

## Evaluation of Advanced Driver Assistance Systems for Supportive Brake Application

Gregor Nitz, BMW Group Forschung und Technik, Hanauerstraße 46,  
80992 München, Tel.: +49 89 382 46673, [gregor.nitz@bmw.de](mailto:gregor.nitz@bmw.de)

Felix Klanner, BMW Group Forschung und Technik, Hanauerstraße 46,  
80992 München, Tel.: +49 89 382 14601, [felix.klanner@bmw.de](mailto:felix.klanner@bmw.de)

New driver assistance systems come up more and more often equipped with the ability to perform a brake maneuver to prevent the driver from collisions. Such systems constitute a big challenge for sensing, interpreting and reacting to the environment and therefore need to be strictly tested.

A method for thoroughly examining all sides of such advanced systems is described in the following. Examples are given from the evaluation of two assistance systems. These are an Active Emergency Brake (AEB) and a Communication-based Intersection Assistant (CBIA).

For development of new ADAS, three fields need to be highlighted:

- **effectivity**: Do drivers, whose vehicles are equipped with the system, manage a hazardous situation superior than non-equipped ones?
- **capacity**: Does the system operate correctly in all situations it shall address?
- **behaviour**: Is the driver able to obtain control over his vehicle while the system malfunctions?

The effectivity of a system can be highlighted as it was done for the evaluation of the CBIA at a testing ground:

For the evaluation, test persons performed several intersection approaches while the right of way was to another vehicle approaching hidden behind an obstacle. For the first turn, the drivers were not instructed about the system and additionally distracted from the scene. A combined warning / brake application was presented only to a part of the drivers and their ability to stop on time was compared to the drivers who drove without system. In additional turns, several warning distances were presented to and compared by the drivers.

The key findings anticipated were as follows:

- Evidence, that in a statistically representative number of intersection approaches, significant more collisions can be avoided by drivers in vehicles equipped with the system.
- A time corridor for the user acceptance can be found and therefore the acceptable deviation of the measured position be calculated.

A method for testing the capacity of highly automated assistance systems such as the AEB is demonstrated by the so called “dummy target trailer”. With the application of this tool, highly hazardous situations can be risklessly depicted.

The trailer presents a fictitious target mounted on the end of a telescope-bracket which points into the next lane. The bracket is additionally equipped with a distance sensor which detects a vehicle approaching from behind and calculates the time to collision for this object. When the TTC falls below a certain threshold, the trailer is triggered to pull the bracket aside. The trailer itself is cased by a special shield to become invisible for RADAR and LIDAR sensors so that the tested system only sees the fictitious target in its own lane but not the trailer.

Having evaluated effectivity and capacity of a perfectly working system, the third aspect to be highlighted is the behaviour of drivers who are confronted with the working system as

well as a system that does not work correctly. To assess the risk of an AEB system, an analysis of the driving behaviour while experiencing correct or incorrect intervention into the braking system is currently accomplished. Four main questions are to be addressed in the study:

- Existence of a justifiable system design for an AEB.
- Relevance of inadequate warnings for the driver.
- Acceptance of different warning modalities or strategies.
- Driver behaviour after an experienced brake intervention.

Corresponding results will be presented in the final version.