Position Paper on:

Safety validation and roadworthiness testing

Safety validation and roadworthiness testing involve the definition of a comprehensive set of methodologies and tools aiming to verify whether vehicles comply with the regulatory and technological requirements. This verification is one of the building blocks for the safe deployment of automated road transport on public roads. These methodologies and tools should address the whole vehicle lifecycle.

Exhaustive (safety) validation and trustful roadworthiness testing of increasingly complex systems are key elements to both guarantee and promote the successful deployment of safe, socially accepted automated road transport on our roads. There is a need to go beyond current state-of-the-art, taking into account the automated vehicle as another element in a complex system that interacts with a highly dynamic and variable environment populated by heterogeneous road users. Cost-effective solutions are paramount as the CAD validation will grow exponentially due to the inherent complexity associated to an exponential growth of the scenarios that the vehicle will be involved.

For this purpose, Europe's future R&D agenda should take into account research on technical, regulatory and societal challenges, guaranteeing Europe's global competitiveness in CAD development and deployment.

Challenges

There are many challenges that need to be addressed regarding road automation and its verification/validation. First of all, it is important to perform an initial validation for new systems to be introduced in the market. However, the safety validation must be observed during the whole vehicle lifecycle. These two approaches present different challenges, among others:

- **Initial release validation:** With the current state-of-the art on validation/verification methodologies it is not feasible to physically test all the possible road situations. It is critical to find out a minimum set of tests that provide high enough confidence for public road release. A comprehensive, reliable, balanced and complementary combination of physical tests and simulated tests should be defined in order to guarantee the safety of a vehicle before its deployment to public roads.
- **Development completeness:** Including validation testing of operational safety and functional safety as part of the development of a new function and/or a whole automation level. Include/adapt/improve existing development methodologies from other domains (i.e. software development).
- **Human interaction:** This topic (see related CARTRE Theme) must include the vehicle interaction with the driver as well as with the rest of road users and must be reflected in safety validation.
- **Granularity:** Testing should cover several levels of the whole system: component level, vehicle level, system level (including interaction with other road users and infrastructure) taking into account its specific characteristics, commonalities and differences (i.e. scenarios and/or raw data)
- **Vehicle update:** If a vehicle hardware and/or software receives an update that modifies its functionalities, these changes and their impact on safety must be addressed. However, it is important to clearly understand when a new update should be considered different enough to start a new validation procedure or if new, whether different approaches able to deal with the update need to be developed.
- **Vehicle lifecycle:** Maintenance of the CAD systems should be followed during the vehicle lifecycle and regular updates (Over the air (OTA) or through other means) have to be considered. The potential impact OTA might have during the vehicle lifecycle and re-certification schemes have to be defined. The Periodical Technical Inspection (PTI) procedure might also have to be reviewed in terms of periodicity and the tests carried out to check the correct functioning of the automation features (sensors, software, …) of the vehicle.

Statements

Different statements have been defined by CARTRE project participants. However, this statements have shown different levels of acceptance. A complete list can be found in the full position paper, however among some of the most relevant ones you may find the following:

- Automotive industry faces an enormous effort to realise the safety validation of AD. A coordinated approach on safety validation is needed.
- Without virtual testing, it is not possible to achieve safety validation. Virtual testing not sufficient : Testing in a real-life environment is necessary
- Sharing scenarios is critical for safety and cost reduction purposes
- Your test cases can never be complete. The scenarios will dynamically change with the increasing number of AD functions on the road
- We need to define initial safety release procedures first before we can handle updates in the functionality

Input for research agenda

Verification/validation of SAE level 4/5 systems/functions can still not be fully achieved with current knowledge and further research in the area is fundamental.

- Development of verification/validation tools and methodologies capable to deal with the initial release of foreseen development of higher levels of automation but also throughout the vehicle lifecycle. These tools and methodologies.
- Include human factors in the whole testing and potential certification scheme especially for those levels that still require a decisive involvement of the driver.
- Research on new (and disruptive) technologies for CAD i.e. artificial Intelligence should always take into account its verification and validation and potentially certification throughout the vehicle lifecycle
- Promote standardisation initiatives for new protocols, methodologies or tools where possible
- Encourage the R&D efforts that technically support the creation/adoption of a European level certification scheme for automation.
- Investigations on what can be tested in simulation and what should be tested on real roads (test tracks, public roads) together with guidelines to validate the simulation models

Impact

All technical developments are useless if a proper regulatory framework is not in place. Europe's leadership in the automotive sector can be compromised if a fair, trustworthy, harmonized and complete process for safety assessment is not developed. At higher levels of automation, the current approaches do not suffice anymore.

A European level approach would speed up the development process and reduce the time to market of new automated functions with a higher level of safety of the deployed systems. The enhancement of the safety level of new functions through a consolidated and trustworthy verification/validation methodology would increase the user acceptance of these technologies and contribute to its market adoption.