Dissemination of Performance Testing Methods for Active Safety Functions in Road Vehicles

Support Action

Grant Agreement Number 269904

Deliverable D2.1

First workshop summary

Confidentiality level: Public

Status: FINAL

Executive Summary

The ActiveTest initiative has the objective to disseminate performance testing methods for ICT-based safety functions in road vehicles.

Among other actions, this objective shall be fulfilled by the implementation of workshops where entities and other initiatives can present their approaches and results related active safety. When the ActiveTest initiative was set up, these workshops were defined as three two-day workshops held in Spain, Germany and Sweden with technical sessions, test demonstrations and small group meetings.

This deliverable summarizes the first workshop hold by the ActiveTest initiative. The workshop was hold by IKA in Germany on 27th and 28th September. The document includes a description of the implementation of the workshop, mainly based in the agenda of the event, a summary of the presentations and discussions, mainly based on the contribution of the attendants, and a summary of conclusions and guidelines for next workshop.

Document Name

ActiveTest-111031-D21-V02-FINAL

Version Chart

Version	Date	Comment
0.1	05.10.2011	First draft
0.2	02.11.2011	Final document

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Summary

1 Introduction

The general objective of ActiveTest is to increase road safety by supporting the introduction of ICT-based safety functions ("active safety") which allow mitigation or even avoidance of accidents.

Performance testing methods are necessary to improve the safety performance of the new safety functions in road vehicles. Performance testing will also increase the awareness of the users that ICT-based safety functions are beneficial for all road users. Several testing methods have been presented by standardization, industry and research projects. Tools are being developed to support performance testing. A forum is needed for exchange of experiences and to compare principles from in-house testing at manufacturers with the results of research initiatives in Europe and overseas. ActiveTest provides a forum independent from industry, and thus neutral ground to allow for informal discussions. The intention is to focus on testing methods and rating approaches, not to address if the safety level of a vehicle is “good” or “bad”.

At the end of the support action, there will be an established network for performance testing and a report presented on the need for future work in the area.

The ActiveTest initiative has the objective to disseminate performance testing methods for ICT-based safety functions in road vehicles by:

- demonstrating performance testing of ICT-based safety functions
- disseminating the test programme developed in the eVALUE research project
- establishing an active dialogue with key stakeholder groups
- compiling an outlook for future research need
- contacting standardisation organisations for road vehicles with research results
- creating awareness of the need of standardised performance testing of ICT-based safety functions

Among other actions, these objectives shall be fulfilled by the implementation of workshops where entities and other initiatives can present their approaches and results related active safety. When the ActiveTest initiative was set up, these workshops were defined: three two-day workshops held in Spain, Germany and Sweden with technical sessions, test demonstrations and small group meetings.

This deliverable summarizes the first workshop held by the ActiveTest initiative. The workshop was hold at IKA in Germany on the 27th and 28th of September. The document includes a description of the implementation of the workshop, mainly based in the agenda of the event, a summary of the presentations and discussions, mainly based on the contribution of the attendants, and a summary of conclusions and guidelines for next workshop.

2 Implementation of the workshop

This first workshop of the ActiveTest initiative has been dedicated to Collision Warning and Autonomous Emergency Braking systems. This corresponds to the ‘cluster 1 – longitudinal assistance’ defined by the eVALUE project. The other clusters defined by the eVALUE project include ‘cluster 2 – lateral assistance’, which include among others Lane Keeping Assistance or Blind Spot Monitoring, and ‘cluster 3 – stability assistance’, which include among others ABS and Electronic Stability Control.

2.1 Motivation of the workshop

The first workshop of the ActiveTest initiative has been dedicated to longitudinal assistance systems because these systems have been identified as the priority of active safety for the automotive industry, consumer organisations and regulatory bodies.

Currently, some American, Asian and European OEMs have started to provide driver assistance systems which fall under the definition of longitudinal assistance systems. This is not only the case of premium OEMs; these systems start to be offered under the C and D segments. Among others, in Europe, these systems can be fitted in Audi (A8, A7), BMW (1, 5, 7 series), Ford (Focus, S-Max), Honda (Accord, Legend), Lexus (LS, IS, GS, RX), Mercedes-Benz (S-Class, E-class), Toyota (Prius), Volkswagen (Passat CC, Touareg) and Volvo (S80, XC/V70, S/V60 and XC60).

