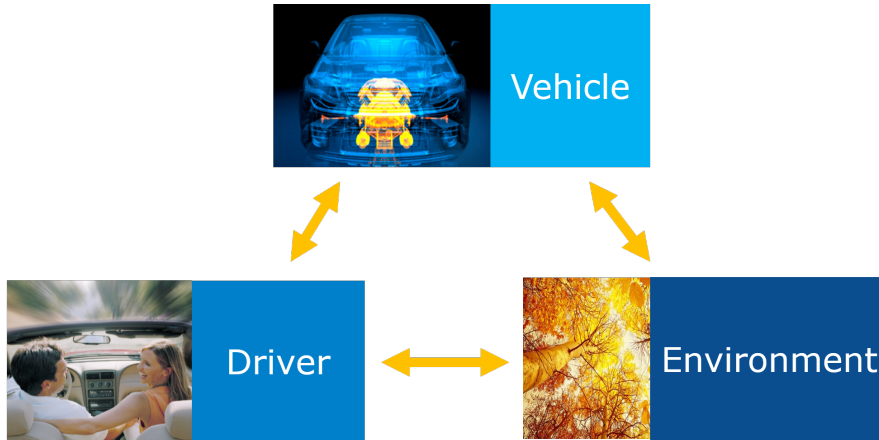
Rush hour



Task 1: Rush hour

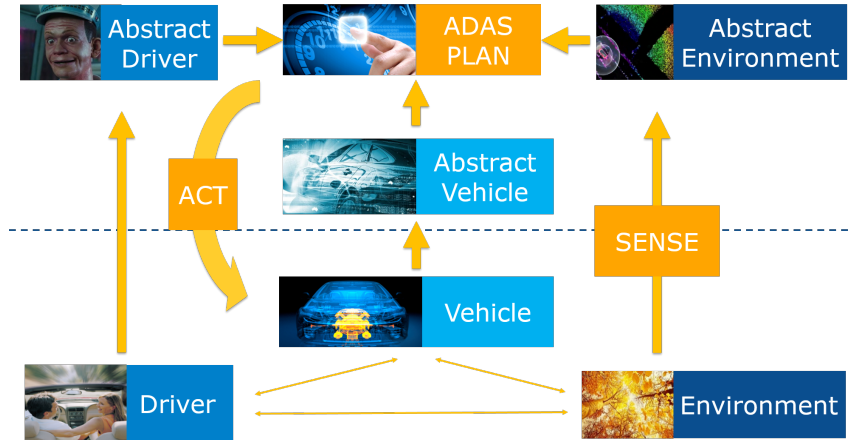
Watch the video [Rush Hour](#) from Fernando Livschitz! How do you feel about this?

Component view on the system ADAS: environment - vehicle - driver



Source: my lecture on advanced driver assistance systems [2]

How Advanced Driver Assistance Systems work



Source: Lecture on Basics on Advanced Driver Assistance Systems

Domains requiring confidence in implementing AI on embedded systems

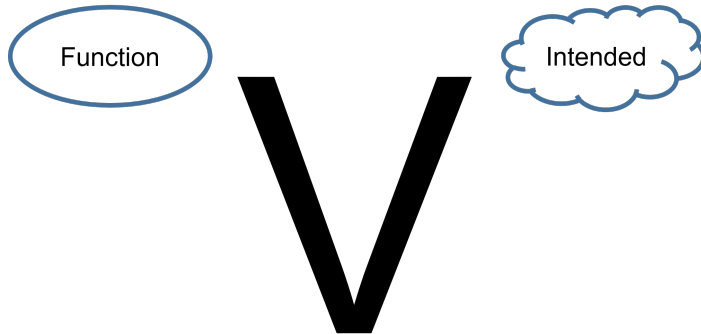
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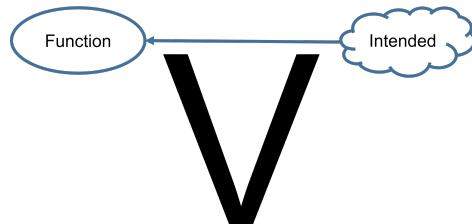
5 Discussion impulses

Task



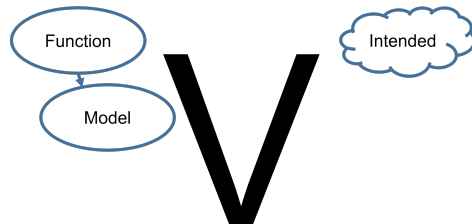
Confidence in function

- Ensuring correct and complete data sets.
- Identifying potential pitfalls in data acquisition and preprocessing.



