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A TEST PROGRAMME FOR ACTIVE SAFETY SYSTEMS – LATEST DEVELOPMENTS OF THE EVALUE PROJECT

Lesemann, Micha*, Lützow, Jörn, Zlocki, Adrian
RWTH Aachen University, Institut für Kraftfahrzeuge (IKA), Germany

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ABSTRACT – Active safety systems are massively implemented into new vehicle generations and offer a high potential in decreasing road accidents. While testing and rating of passive vehicle safety are based on established and accepted methods and programmes, no such are available for active vehicle safety today. Thus it is difficult to assess the performance of those systems for industry, legislation and further stakeholders. In particular, the end customer cannot judge about active safety of different vehicles based on easy-to-understand ratings as they are offered by different NCAP programmes. This leads to a relatively low awareness of active safety systems and can hinder a higher market penetration.

The main focus of the European research project "Testing and Evaluation Methods for ICT-based Safety Systems (eVALUE)" is to define objective methods for the assessment of active safety systems. These methods are based on relevant traffic scenarios that, according to investigated statistics and databases, represent the majority of accidents, where active safety systems can come into effect.

Based on these scenarios, draft test methods have been developed and lately compiled as test protocols. Intensive physical testing and application of the draft test protocols is performed in order to validate and improve the methods proposed by the consortium. Another important topic are indicators which show potential to assess the safety benefit of different active safety functions. Here, a major challenge is given by the lack of required input data, i.e. detailed accident statistics for Europe. A first set of indicators has been identified and will be validated. However, it can already be stated today that additional research beyond the scope of the eVALUE project will be required.

This new and highly needed test programme will allow first assessment of potential of the overall safety performance of a vehicle with respect to active safety systems. However, the eVALUE consortium will only define the test methods while the thresholds for the specific values are not specified. This remains the competence of every institution adopting the test methods and actually applying them in order to assess different vehicles. The later results of the programme will increase the public awareness for active safety systems and foster the development within the industry.

This paper focuses on the latest results regarding testing and evaluation methods for safety systems of the longitudinal and lateral assistance domains. A second paper (F2010-C-176) is covering details of the vehicle stability domain with its special requirements.

TECHNICAL PAPER

Modern society strongly depends on mobility, and the need for transport of both people and goods is expected to grow further in the future. Cleaner, safer and more efficient transport systems are needed. Mobility and especially road transport cause major societal problems: accidents, pollution and congestions. More than 40,000 lives are lost every year due to road accidents in the European Union only, and the costs are estimated to be about 2 % of its GDP (1).

The European Commission and its member states have made major efforts to improve traffic safety, and the results can be seen in a decreasing number of fatalities in many European countries (2). Nowadays, new ways must be found to reduce the number of fatalities and injuries even further. The public awareness of the enormous impact that active safety systems would have on road safety must be raised. It must be easy for the customer to understand the benefits of safety systems, which are based on Information and Communication Technologies (ICT).

The average car buyer cannot assess the performance of active safety systems in vehicles, nor their impact on traffic safety. Today, there are no publicly accepted test methods and no established ways to communicate the test results. The situation is quite different for passive safety systems, where test programs such as Euro NCAP (Figure 1) have established impact test methods and ways to explain the test results in different levels of detail. While the car buyers may compare star ratings for passive safety between different cars, the professional safety engineer may compare measurement data from the tests.

THE EVALUE PROJECT

The main focus of the European research project "Testing and Evaluation Methods for ICT-based Safety Systems (eVALUE)" is to define objective methods for the assessment of vehicle active safety. The methods are based on relevant traffic scenarios that, according to investigated statistics and databases, represent the majority of accidents, where active safety systems can come into effect. The project is funded under the 7th Framework Programme of the European Commission. It started in January 2008 and will close in December 2010.

As main outcome of the project, the eVALUE consortium will define the test methods focusing on the objectiveness and repeatability while rating will be up to the users of these methods. This remains at the competence of every institution adopting the test methods and actually applying them in order to assess different vehicles.

