Design of effective collision mitigation systems and prediction of their statistical efficiency to avoid or mitigate real word accidents

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Abstract:

Active safety systems are designed to help avoiding accidents or, if that is not possible, stabilizing respectively reducing the dynamics to such an extent that the passive safety elements are able to act optimally. The effectiveness is a measure for the efficiency, with which a safety system succeeds in achieving this target within its range of operation in interaction with driver and vehicle. The avoidance as well as the reduction of the severity of accidents can be expressed in characteristic values like avoided accidents, collision velocity, impact or injury severity. They can be used to compare as well as optimize not only different development stages of an active system, but also different systems with each other within their range of operation. Based on Daimler´s philosophy of the "Real Life Safety Concept" the reflection of the real word accidents in the systems range of operation is the starting point for optimization. The optimization process is aimed at achieving the best system performance under the spectrum of real word accidents.

Up to now, the effectiveness of an active safety system has usually been determined in retrospect, through changes in the accident statistics, or prospectively by appropriate tests such as driving simulator tests or driving tests in the field. The retrospective method facilitates the determination of effectiveness only several years after the market launch. Conducting tests with test persons allows individual but representative accidents to be examined with great precision. This approach, however, fails if statistically significant statements about the efficiency of the system in the complete range of operation are desired.

This gap, existing up to now in the development chain, is closed with the new method described in this paper. Starting from accident analysis the effectiveness of an active safety system is determined on the basis of in-depth accident data. A holistic approach is presented, considering the different phases of the accident up to the crash. This way, the effectiveness to

be expected can be predicted reliably. It can easily be extended to integrated safety systems so the true potential for further improvements of occupant protection can be considered.

The method starts from a characterization of the conflict and the crash situation. Taking rear-end collisions as an example, it is shown how the quantification of the effectiveness can be used for a continuous systematic development of collision mitigation systems. At first, the effectiveness of basic elements such as a collision warning, the boost of a brake intervention, an autonomous temporary braking, the response characteristics of the brake, etc. in real word accidents are determined.

In the year 2002, Daimler determined the avoidance of head-to-tail accidents by the brake assistant evaluating retrospectively data of the German Federal Office for Statistics. This former result is compared with the effectiveness of the BAS provided by the presented method. Following this, the effectiveness of the new Brake Assist Systems BAS-PLUS and PRE-SAFE-Brake offered lately in the S-Class are examined. It will be shown, that they are consistent and efficient optimization of the classical brake assistant aimed at avoiding and reducing the severity of accidents in the spectrum of real world rear-end collisions.

Reference: Fahrzeugsicherheit und Fahrerassistenz – neue Trends und Prognose ihrer Effizienz, Dr. Ziegler, Dr. Schittenhelm, Braunschweiger Verkehrskolloquium, 04. Oktober 2007, Braunschweig, DLR.