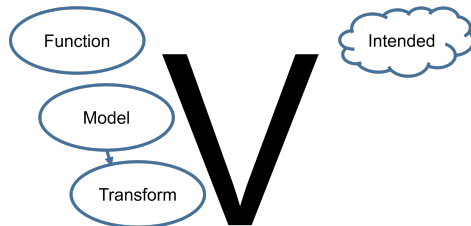
Confidence in model

- Evaluating tools used to model AI.
- Ensuring robustness, reproducibility, and compliance with safety standards.



Confidence in transformation

- Challenges in transforming models to executables.
- The role of compiler qualification in ensuring safety and correctness.



Discussion impulses

4 Domains requiring confidence

5 Discussion impulses

- Table of contents for this section
- Questions arise
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6 Vision and call to action

Questions arise

In the future, we are on the way to putting our well-being into the hands of automated processes and algorithms.

There are questions:

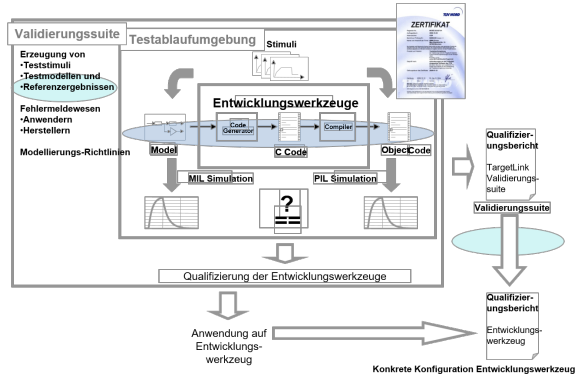
- Who is currently working in these fields?
- Who has expertise and could contribute to improvement?
- Are there synergies between academia, industry, and standardization bodies?

If you are interested, send an [email to me](#) and I will connect everyone in a LinkedIn group AI compiler qualification.

Source: Dr. Bernhard Thies, Vorlesung, Schutzmassnahmen und Schutzeinrichtungen in elektrischen Netzen und Anlagen, 01.07.2009



Validation Suite for Automated Code Generation at BMW AG



see [3, 4, 5, 6, 7, 8, 9]

Starting point principles for software architectural design

Table 3 — Principles for software architectural design

Principles		ASIL			
		A	B	C	D
1a	Appropriate hierarchical structure of the software components	++	++	++	++
1b	Restricted size and complexity of software components ^a	++	++	++	++
1c	Restricted size of interfaces ^a	+	+	+	++
1d	Strong cohesion within each software component ^b	+	++	++	++
1e	Loose coupling between software components ^{b,c}	+	++	++	++
1f	Appropriate scheduling properties	++	++	++	++
1g	Restricted use of interrupts ^{a,d}	+	+	+	++
1h	Appropriate spatial isolation of the software components	+	+	+	++
1i	Appropriate management of shared resources ^e	++	++	++	++
^a In principles 1b, 1c, and 1g "restricted" means to minimize in balance with other design considerations.					
^b Principles 1d and 1e can, for example, be achieved by separation of concerns which refers to the ability to identify, encapsulate, and manipulate those parts of software that are relevant to a particular concept, goal, task, or purpose.					
^c Principle 1e addresses the management of dependencies between software components.					
^d Principle 1g can include minimizing the number, or using interrupts with a clear priority, in order to achieve determinism.					
^e Principle 1i applies for shared hardware resources as well as shared software resources in the case of coexistence. Such resource management can be implemented in software or hardware and includes safety mechanisms and/or process measures that prevent conflicting access to shared resources as well as mechanisms that detect and handle conflicting access to shared resources.					