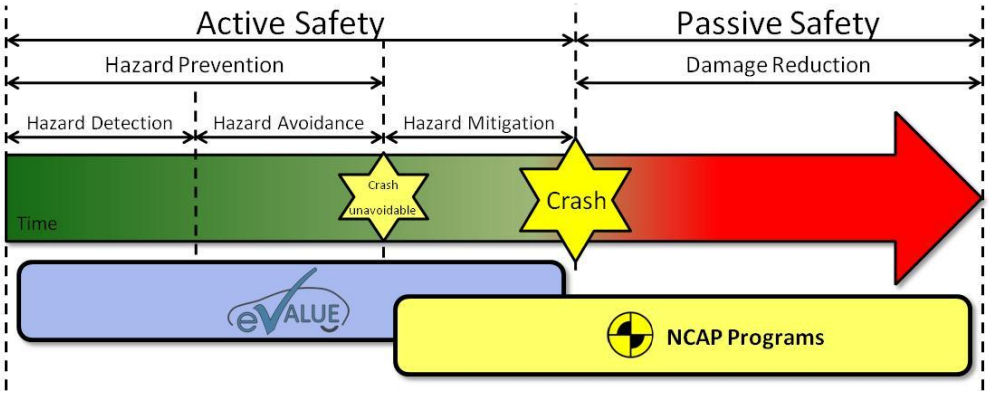

Figure 1: eVALUE in the holistic view of safety

The project consortium consists of eight partners from four European countries and is led by the Institut für Kraftfahrzeuge (ika) of RWTH Aachen University, Germany. Partners come from both research organisations and industry, including vehicle OEMs. In particular, Centro Ricerche FIAT (Italy) and Volvo Technology Corporation (Sweden) contribute as OEMs while Germany's SICK AG is a supplier of laser scanners. SP Technical Research Institute of Sweden and Swedish National Road and Transport Research Institute (VTI) are research organisations with Fundación Robotiker and Applus+ IDIADA of Spain being well-known as research and testing suppliers.

Approach

In 2007, the ASTE study (3) has investigated the feasibility of performance testing for active safety systems, where different approaches were considered. The scenario approach is directly based on traffic scenarios where the vehicle is tested as a black-box and its overall performance on those scenarios is determined. This performance is substantially affected by the properties of the vehicle itself. For instance, such vehicle properties include tire characteristics, vehicle dynamics behaviour and friction potential in road/tire contact.

According to the conclusions of the study, vehicle active safety shall be tested following the scenario-based approach. The eVALUE project is a direct follow-up of this study. Most partners are now part of the eVALUE consortium. Figure 2 gives an overview of the approach for the development of the testing and evaluation methods. Based on accident statistics, relevant scenarios have been derived that represent the majority of accidents in which active safety systems could possibly mitigate the outcome. A vehicle will be assessed by applying the procedures. Those shall be recognisable also by the end customer as critical situations that can happen at any time.

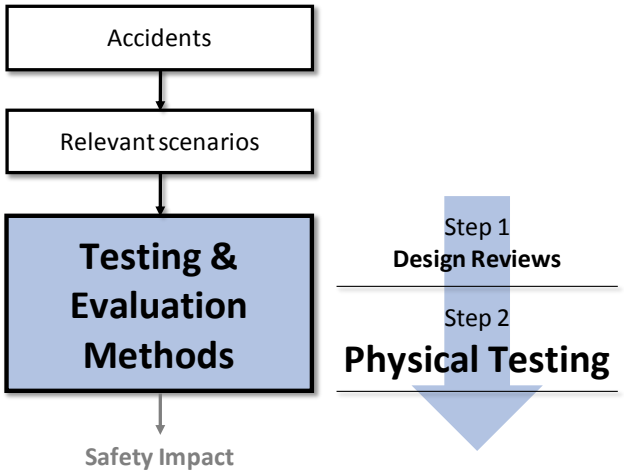

Figure 2: Scientific approach for assessment development

Considered Scenarios

The derivation of relevant scenarios and indicators from accident statistics directly has already turned out to be a challenge. No reliable accident databases are available that are capable of delivering a comprehensive analysis of accident circumstances in Europe. Thus the partners have defined relevant scenarios based on information that is available today. This includes standards for testing of certain systems, results from other projects and the expertise of the involved institutions.

Based on the different assistance domains considered, scenarios have been divided into longitudinal, lateral and stability-related domains:

Longitudinal Scenarios

For active safety functions aiming at longitudinal control, three different scenarios have been chosen. They represent a straight road, a curved road and a target, which is transversally moving in the way of the subject vehicle.

