Informal document **GRVA-13-37**
13th GRVA, 23-27 May 2022
Provisional agenda item 4(a)

Informal Working Group on Functional Requirements for Automated Vehicles

Status Report

13th GRVA Session

23-27 May 2022

FRAV

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

- DDT performance safety models
  - Global requirements/local variables
- Traffic law conversion procedure
  - ADS-applicable criteria for determining compliance with local laws
- OEDR framework to address ORU interactions
  - Recognition at level of detail needed to underpin response requirements (e.g., comply with traffic laws concerning response to priority vehicle)
- ADS user HMI and interactions specifications

General overview of activities

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

General overview

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

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Safety models for DDT

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- Challenge of local variables and assumptions.
  - Local operating conditions cannot be harmonized: Traffic laws, signs, signals, markings, languages, driver education and behaviors, etc.
  - Safe driving depends upon adaptation to local conditions and assumptions.
- Verifiable metrics can be derived from the application of an ODD-based approach.
  - Allow application of local variables and assumptions
  - Propose multiple modeling methodologies. (safety envelopes, scenario-based, driver modeling, technology state-of-the-art, etc.)
  - Compare ADS performance against benchmarks for expected behavior (e.g., ADS performance vs model performance)
  - Address collision-avoidance/crash-mitigation boundaries.

Safety models for DDT

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- Global requirements with verifiable criteria established via an ODD-based approach.
  - DDT performance requirements will not be prescriptive.
  - Approach allows for local constraints and parameters.
  - Performance acceptable if satisfies model expectation.
- FRAV analyzing various models.
  - Aim to propose various models that result in safe driving actions.
  - May result in multiple models that may be used to demonstrate performance.
  - Models can address nominal driving and collision avoidance/mitigation.
- Expectation to furnish global specifications with annexes providing methods for establishing verifiable criteria.

General overview

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ORU properties-based approach

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- Objects and other road users (ORU) have attributes detectable by an ADS.
  - These attributes enable differentiation.
- OEDR involves detection, recognition, and classification.
  - At the most basic level, an ADS must detect safety-relevant objects in and around the 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., police car, fire truck, road worker).

ORU properties-based approach

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- The properties-based approach aims to address ORU safety by ensuring that ADS will respond appropriately to roadway objects.
  - Detect the attributes that enable differentiation.
  - Recognize and classify objects in accordance with differences in the safety needs and ADS responses.
- This approach relates to issues surrounding ADS communications or signaling in ORU interactions.
  - Some, but not all, ORU may need information from the ADS.
  - For example, law enforcement may need to know if an ADS is operating a vehicle. However, this information could adversely impact ORU behaviors (e.g., increase in higher-risk behaviors based on predictability of ADS responses).

ORU properties-based approach

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- ORU workstream building out OEDR-based framework.
  - Detectable properties to differentiate and classify ORU.
  - OEDR-based detection, recognition, and classification.
  - ADS safety recommendations for interactions with subsets of ORU.
- ORU workstream developing FRAV response to AC.2 mandate regarding external light-signaling.
  - Identify safety-relevant needs for external communication/signaling, if any.
  - Evaluate possible solutions to meeting needs.
  - Define nature of light-signaling solutions, if any.
  - Particular attention to communicating ADS operational status.
  - Deadline set for November 2022.

General overview

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

- Performance Models
- Detectable Properties
- User Roles
- EDR/DSSAD

Roles-based approach to users

- 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

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- Aim to 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).

General overview

FRAV

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WORKSTREAMS

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  CLEPA
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  China
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APPROACHES

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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).

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 clear 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)

Summary

FRAV

- ODD-based approach to verifiable criteria.
- Non-prescriptive DDT performance requirements.
- Safety models as basis for determining fulfillment of requirements.
- ORU safety needs and risk/benefit of external signaling.
- OEDR-based approach to addressing ORU interactions.
- ADS configurations/use cases and user roles context for HMI and user-safety requirements.
- Data collection input to EDR/DSSAD completed (expect continued sharing and exchanges)