FG-AI4AD

Safe interaction between AVs and other road users

UNECE WP.1 84th Session

9th March 2022

Hybrid Meeting

Human Factors & Automated Driving

Safe interaction between the AV and other road users

Predictability + Explainability

BEFORE THE SAFTY EVENT

AFTER THE SAFTY EVENT

Safe interaction with other road users

Predictability of behaviours before a safety event occurs

- AV viewpoint
  - Is the behaviour of other road users predictable?
- Other road user viewpoint:
  - Is the behaviour of the AV predictable?
- Common models of behaviour?
  - 1949 and 1968 Conventions on Road Traffic
  - 1949 and 1968 Conventions on Road Signs and Signals

Safe interaction with other road users

Predictability - 1968 Convention on Road Traffic

7.1 Road-users shall avoid any behaviour likely to *endanger* or obstruct traffic, to *endanger* persons, or to cause damage to public or private property.

Safe interaction with other road users

Predictability - ALKS

5.1.4. A transition demand *shall not endanger* the safety of the vehicle occupants or *other road users*.

5.1.5. If the driver fails to resume control of the DDT during the transition phase, the system shall perform a minimum risk manoeuvre. During a minimum risk manoeuvre, the system shall *minimise risks to safety* of the vehicle occupants and *other road users*.

5.4.4.1. In case the driver is not responding to a transition demand by deactivating the system (either as described in paragraph 6.2.4. or 6.2.5.), a minimum risk manoeuvre shall be started, *earliest 10 s after the start of the transition demand.*

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Predictability - ALKS Transition & MRM for other road users

- Traffic congestion eases and the car ahead accelerates
- The car ahead stops accelerating and stays at 60kph (37mph) without external indication as to the reason
- After 10 seconds surrounding lanes reach 96.5kph (60mph)
- Car ahead then brakes aggressively, activating hazard lights and stops in lane
- Surrounding lanes have now reached 111kph (69 mph)
- Is anyone endangered? Has the behaviour minimised risks to safety?

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Predictability - ALKS, Phantom Traffic Jams & Wave Suppression

- Stop-and-go traffic instabilities can be suppressed using bilateral control- which differs from “car following” and adaptive cruise control in that, counter-intuitively, it uses information about the following vehicle (as well as about the leading vehicle).

- Implementing bilateral control will be well worth the effort since it will reduce travel times, fuel consumption and greenhouse gas emissions. Existing infrastructure need not be modified—yet higher traffic throughput can be supported.

- Will ALKS reduce or increase Phantom Traffic Jams? Is ALKS aware of following vehicles?

Wave Equation of Suppressed Traffic Flow Instabilities
IEEE Transactions on Intelligent Transportation Systems (Volume: 19, Issue: 9, Sept. 2018)

Safe interaction with other road users

Explainability of behaviours after a safety event occurs

- Other road users, police, local authorities, smart infrastructure may all act as witnesses to a safety event.
- Safety investigations will focus on building a shared understanding of contributory factors to the event.
- Should the AV act as a witness to the safety event and be able to provide evidence?
- What level of explainability is expected by the public?

Safe interaction with other road users

Explainability - ITU FG-AI4AD driving behaviour data sources

Situation

Did the AD understand the circumstance and situation?

Extracted from the local world model. Where is the vehicle and where are all the other static/dynamic objects?

Hazard

Did the AD understand the hazards?

Prediction of risk presented by the situation. Levels of uncertainty in the models used to make the prediction.

Action

Did the AD execute the correct mitigating action for the hazards?

Control inputs to the vehicle and resultant dynamics.

Outcome

Was the level of final danger acceptable?

Using real-time continual monitoring of three input data sources.

99% **expect recall of the *time* of the collision**

1% don't

99% **expect recall of the *location* of the collision**

1% don't

98% **expect recall of the *speed* at point of the collision**

1% unsure 1% don't

93% **expect recall of *when* the collision risk was identified**

6% unsure 1% don't

The Molly Problem: A young girl called Molly is crossing the road alone and is hit by unoccupied self-driving vehicle. There are no eye-witnesses. What should happen next?

96% **expect recall of *if* Molly was detected**

3% unsure 1% don’t

96% **expect recall of *when* Molly was detected**

2% unsure 2% don’t

91% **expect recall of *if* Molly was detected as a *human***

6% unsure 3% don’t

90% **expect recall of *when* Molly was detected as a *human***

7% unsure 3% don’t

The Molly Problem: A young girl called Molly is crossing the road alone and is hit by unoccupied self-driving vehicle. There are no eye-witnesses. What should happen next?

98% **expect recall of *whether* mitigating action was taken**

1% unsure 1% don’t

97% **expect recall of *when* mitigating action was taken**

2% unsure 1% don’t

96% **expect recall of *what* mitigating action was taken**

3% unsure 1% don’t

The Molly Problem: A young girl called Molly is crossing the road alone and is hit by unoccupied self-driving vehicle. There are no eye-witnesses. What should happen next?

Safe interaction with other road users

Explainability - VMAD New Assessment/Test Method (NATM)

10.3 The three main purposes of *in-service monitoring and reporting* is to use retrospective analysis of data from manufacturers and other relevant sources to:

(a) demonstrate that the initial safety assessment (residual risk) in the audit phase before the market introduction is confirmed in the field overtime ("*safety confirmation*").

(b) to fuel the common scenario database with important new scenarios that may happen with automated vehicles in the field ("*scenario generation*")

(c) to derive safety recommendations for the whole community by sharing learnings derived from key safety accidents/incidents to allow the whole community to learn from operational feedback, fostering continuous improvement of both technology and legislation ("*safety recommendations*").

AI for Autonomous and Assisted Driving
ITU Focus Group

THANK YOU. STAY SAFE. STAY HEALTHY.

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