Regarding the straight road, the objective of the chosen scenario is to validate that the subject vehicle can detect and handle (warn, support, and/or intervene) a target vehicle in the same lane. The same objective applies for the scenario, however for a curved road, Figure 3.

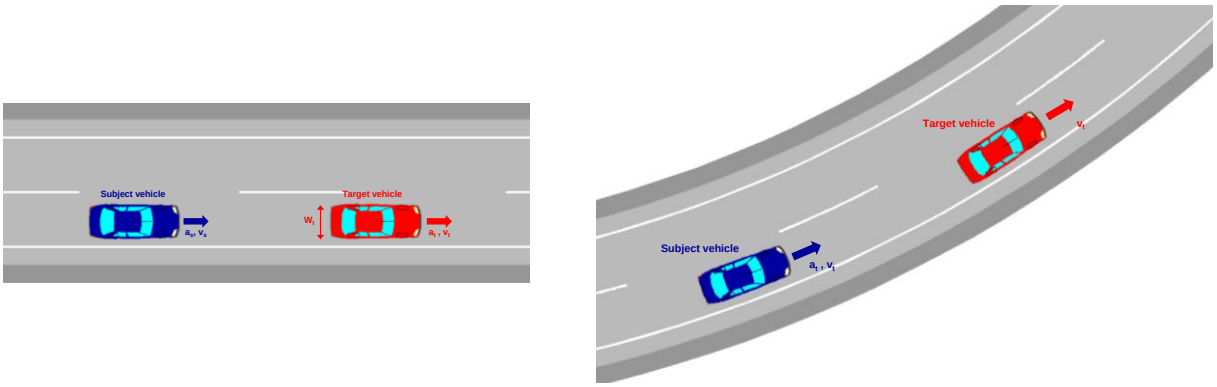

Figure 3: Straight and curved road scenarios

The objective of the third scenario is to validate that the subject vehicle can detect and handle (warn, support, and/or intervene) a target (e.g. other vehicle, pedestrians …) which moves lateral to the subject vehicle, Figure 4.

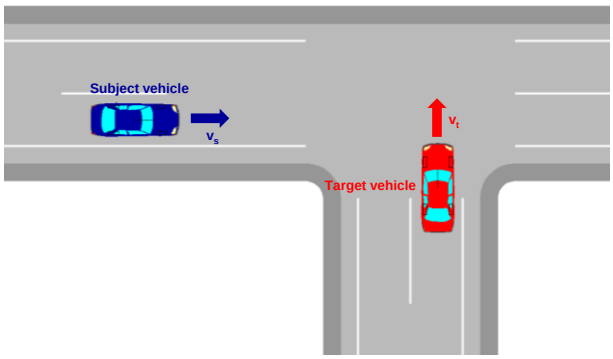

Figure 4: Transversally moving target scenario

Lateral Scenarios

The second cluster of scenarios is addressing systems which are providing lateral assistance. For straight as well as curved roads, a differentiation is made regarding lane and road departure. Accordingly, four different scenarios are considered in total.

The first scenario is meant to validate the subject vehicle capability to avoid involuntary (left/right) lane departure driving on a straight road. As a form of extension of the first scenario, the second is meant to validate the subject vehicle capability to avoid involuntary road departure driving on a straight road, Figure 5.

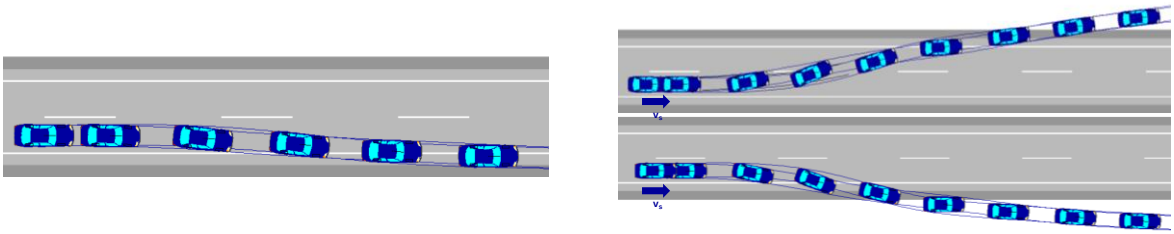

Figure 5: Lane and road departure scenarios

Comparable to the first two, the second and third scenario, which are aiming at lateral control, regard lane or road departure while the subject vehicle is driving in a curve. Again, the capability to avoid the involuntary lane or road departure is the objective here. A modification to the aforementioned is given by scenario five and six, namely to validate the subject vehicle capability to avoid involuntary lane departure driving on a straight road just before entering an upcoming curve, Figure 6.