Source: ISO 26262, Volume 6 software, table 3, principles for software architectural design

Starting point design principles for software unit design and implementation

Table 6 — Design principles for software unit design and implementation

	Principle	ASIL			
		A	B	C	D
1a	One entry and one exit point in subprograms and functions ^a	++	++	++	++
1b	No dynamic objects or variables, or else online test during their creation ^a	+	++	++	++
1c	Initialization of variables	++	++	++	++
1d	No multiple use of variable names ^a	++	++	++	++
1e	Avoid global variables or else justify their usage ^a	+	+	++	++
1f	Restricted use of pointers ^a	+	++	++	++
1g	No implicit type conversions ^a	+	++	++	++
1h	No hidden data flow or control flow	+	++	++	++
1i	No unconditional jumps ^a	++	++	++	++
1j	No recursions	+	+	++	++
^a Principles 1a, 1b, 1d, 1e, 1f, 1g and 1i may not be applicable for graphical modelling notations used in model-based development.					

NOTE For the C language, MISRA C (see Reference [3]) covers many of the principles listed in [Table 6](#).

Source: ISO 26262, Volume 6 software, table 6, design principles for software unit design and implementation

A Vision for the future and call to action

5 Discussion impulses

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- Any ideas and/or questions?

7 Safe the dates in 2025

Vision for future and call to action

A **Vision for the Future**: let's **explore ideas** of an organization to define specifications and set **goals for verification and validation** in functional safety contexts.

Call to Action: let's reflect and share your **interest in such a collaboration**:

- Where do you see the **most pressing challenges**?
- What would a **collaborative effort in this domain look like**?

Source: [Rush Hour](#) by Fernando Livschitz





Any ideas and/or questions?



Source: www.livenet.de

Note of thanks

This document would be without $\text{\LaTeX}$ and its creator [Leslie Lamport](#), that I would like to mention here as a representative of the **$\text{\LaTeX}$ -community**, not even possible!
Thank you so much!

And also **unthinkable without coffee** - **thanks** therefore also to the many **coffee plantations workers**! More about preparation in [10].

Does **math work without coffee**? Without coffee breaks? And how do you actually stir your Jamaica Blue Mountain properly? Listen to the [Podcast](#).



Safe the dates in 2025

6 Vision and call to action

7 Safe the dates in 2025

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- ROAD 2025: September 3rd to 5th (tentative) at Kanazawa Insititute of Technology, Japan

2nd ICAITD: June 1st to 4th, 2025 in Tokoy, Japan



The banner for the 2nd ICAITD International Conference of AI new Technology and open Discussion. It features a green background with a blue globe logo in the top right corner. The text '2nd ICAITD' is prominently displayed in large black letters. Below it, the dates 'June 1-4, 2025' are shown. A green 'ALGORITHM LAB.' logo is positioned on the left, and the 'Media Partner' information with the website 'https://internationalconferencealerts.com.' is on the right. A navigation bar with four buttons ('ICAITD_2025', 'Call For Papers', 'Registration', 'More') is located in the center. At the bottom, the full conference title is written in a monospace font.

2nd ICAITD

June 1-4, 2025

ALGORITHM LAB.

Media Partner
<https://internationalconferencealerts.com.>

ICAITD_2025 Call For Papers Registration More

The Second ICAITD International Conference of AI new
Technology and open Discussion

the second ICAITD International Conference of AI new Technology and open Discussion organized by Kazuo Ohzeki-sensei, Professor Emeritus of SIT and IPUT, see also appendix page 36

FAST-zero'25: September 23rd to 26th, 2025 in Procence, France

FAST-zero'25



8th International Symposium on Future Active Safety Technology toward zero traffic accidents

September 23 to 26, 2025 in Procence, France

Organized by The Laboratory of Accident Mechanisms Analysis,
Gustave Eiffel University.

In association with Society of Automotive Engineers of Japan, Inc. 



Université
Gustave Eiffel

Save the Dates!

Symposium Topics

FAST-zero'25 topics will cover wide range of active safety technology topics including but not limited to:

- Active Safety Systems
- Driver Characteristics and Human Factors
- Active Safety Testing Methods and Assessment
- Other Related Topics on Active Safety

Contributions on the following topics are also welcome: Vulnerable road users, Naturalistic driving studies, International comparisons of accident data or ADAS effectiveness assessment.

