Updated Proposal for an Approach to Defining Rules of the Road: United Kingdom Proposal

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Motivation

FIRST PART: ADS Safety Topics

1. The ADS should be capable of performing the entire Dynamic Driving Task (DDT)
2. The ADS should recognize the ODD conditions and boundaries of the ODD of its feature(s)
3. The ADS should detect and respond to objects and events relevant for the DDT
4. The ADS should comply with traffic rules
5. The ADS should interact safely with other road users
Motivation

The ADS should drive safely
1. The ADS should be capable of performing the entire Dynamic Driving Task (DDT)
2. The ADS should recognize the traffic rules
3. The ADS should detect and respond to traffic signs
4. The ADS should comply with traffic laws and signals
5. The ADS should interact safely with other vehicles

FRAV DDT Workstream

FRAV ORU Workstream

FIRST PART: ADS Safety Topics

| The ADS should respond in line with | Scenario/Virtual test/Track test: |
| traffic laws to markings and signals used to identify the functions and authorizations of ORUs. | - Object: Emergency/Special vehicle with visual signal (flash/painting), ego vehicle; |
| | - Case: 2-lane road, an emergency vehicle moves at low speed (in operational state) ahead while test vehicle drives in the same lane. |
**Motivation**

The ADS should drive safely

1. The ADS should be capable of performing the entire Dynamic Driving Task (DDT)
2. The ADS should recognize the environment
3. The ADS should detect and respond to obstacles
4. The ADS should comply with markings and signals
5. The ADS should interact safely

**FIRST PART: ADS Safety Topics**

| The ADS should respond in line with traffic laws to markings and signals used to identify the functions and states of a vehicle. |
| Scenario/Virtual test/Track test: |
| • The ADS should respond in accordance with traffic rules upon the operational status or dedicated signals displayed by |
| • Object: Emergency/Special vehicle with visual signal (flash/painting). ego vehicle; |
| • Case: 2-lane road, an emergency vehicle moves at low speed in |

5.1.2. The activated system shall comply with traffic rules relating to the DDT in the country of operation.

4.1.1. Verification of the function of “The System”

The Type approval authority shall verify “The System” under non-failure conditions by testing on a track a number of selected functions from those described by the manufacturer in paragraph 3.2, above, and by checking the overall behaviour of the system in real driving conditions including the compliance with traffic rules.

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As you approach a zebra crossing: look out for pedestrians waiting to cross and be ready to slow down or stop to let them cross; you MUST give way when a pedestrian has moved onto a crossing.
ODD based Codified Rules of the Road

Current Rules of Road (for human drivers) = \( f(\text{Operating condition, Behaviour competency, Assumptions}) \)

Codified Rule of the Road

Applying the proposed process

= \( f(\text{Operating condition, behaviour competency, driving characteristics}) \)
Using Rules of Road in wider Safety Assurance

Layer 1: High level requirements
Layer 2: Process to create verifiable req.
Layer 3: Concrete rules/values for req.
Focus for FRAV: Process for deriving requirements

Layer 1: High level requirements

Layer 2: Process to create verifiable req.

Layer 3: Concrete rules/values for req.
Using Rules of Road in wider Safety Assurance

Scenario Database e.g. Safety Pool™ Scenario Database

ODD Attributes

Behaviour Competency

Scenario

ODD based Rules of the Road

Test case Metrics Completeness

Scenario Database e.g. Safety Pool™ Scenario Database

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Using Rules of Road in wider Safety Assurance

Scenario Database e.g. Safety Pool™ Scenario Database

ODD Attributes
ODD based Rules of the Road
 Behaviour Competency

Scenario

Test case Metrics Completeness

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Focus for FRAV: Process for deriving requirements

Layer 1: High level requirements

Layer 2: Process to create verifiable req.

Layer 3: Concrete rules/values for req.
The speed limit is the absolute maximum and does not mean it is safe to drive at that speed irrespective of conditions. Driving at speeds too fast for the road and traffic conditions is dangerous. You should always reduce your speed when:

- the road layout or condition presents hazards, such as bends
- sharing the road with pedestrians, cyclists and horse riders, particularly children, and motorcyclists
- weather conditions make it safer to do so
- driving at night as it is more difficult to see other road users.
Deriving Requirements from Rules of Road
UK Highway Code Rule 125

- The **speed limit** is the absolute maximum and does not mean safe **speed**; reduce **speed** when:
  - road layout or condition hazards, bends
  - sharing the road: pedestrians, cyclists, and horse riders, particularly children, and motorcyclists
  - **weather conditions** make it safer
  - driving at night

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Deriving Requirements from Rules of Road
UK Highway Code Rule 125

- speed limit is absolute maximum and does not mean safe speed.
- reduce speed when:
  - road layout or condition hazards, bends
  - sharing the road pedestrians, cyclists and horse riders, particularly children, and motorcyclists
  - weather conditions make it safer
  - driving at night

\[
\text{isVehicle}(x) \rightarrow \text{speed}(x) < \text{limit(speed)}
\]

\[
isVehicle(x) \land (\text{isAtHazard}(x) \lor \text{isAtHazard}(a_1) \lor \text{isAtHazard}(a_2) \lor \text{isAtHazard}(a_3) \lor \text{isAtHazard}(a_4) \lor \text{isAtHazard}(a_5)) \lor \text{isUnsafeWeather}(env) \lor \text{isNight}(tod)
\]

\[
\rightarrow \text{action}(\text{reduceSpeed})
\]

Define “near” ; “hazard” ; “UnsafeWeather”

We define vehicle to be anything that is a four wheeler or larger

Need to define what reduceSpeed means
What would an acceptable “slow” speed mean?
Thank you…
Discussions…

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