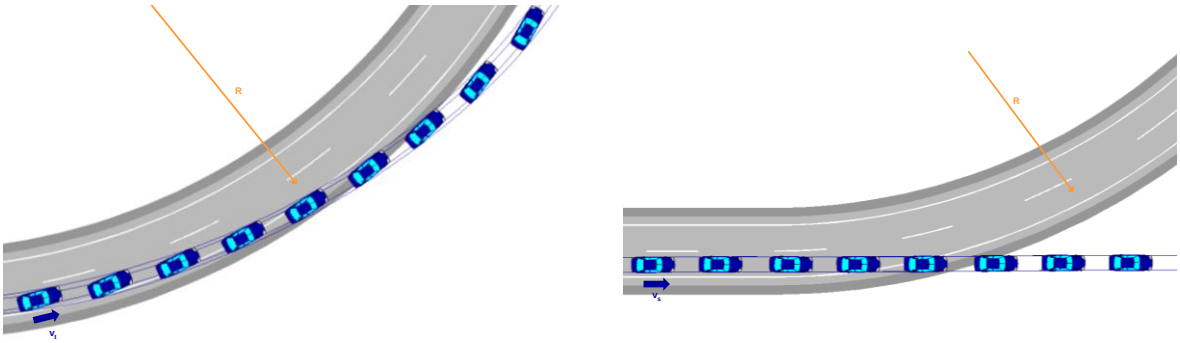

Figure 6: Lane or road departure in or before a curve scenarios

While these scenarios do not consider interaction with a second (called target) vehicle, the seventh scenario does so. It addresses lane change collisions which are well-known in multi-lane traffic both at low and high speeds, Figure 7.

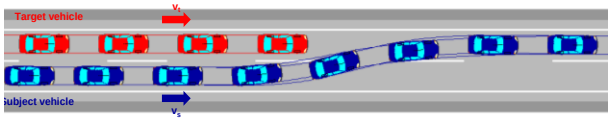

Figure 7: Lane change collision avoidance on a straight road scenario

Stability Scenarios

Yaw and stability assistance is given by systems which have been collected under the third cluster. Here, three manoeuvres have been selected which are connected to already established methods. A dedicated paper (F2010-C-176) is covering details of this domain.

Current Development and Next Steps

Having defined the scenarios, the development of the methods themselves started. The main focus here is on physical testing using vehicles in series conditions. For each of the scenarios, different draft test methods have been developed and were integrated into test protocols. Currently, they are validated by means of physical testing. A draft version of the test protocols will also be circulated to distinguished experts outside of the consortium for review. These

external reviews as well as the results of the validation tests will be used to enhance and optimise the test methods and in the end lead to the final eVALUE test protocols.

Another important topic are indicators which show potential to assess the safety benefit of different active safety functions. A first set of indicators has been identified and will be validated as far as the limited available input data, i.e. detailed accident statistics for Europe, allows this.

The final test protocols will be applied to several series vehicles in a final demonstration event which is scheduled to take place in November 2010. Invitations for this event will be sent during the summer of 2010.

CONCLUSIONS

In the development of automotive active safety systems, no generally accepted standards are available today. Manufacturers of systems, components or vehicles all need to develop their own testing procedures in order to provide both development goals and means to evaluate the system performance. Large R&D efforts are undertaken in parallel by various companies in order to provide the technological background for the development of testing procedures. Due to this situation of inhomogeneous testing practice throughout the industry, test results acquired in different manufacturer-specific tests cannot be compared by customers and authorities. Furthermore, manufacturers have no means to assess their systems in a generally accepted way.

The outcome of the eVALUE project will be explicit testing protocols for active safety systems that can found the basis for a de-facto standard whilst and after the duration of this project. In addition, communication with stakeholders that might be involved in a later standardisation process has been established to get a broad picture of currently on-going standardisation efforts towards those systems.

The project continuously generates results. Due to the production deadline, the latest findings cannot be covered by this paper but are available on the project's website under www.evalue-project.eu.

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