Hi-Drive
Designing Automation

V2X AS TECHNOLOGY ENABLER FOR BRIDGING ODD GAPS AND IMPROVING PERFORMANCE OF HIGH LEVEL AUTOMATED DRIVING AT ODD BOUNDARIES

Take Over Request and Minimum Risk Maneuver on a Connected Automated Vehicle prototype

Being able to operate safely under a complete set of conditions called Operational Design Domain (ODD) is a pre-requisite for Automated Vehicles (AVs) introduction. Unfortunately, real-world application scenarios are not suitable for AVs to always operate under ODD conditions: a number of challenges often requires the driver to take over from automated driving mode. This may compromise safety and user acceptance and is unacceptable for AVs marketability.

Future technology enablers like V2X can help bridging ODD gaps and improve AV performance within and outside the ODD. Thanks to this, Connected AVs (CAVs) interact with other vehicles, as well as with road and digital infrastructure, operating more safely and user-friendly.

As an example, CAVs can receive notifications about road hazards downstream when not yet visible by on-board sensors. An anticipated, explicit and detailed description of the hazard (e.g. a roadworks blocking two of four available driving lanes at a precise point of the highway) can help AVs deciding whether to keep driving automated (hence bridging a possible ODD gap) or to ask the driver to take over. When a Takeover Request (ToR) is unavoidable, the earlier V2X notification allows the driver to intervene much before reaching the hazardous location and with a better situational awareness. Minimum Risk Maneuvers, if needed, would be more comfortable and take place at more convenient locations thanks to the time advance gained via V2X.

Based on this concept, the Hyundai Motor Europe Technical Center has showcased the integration of V2X in a CAV prototype in the IEEE Intelligent Vehicle Symposium 2022. After activating the AD mode, the CAV starts driving towards a road accident situation. Much before reaching it, a V2X roadside unit notifies the CAV about this hazard, which in turn triggers a ToR with instructions on the dashboard.

If the driver does not take over, an automated Minimum Risk Maneuver (MRM) is initiated. In this case, the CAV conveniently slows down, changes lane onto the emergency lane and finally stops.

V2X Demo

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Vehicle Sensor Setup

The Hyundai CAV prototype integrates additional HW and dedicated SW modules for sensing, communication, localization, processing, control and HMI. This integration allows high level AD supervised by a safety driver that can override the lateral and longitudinal control at any moment. The particular combination of HW & SW supports implementation of technology enablers (mainly V2X and localization ones) used by AD functions that will be evaluated in Hi-Drive use cases to qualify and quantify their effects.

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PROJECT FACTS

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