Document FRAV-27-08

Informal Working Group on Functional Requirements for Automated Vehicles

Status Report

13th GRVA Session

23-27 May 2022

FRAV

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FRAV current status

Diversity of ADS and ODD → 142 safety proposals → Five “Starting Points” → List of “Safety Topics” →

Safety topics review → Tasks/Objectives → Common Understanding → Safety Needs →

General Requirements → Specifications → ADS descriptions → Package Delivery

- Updated draft safety recommendations
- Three paths to verifiable criteria
  - DDT performance within model expectations
  - OEDR framework to determine property detection for ORU recognition
  - Roles approach for ADS interactions with users

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General overview

FRAV

SCOPE

- Nominal DDT
- Safety-Critical
- User Safety
- Failure Management
- Safety Maintenance

WORKSTREAMS

- DDT Performance — CLEPA
- ORU Safety — China
- User Safety — Netherlands
- Performance Data — SAE

APPROACHES

- DDT Models
- ORU Properties
- User Roles
- EDR/DSSAD

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General overview

FRAV

SCOPE	WORKSTREAMS	APPROACHES
Nominal DDT	DDT Performance (CLEPA)	DDT Models
Safety-Critical	ORU Safety (China)	ORU Properties
User Safety	User Safety (Netherlands)	User Roles
Failure Management	Performance Data (SAE)	EDR/DSSAD
Safety Maintenance		

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Model-based approach to DDT

- Driving requires adaptation to local conditions and assumptions.
  - FRAV cannot harmonize traffic laws, signs, languages, human behaviors, etc.
  - ADS respond to real-time conditions in virtual infinite combinations.
- Global specifications can address desired behaviors/responses.
  - Respond to conditions in manner consistent with global specifications and safety expectations.
- Models represent performance expectations.
  - Address nominal driving and collision avoidance/mitigation.
  - Allow for local constraints and parameters.
  - Performance acceptable if satisfies model expectation.

Model-based approach to DDT

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- DDT workstream assessing various models.
  - Aim to agree on models that provide a basis for determining safety of ADS driving performance.
  - Anticipate multiple models that may be used to demonstrate compliance.
    - Models provide verifiable criteria for safe performance in scenario, but no single model can cover full range of scenarios.
    - Careful and competent driver model, state-of-the-art performance model, mathematical safety envelope model, etc.
- Expectation to furnish global specifications with annexes providing models for establishing verifiable criteria.
  - Pass/Fail: ADS response under scenario satisfies global requirements within expectations of relevant model.

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ORU properties-based approach

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- Virtually infinite variety of objects may be encountered worldwide in and around roadways.
- Responses to objects based on physical, functional, and behavioral properties of the objects.
- ADS can detect physical properties that enable recognition and classification (differentiation).
- Properties-based approach covers detection aspect of OEDR.
  - Detect the attributes that enable differentiation of objects based on their functional and behavioral characteristics.
  - Recognize and classify objects in accordance with differences in the safety needs and ADS response expectations.

ORU properties-based approach

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- ORU workstream building out OEDR-based framework.
  - Detectable properties to differentiate and classify ORU.
  - Level of differentiation based on functional/behavioral properties.
  - ADS safety recommendations for interactions with subsets of ORU.
- OEDR framework based on detection, recognition, and classification.
  - Basic need to detect safety-relevant objects in and around roadway.
  - Subsets of objects must be recognized to enable correct ADS evaluations and responses (e.g., car, truck, bus, motorcycle, cyclist, pedestrian, animal).
  - In some cases, subsets may need to be further classified (e.g., emergency vehicles have special functions and behaviors).

ORU properties-based approach

- Framework enables ORU-specific provisions where needed.
  - Responses to subsets of ORU.
  - Balance safety needs against safety risks (e.g., beneficial to know ADS in operation against risk of adverse changes in ORU behaviors).
- ORU workstream developing FRAV response to AC.2 mandate regarding external light-signaling.
  - Identify safety-relevant needs for external communication/signaling, if any.
    - Particular attention to communicating ADS operational status.
  - Evaluate possible solutions to meeting needs.
  - Define nature of light-signaling solutions, if any.
  - Deadline set for November 2022.

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FRAV

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Roles-based approach to users

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- ADS have different kinds of users.
  - Dependent upon ADS configuration and intended use.
  - Real-time role of the user which may change during a trip.
- Currently focused on in-vehicle user roles (vehicle occupants).
  - Driver controlling the vehicle.
  - Fallback user who may be permitted or requested to intervene in control.
  - Passenger with no possibility for direct physical role in vehicle control.
- Recognize possible external user relationships for future consideration of possible safety needs.
  - Forms of external activation (e.g., “dispatcher”).
  - Forms of external control (e.g., “remote operator”).
  - Forms of external commands (e.g., “summoning”).

Roles-based approach to users

- Address user safety across roles, including but not limited to:
  - User information and education.
  - Driver activation of an ADS.
  - Fallback-user interventions to assume control.
  - Fallback-user responses to transition demands.
  - Transitions of control: notifications, fallback-user feedback evaluations, fallbacks to minimal risk condition.
  - Passenger interactions with ADS in driverless operation.
- Ensure commonality across ADS.
  - Avoid learning-curve risks.
  - Experience transferable across ADS vehicles.
  - Design neutrality: “commonality more than uniformity”.

Roles-based approach to users

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- Refining input on detailed provisions.
- Structuring recommendations for applicability across ADS use cases.
- Discussing alignment of roles with ADS configurations/use cases.
  - ADS that can be activated by a driver while the vehicle is in motion.
  - ADS that permit or request transitions to fallback user while vehicle moving.
  - ADS that only permit either ADS or driver control for duration of a trip.
  - ADS passenger vehicles with no driver controls (driverless vehicles).
  - ADS vehicles designed solely for goods (no possibility for any occupants).

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ADS data and EDR/DSSAD

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- EDR/DSSAD addressing data collection/recording, including ADS.
  - EDR/DSSAD requested FRAV perspectives on data collection for ADS vehicles.
- FRAV provided recommendations to EDR/DSSAD
  - ADS data elements should be aligned to ADS configurations/use cases.
    - ADS differ in ways that impact relevant data (e.g., not all ADS would have driver controls, transport occupants, or permit transitions of control while vehicle is moving).
  - ADS data useful in crash investigations and general performance monitoring.
    - VMAD's In-Service Monitoring and Reporting pillar concerns in-use performance.
    - "Crash-event recorder" (EDR) different from uploaded general performance data.
  - User-interactions differ from "TTC minus five seconds" data.
    - User interactions outside "five-second window" may be relevant.
    - ADS can "flag" sequential interactions aligned with safety requirements (e.g., activation, user intervention, transition demand).

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ADS data and EDR/DSSAD

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- EDR/DSSAD considered recommendations and requested example(s) to illustrate more concretely.
- FRAV provided “transition of control” example.
  - TOC only apply to ADS that permit fallback-user interventions.
  - TOC may be user-initiated or ADS-initiated.
  - TOC may be successful or unsuccessful. (Based on ADS evaluation of user inputs)
  - ADS can flag sequence of interactions to provide picture of occurrence.
  - Same elements can be used for crash analysis and in-service analysis.
- Communication across EDR/DSSAD, FRAV, and VMAD important.
  - Each group can work individually (i.e., not essential to wait on each other) but share drafts to ensure coherence (i.e., consistent terms and understanding)