In parallel to the appearance of these systems into the market, consumer testing organisations, manufacturers, engineering companies and research centres are interested in the development of test and assessment methodologies allowing the evaluation of the safety level that these systems bring to the users.

It is accepted that a key aspect for the success of these systems and the improvement of safety is the information to the consumer. With this objective, Euro NCAP started in 2010 an awarding campaign to those OEMs which fitted driver assistance systems and demonstrated the safety benefit of them. Information on the vehicles awarded can be found in the reference [ENCAP2010]. These awards are open to any technology fitted in a vehicle with the aim of improving safety. The award mechanism is based on the assessment of a report done by the OEM where the innovation, safety issue, accident mechanism, target requirements, test protocol, validation and real world evaluation have to be justified. It is important to remark the main characteristics of these awards:

- they are open to any new safety system fitted in a vehicle evaluated by Euro NCAP under the regular assessment
- they are based on the documentation delivered by the OEM

Of course, this practise has a positive effect, because through the award, consumers can get information of new safety systems. But, the main issue of this process is that the consumer does not get a comparison among different systems, which is the final objective of consumer organisations. This justifies the need of having test and evaluation methods for longitudinal assistance systems, Collision Warning and Autonomous Emergency Braking systems in particular.

In order to give an answer to this need, several public or private initiatives have been started. This is the case of the following projects: ADAC (private initiative lead by ADAC [ADAC2011]), AEB (private initiative lead by Thatcham [AEB2011]), AsPeCSS (FP7 project, lead by IDIADA [AsP2011]), ASSESS (FP7 funded project, lead by Humanetics [ASS2011]), interactIVe (FP7 funded project, lead by Ford [int2011]) and vFSS (private initiative, lead by DEKRA [vFSS2011]). Additional references to these projects can be found in the chapter of technical content of the workshop.

The objective of this first workshop is:

- To bring together all the initiatives addressing longitudinal assistance systems
- To allow other entities not participating in these initiatives have direct contact with them
- To define the next research steps for having comprehensive test and assessment methods for Collision Warning and Autonomous Emergency Braking systems

2.2 Structure of the workshop

The workshop has been divided into five sessions:

Session I – Introduction and Initiatives
This is the introductory session, where the organizers and attendants presented themselves. The main initiatives (ADAC, AEB, AsPeCSS, ASSESS, interactIVe and vFSS) had between 20 and 30 minutes to present their objectives, approach and status.

The objective of this session is to have a first contact between the initiatives and the attendants. After this session, lunch was served, in order to allow first discussions.

Session II – Scenarios Discussion
Scenarios to test the Collision Warning and Autonomous Emergency Braking systems is one of the main issues to agree on. These scenarios need to be representative of the accidents that take place in the real world and need to be balanced according to their relevance. It is also important to define test scenarios which are reproducible and repeatable. For this reason, a special emphasis on the test houses and proving grounds was also done.

The objective of this session was to present the scenarios proposed by the initiatives and find similarities and differences, as well as to present the feasibility of implementing them in current test facilities.

Session III – Test Targets
Test targets are also a main issue to agree on. This is comparable to crash test dummies used in passive safety. There is a need of having a standardised test target which represents a vehicle to the RADARS, LIDARS and cameras used in the safety systems. When they be-

come standard, they can be used as a reference for developing systems according a certain pattern and for later validating them with a standard tool.

Some test houses and engineering companies showed the test targets they had developed, while some OEMs indicated the requirements for having a representative tool.

The day ended with a visit to different test targets and propulsion systems and joint dinner in the city centre of Aachen. These two activities enhanced additional discussions among the attendants.

Session IV – Physical Testing
The second day started in the proving grounds of IKA in Aldenhoven. The test targets showed at the end of the session of last day were tested with different vehicles.

The objective of this session was to show current testing capabilities, the behaviour of the test targets in the field and the performance of different vehicles fitted with Collision Warning and Autonomous Emergency Braking systems.