Important Dates

Deadline for Extended Abstracts: Nov 30, 2024

Notification of Acceptance: Mar 15, 2025

Deadline for Full Papers: June 15, 2025

Deadline for Early Registration: June 15, 2025

FAST-zero'25 Website:

<https://fast-zero25.sciencesconf.org/>



FAST-zero'23 in Kanazawa



Source: <https://www.atlasobscura.com/places/procence>



Source: <https://www.atlasobscura.com/places/colosseum>

8th International Symposium on Future Active Safety Technology toward zero traffic accidents, see also appendix page 40

ROAD 2025: September 3rd to 5th (tentative) at Kanazawa Insititute of Technology, Japan



ROAD 2025 will be hosted at [Kanagawa Institute of Technology](#) in **September 2025**, see also appendix page 41

Flyer

7 Safe the dates in 2025

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- 7th international conference ROAD 2025 in Kanagawa Institute of Technology

2nd International Conference on AI and new Technology and Discussion I

ICAITD 2025



The Second International Conference on AI and new Technology and Discussion will be held in Tokyo, Japan on June 1st -4th 2025.

2nd International Conference on AI and new Technology and Discussion II

ICAITD 2025



Features

- From paper ranking to paper understanding
- Presentation: Free format, presentation and question time can be extended
- From cram parallel sessions to serial sessions

2

2nd International Conference on AI and new Technology and Discussion III

ICAITD 2025



ADAS/AD session:

- Call for papers on
- Software/Hardware
- Experiments
- EV Battery problems
- Batteries
- Large capacity
- Replacement type
- A robot of replacing batteries at gas stations
- Evaluation of used batteries

3

2nd International Conference on AI and new Technology and Discussion IV

ICAITD 2025



Paper Submission

- Deadline Oct 31th 2024
- Full paper/Position paper/ Poster....
- <https://aitokyoseminar.wixsite.com/my-site-3>
- Call for Papers /Committee members/ Reviewers



8th International Symposium on FAST-zero 2025 I

FAST-zero'25



8th International Symposium on
Future Active Safety Technology
 toward **zero** traffic accidents
 September 23 to 26, 2025 in Provence, France

Organized by The Laboratory of Accident Mechanisms Analysis,
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Université
 Gustave Eiffel

Save the Dates!

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FAST-zero'25 Website:

<https://fast-zero25.sciencesconf.org/>



FAST-zero'23 in Kanazawa

Important Dates

Deadline for Extended Abstracts: Nov 30, 2024

Notification of Acceptance: Mar 15, 2025

Deadline for Full Papers: June 15, 2025

Deadline for Early Registration: June 15, 2025



Source: <https://www.alainprovencaletourism.com/>



Source: <https://www.aftestourisme.com/fr/>

7th international conference ROAD 2025 at KAIT I



ROAD 2025 in KAIT

Prof. Hideo Inoue, Kanagawa Institute of Technology (KAIT)



KAIT



DIVP - perception simulation

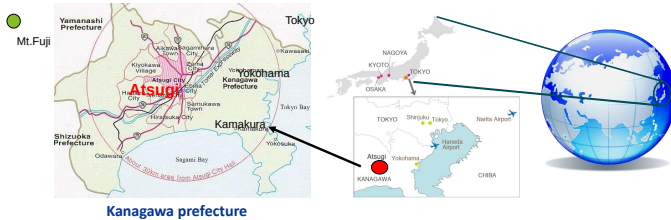
1 2024.7.4. ROAD 2025_KAIT_presentation

7th international conference ROAD 2025 at KAIT II

Symposium location of ROAD 2025

Kanagawa Institute of Technology (KAIT), Atsugi-shi, Kanagawa-ken, Japan

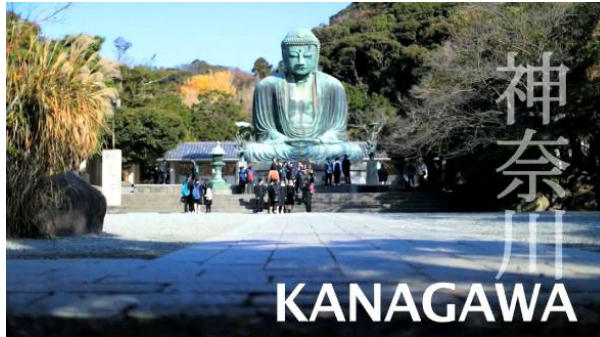
- 1Hour from Haneda, 1.5Hour from Narita, with convenient transportation!
- **Atsugi** is located at the **very center of Kanagawa prefecture**, approximately 50km south-west from downtown of Tokyo



2 2024.7.4. ROAD 2025_KAIT_presentation

7th international conference ROAD 2025 at KAIT III

What is Kanagawa like?



