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Trustable architectures with acceptable residual risk for the electric, connected, and automated (ECA) cars

Abstract:

ArchitectECA2030 contributes to the safety of electric, connected, and automated (ECA) vehicles. The research project relies on independent validation through testing before deployment. Given the diverse origins and integration methods of software and hardware components in vehicles, pre-deployment and rigorous testing in a controlled setting are crucial. Careful integration of primary and secondary components requires a comprehensive understanding of required validation levels. In this context, the primary goals of ArchitectECA2030 include developing a robust, mission-validated design for electronic components and systems (ECS), quantifying residual risk in ECS for type approval, and enhancing end-user acceptance with more reliable ECS.

Proposed approaches involve quantifying residual risk, virtual validation, and using multi-physical and stochastic simulations. The project implemented an in-vehicle monitoring device/function (MonDev) for assessing electronic health, enabling model-based safety prediction, fault diagnosis, and anomaly detection. The ArhitectECA2030 project aims to design ECA vehicles that are safe, secure, and reliable, ensuring a well-defined, quantified, and acceptable residual risk across all ECS levels.

To maximize the learning from in-service data, ArchitectECA2030 developed a hierarchical MonDev concept including 4 distinct abstraction layers for ECA vehicles (namely: sub-component, component, sub-system, and system layers). The main purpose of the hierarchical monitoring device approach is to monitor the health status of the individual elements across the 4 specified layers to guarantee the safe operation of the vehicle within its specified ODD. The nominal behavior of the 4 specified layers is directly specified via the system requirements and specification of the entire ECA vehicle. The contributions of Virtual Vehicle Research GmbH include formulating the MonDev concept for the system layer, integrating it into the automated driving system using Autoware.AI, and applying the solution to a real-world automated driving demonstrator platform. Watch the general project introduction video here: ArchitectECA2030 - Presentation Video on Vimeo and Virtual Vehicle's automated driving demonstration video here: https://www.youtube.com/watch?v=67ldtb56W-4.

The overall advancement of the project proved to be a significant success for the entire consortium, with a notable impact on Virtual Vehicle Research GmbH. It cultivated expertise in risk estimation, redundant systems, and resilient solutions for automated driving. Crucial partnerships were established, fostering potential future projects. Virtual Vehicle's contribution to 8 academic publications demonstrates substantial dissemination output and societal contribution. Despite a 6-month extension due to COVID-19, Virtual Vehicle successfully completed all project deliverables according to the original timeline, showcasing ArchitectECA2030 as a significant success in advancing automated driving technologies.