Session V – Overall Assessment
Overall assessment was the closing session of the workshop. The objective was to have a final discussion on how to assess the systems, once they have been tested. This might be very sensitive, because it is complex to define what should be more safe and what less safe for systems which just have started to be in the market. The tuning of most of these systems is defined by the OEM according to their branding image and this should not be influenced by a rigid assessment.

For this reasons, the session was oriented to address additional aspects of Collision Warning and Autonomous Emergency Braking systems. In addition to performance in proving grounds (active safety), behavioural aspects (HMI) and combination of these systems with the restraint systems (passive safety) were proposed as topics of discussion. There was also a final presentation showing the future of the regulatory frame of these longitudinal assistance systems.

2.3 Agenda of the workshop

This chapter describes the agenda of the 2 days workshop, according to the structure defined in the previous chapter. Sessions and presentations with speakers and companies are detailed.

27 September 2011

Session I – Introduction and Initiatives

10:00	Welcome by the workshop host *Lutz Eckstein, ika*
10:05	Role call
10:20	ActiveTest welcome and introduction

	Jan Jacobson, SP
10:30	ADAC *Dino Silvestro, ADAC*
11:00	AEB *Mats Petersson, Volvo Cars*
11:30	ASSESS *Andrés Aparicio, IDIADA*
12:00	vFSS *Heiko Schebdat, Opel*
12:30	interactIVe (subproject Evaluation) *Felix Fahrenkrog, ika*
13:00	AsPeCSS *Mario Nombela, IDIADA*
13:20	*Lunch*

Session II – Scenarios Discussion

14:30	Longitudinal test scenarios – What test track will be required? *Anders Axelsson, Volvo Cars*
15:00	Potential results of AEB systems in rear end scenarios *Carmen Rodarius, TNO*
15:20	Round table discussion
15:50	*Coffee Break*

Session III – Test Targets

16:10	System requirements *Maminirina Ranovona, Toyota*
16:40	Test target and propulsion systems presentations/display *ABD, ADAC, ASSESS, BASt, Bertrandt, EVITA*
18:15	Closure of first day *Jan Jacobson, SP*
20:00	***Joint Dinner***

28 September 2011

Session IV – Physical Testing

08:30	Pick-up of participants at ika, bus transfer to Aldenhoven
09:00	Demo on test implementation *ASSESS/BASt, ADAC, Bertrandt, EVITA*
11:00	Bus transfer back to ika
11:30	*Coffee break*

Session V – Overall Assessment

12:00	Behavioural aspects *Paul Lemmen, Humanetics*
12:30	Influences of active safety on crash assessment *Alois Seewald, TRW*

13:00 *Lunch*

14:30 Regulatory situation of Advanced Emergency Braking Systems
Kai Frederik Zastrow, PSA

15:00 Final discussions and conclusions

16:00 Closure of the meeting
Jan Jacobson, SP

2.4 Implementation of the workshop

This workshop represents the first of the three two-day workshops which will be implemented inside the ActiveTest initiative. It was organized by IKA, with support of the other partners: SP and IDIADA.

The workshop was defined with the collaboration of the three partners. The scope of the workshop, the sessions, content of the sessions and the agenda was agreed among all the partners. Possible attendants and speakers were proposed by the three partners as well.

IKA took the responsibility of implementing this first workshop at its facilities in Aachen. All the logistics, including hotels proposal, catering services, bus services, rooms and proving ground reservations were arranged by IKA.

The workshop was implemented successfully. The agenda was fulfilled according to the schedule defined. All the speakers made their presentations and gave the audience relevant content. Interesting discussions were arisen, always with the objective of having success in the development of new test and assessment methods for Collision Warning and Autonomous Emergency Braking systems.

3 Technical contents of the first workshop

As was described in the previous chapter, there were five technical sessions during the workshop. A wide range of presentations were complemented by static and dynamic displays of test targets and propulsion systems as well as a couple of round table discussions.

3.1 Session I – Initiatives

During the first session, six initiatives/research projects presented their activities related to performance testing of longitudinal active safety systems, i.e. warning and automatic brake systems for detection of other vehicles, pedestrians and two-wheelers.