3 2024.7.4. ROAD 2025_KAIT_presentation



7th international conference ROAD 2025 at KAIT IV

Symposium venue of ROAD 2025, KAIT

Information Technology Building



Student Service Building

Lecture Building

Institute for Advanced Technology



Facilities



4

2024.7.4. ROAD 2025_KAIT_presentation

7th international conference ROAD 2025 at KAIT V

Reception Hall

KAIT 50th Anniversary Memorial Institute for Advanced Technology

-The center will give spot-light on the cutting-edge research projects from among the numerical studies of KAIT to tailor them to be a significant addition to the society.



5 2024.7.4. ROAD 2025_KAIT_presentation

神奈川工科大学
KANAGAWA INSTITUTE OF TECHNOLOGY



7th international conference ROAD 2025 at KAIT VI

Main Conference Room

At the top of the Information technology building

Capacity : 276 persons

Opening Ceremony, Keynote Speeches, Closing Ceremony



Various convention equipment

- PC projector
- Multi-channel microphone
- Multi overhead projectors
- AV system



DIVP

7th international conference ROAD 2025 at KAIT VII

Lecture halls for round table discussion

Each session room is equipped with PC projector and AV equipment.
Multi-channel microphone system is also available in the rooms.



7 2024.7.4. ROAD 2025_KAIT_presentation



7th international conference ROAD 2025 at KAIT VIII

Theme on ROAD 2025 (tentative)

"Safety" as a Last Piece in "ADS" !

7th international conference ROAD 2025 at KAIT IX

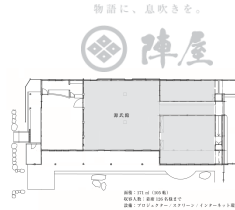
Symposium date (tentative)

ROAD 2025 will take place on **September 3rd - 5th, 2025.**

Date	Event	Venue
Wednesday 3 rd	Opening, Keynote, Roundtable discussion	KAIT, Atsugi
	Conference dinner	Japanese traditional restaurant
Thursday 4 th	Keynote, Roundtable discussion, Closing	KAIT, Atsugi
	Introduction of safety assurance initiatives for ADS/ADAS in Japan	
Friday 5 th	Technical visit to "Tier IV "	Tier IV , Tokyo

7th international conference ROAD 2025 at KAIT X

Conference dinner, at Tsurumaki Onsen JINYA(tentative)



10 2024.7.4. ROAD 2025_KAIT_presentation

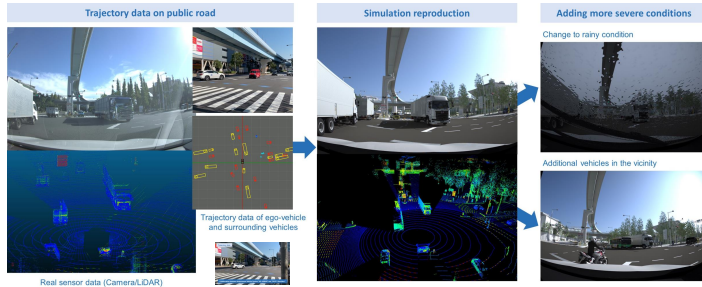
神奈川工科大学
KANAGAWA INSTITUTE OF TECHNOLOGY

DIVP

7th international conference ROAD 2025 at KAIT XI

Reproduce intersection driving scenarios using DIVE simulator based on traffic data from ADS vehicles' FOT, and evaluate safety by changing various environmental conditions.

Introduction of Safety Assurance Initiatives for ADS/ADAS in Japan



11 2024.7.4. ROAD 2025_KAIT_presentation



7th international conference ROAD 2025 at KAIT XII

Technical visit, TIER IV in Tokyo (tentative)



https://tier4.jp/media/detail/?sys_id=3zc5Jf8KEJ9fJOqewaAiUM&category=NEWS

https://www.youtube.com/watch?v=8u_Y_pVRSGw&t=42s

12 2024.7.4. ROAD 2025_KAIT_presentation



7th international conference ROAD 2025 at KAIT XIII



Handover Bell of ROAD ..



KAIT



Tokyo Odaiba → Virtual Community Ground



13 2024.7.4. ROAD 2025_KAIT_presentation

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Schneider, S.-A. and Mai, Pierre R. and Lovric, T., "Validierungssuite," April 2008, Sicherheit 2008: Saarbrücken, Germany. [Online]. Available: https://www.researchgate.net/publication/284178798_Validierungssuite

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