A Note on Confidence Awareness in Automotive Perception

Hardi Hungar

Institute of Transportation Systems, German Aerospace Center, Brunswick, Germany
hardi.hungar@dlr.de

Abstract. Trustworthy environment perception is one of the main challenges in realizing safe automated driving. Current solutions rely on a combination of sophisticated sensors, (artificially) intelligent sensor signal interpretation, and fusion functionality, to produce a highly accurate view of the traffic environment. For homologation of an automated driving system, the accuracy and reliability of its perception functionality must be assured to a high degree. Efforts to achieve this will comprehend targeted component and system tests in the lab, in real-world tests, and in simulations. Due to the overall system complexity, no fully satisfactory method is currently available. Two main obstacles have to be overcome. First, the AI models interpreting the sensor signals are hard to assess. There is no formal description of their functionality against which they could be verified, and their inner workings are virtually impossible to analyze. Second, though different sensor types are partly complementary in their potential to compensate weaknesses, this can as yet be only roughly captured in a compositional reasoning establishing the quality of the result of sensor fusion. These two points illustrate that we lack a comprehensive concept of capturing and establishing the quality of the perception component of an automated driving system.

A main ingredient of a solution to this problem would be a measure of current confidence, qualitative and quantitative, of each stage of the perception system. And verification and validation means must support this measure at every level. In particular, sensor models would have to produce the additional information, comprising the need to include the contribution of the AI part to uncertainty. And the information should permit compositional reasoning over the fusion chain.

Building on such confidence information, verification and validation could produce assertions much closer to the performance of the implemented system. This would help to *prove* the system sufficiently safe, if it is.

The approach of assuring confidence at each perception stage in its verification can even be taken a step further. Also, in the implemented system, information of this kind would be extremely helpful to reach a high level of safety. This would need components which are aware of their current accuracy, and fusion functions which use this information to improve and assert the quality of their output. This, in the end, could significantly improve automation functionality and its range of applicability. As of today, technological support for confidence awareness is far from being able to support such a concept comprising the full automation system.

Keywords: Automated driving systems, verification and validation, AI based perception, perception quality