

## **Session 335 - AV Testing and Data Collection**

### **Organizers**

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### **Rapporteurs**

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### **Session Focus**

This session presented updated efforts to develop shared frameworks for automated vehicle testing and data collections. In contrast to the work of individual companies on proprietary frameworks, research and innovation projects at the scale of federal governments, European Union, and other international organizations are conducted for the benefit of all stakeholders with an eye towards transparency, standardization and homologation. The trilateral working group on automated road transportation is an example of cooperation among the US, EU, and Japan to advance the industry while seeking opportunities for cooperation.

The goals of this session were to present new project updates and results that align with federal and international efforts to develop shared frameworks for AV testing and data collection. Presentations intended to meet the following objectives:

- Offer international perspectives
- Cutting edge program/project updates
- Project developments for the next year
- Inform audience of shared frameworks and open tools

### **Session Summary**

There are several efforts underway and about to kick off to develop shared frameworks for testing automated vehicles and to streamline the process of collecting and processing data. These efforts are designed to meet needs throughout the process of testing and certifying AVs so that their operational performance and safety can be assured. A few of these were highlighted during this ARTS session. Five speakers shared presentations that cut across international borders and applications.

Professor Jiaqi Ma of UCLA presented work on the **ADS Data Acquisition & Analytics Platform** that he participated in with the Transportation Research Center (TRC). This platform is a US initiative that should streamline the data flow, from collection to processing, for multiple ADS-equipped vehicles. The title of his talk was titled “Connected and Automated Vehicle Performance Datasets for Understanding Mixed Traffic Behavior.”

Dr. Stephane Dreher of ERTICO presented two initiatives from the European Union. **ARCADE** is a Coordination and Support Action (CSA) aimed at building consensus across many stakeholders and is funded through July 2022. A test data sharing framework was developed that standardizes data and metadata descriptions while trying to protect data security and privacy. The **Data for Road Safety** ecosystem is a cross-border, cross-brand, public private cooperation managed by ERTICO-ITS Europe. Information is collected on events such as accident areas, debris on road, reduced visibility, work zones, and others.

Stefan de Vries (PMP) of IDIADA presented two European initiatives called HEADSTART and SUNRISE. **HEADSTART** defines testing and validation procedures for Connected, Cooperative and Automated Mobility (CCAM) functions, including enabling technologies, cross-linking simulations with field tests, and validating safety and security performance. The **Safety Assurance Framework for Connected, Automated Mobility Systems (SUNRISE)** aims to develop a harmonized and scalable safety assurance framework that fulfills the needs of different automotive stakeholders and is scheduled to run from September 2022 through August 2025.

Zhitong Huang and Kyle Rush from Leidos presented a talk titled “Developing an Open-Source Co-Simulation Tool to Support Development and Deployment of Cooperative Driving Automation Research”. This connected driving automation (CDA) simulation platform aims to improve modeling capabilities and lays the groundwork for other initiatives such as the VOICES community of practice around AV testing. Ethan Slattery from Leidos presented a talk titled “**VOICES: A Framework for Live, Virtual and Constructive AV Testing**”. These US programs provide an open framework for stakeholders to test scenarios using a common, interoperable set of tools and collaborate on testing efforts.

### **Suggested Action Items**

Collaboration is required to tackle the massive problems faced in the development, testing, and deployment of AV fleets around the world. Collaboration may be in the context of pre-competitive activities across companies, standards development, and testing tools that are open and interoperable. But efforts to develop standards, databases, and testing and safety frameworks are still in their early days. In the marketplace of ideas some tools and frameworks will likely see greater adoption than others. The ones that remain must also become interoperable with each other.

Key words mentioned during the presentations included *collaboration*, *harmonization*, and *standardization*.

ADS simulations still require more harmonization. Results should be consistent across different frameworks. Moreover, it should be possible for organizations to deploy their own simulation subsystems (e.g. vehicle dynamics) within a framework. Capabilities and limitations of the models used in a framework should be made clear to users and there should be common understanding about the accepted applications for a given set of models.

Several databases have been established to collect ADS scenarios, but they do not all use the same standard formats for scenario definition and road formats. Fortunately, efforts to establish databases have taken place at the national level and the lack of harmony that remains occurs across international borders. Nevertheless, it should be possible for one country's database to become a scenario resource for organizations in other countries.

Compatibility between physical tooling and simulation tooling largely remains project/organization-specific. Continuing developments in industry 4.0, internet of things, and the digital twin paradigm should continue to bring standardization to this area. However, different organizations will inevitably select different protocols from the variety of choices (e.g. TENA vs. HLA vs. DIS).

Frameworks for testing and data collection have been built up piece by piece over several years of intense effort. They must continue to mature into fully-formed safety assurance frameworks that can provide metrics for use in certification. There remain fundamental questions about which measures of safety are most appropriate in various scenarios and what baseline thresholds should be set for pass/fail criteria.

This year's session showed that good progress continues to be made in testing and data collection frameworks. We suggest the following list of action items:

- Since standards development is such an active area right now, effort should be made, either now or after upcoming standards have been published, to synchronize them and identify remaining gaps.
- Several safety measures should be integrated into testing frameworks so that commonly accepted metrics are easy to obtain from test suites. The various choices should continue to be compared and evaluated to match the most appropriate metrics, scenarios, and use cases (e.g. internal testing vs. certification vs. regulation).
- Develop databases and workflows that collect in-vehicle data and use it to generate test scenarios and even provide real-world sensor data.
- Additional rounds of collaborative projects should be funded to further exercise new testing frameworks with real-world data, scenarios and use cases.

It has been suggested that a single concrete approach should be agreed upon to deal with a wide variety of scenarios. While this type of convergence may occur in countries and even some continents, it is unlikely that we will ever reach universal agreement. Progress towards this end requires a number of factors, of which we note only two:

1. Existing methods, standards, and frameworks need to be continually exercised and stressed in competitive and cooperative contexts so that the best ideas can percolate up.
2. Conversion between standardized formats must exist at every level (e.g. scenario, road, ODD, network interface files, etc.).

For example, it should be well understood how to translate a left-driving scenario to a right-driving environment and vice-versa. Ideally, such a conversion ought to be contained to difference in roadway files with minimal changes needed to the scenario itself. This, and other tricky cases, make the end goal far from being easy or simple.

The organizers would like to express sincere gratitude to all the speakers who shared of their time and expertise about the important contributions being made in the field of AV testing and data collection.