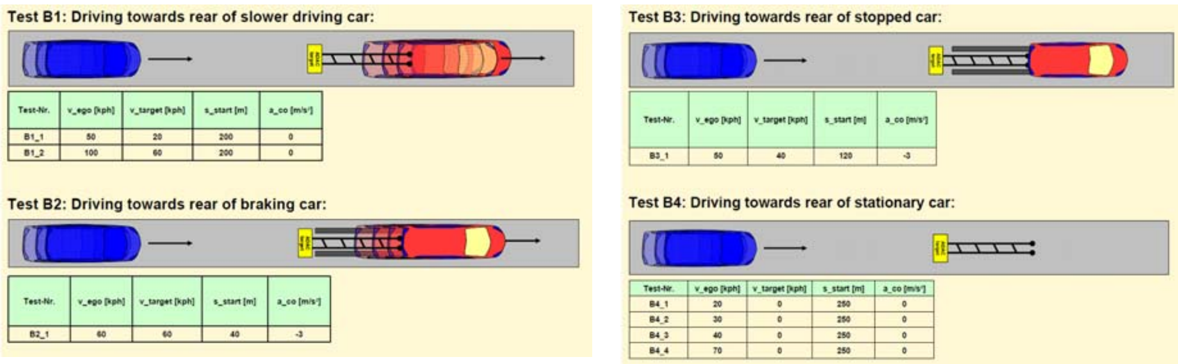
3.1.1 ADAC

Mr. Dino Silvestro from ADAC (Allgemeiner Deutscher Automobil-Club) presented their test procedure for advanced emergency braking systems (AEBSs) [ADAC2011b]. The goals of the ADAC test procedure are to give advice to consumers regarding the effectiveness of AEBS, and encourage the development of AEBS. To accomplish these goals, it has been necessary to develop a target (which shall be movable), develop a simple measuring system for speed and distance, and define standardized test scenarios. The focus of the test procedures will be on warning and braking strategies. ADAC has observed that the main causes of rear-end accident causes include:

- Faulty judgement of approach speed
- Short distance to vehicles in front
- Driver distractions

Details on the requirements and design of the ADAC target are presented in Section 3.3.2.2. In order to measure all required data, a GPS data logger with video cameras and a microphone was used. Additionally a radar sensor was used to measure headway, and a tape switch to record the collision instant.

The ADAC test procedure defines 4 base test scenarios shown in Figure 1 below. In some of these scenarios there are different combinations of the ego and target car speeds.



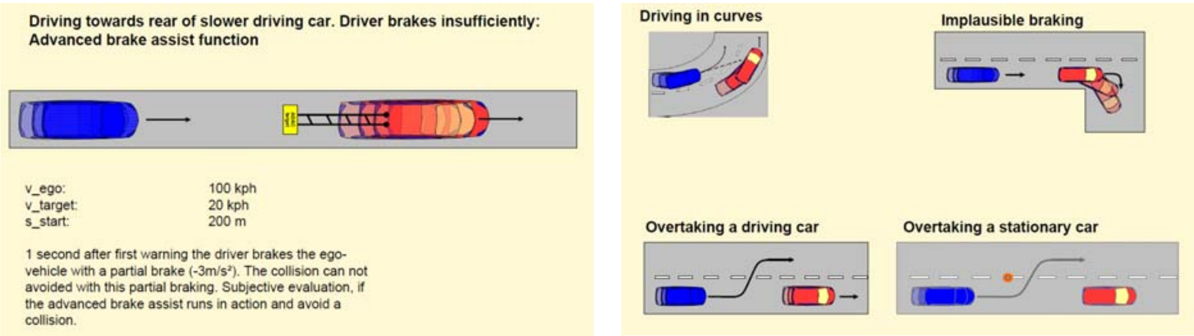
(a) (b)

Figure 1 The four main test scenarios of the ADAC test procedure

During these test scenarios, the driver is passive, and the goal is to record and evaluate the warning strategy as well as measure the speed reduction. According to ADAC, a good warning strategy shall include at least two of the following warning types:

- optical (e.g. in windscreen)
- audible (laud and clear)
- haptic (e.g. brake jerk or partial braking)

ADAC also proposes a rating where 80% of the points are achieved from the speed reduction and time of first warning. The remaining 20% of the points are the result from an evaluation of the warning strategy and the perceptibility of the warnings. Bonuses can be achieved by having a brake assist functionality and produce a low number of false alarms. The bonuses are determined by performing the extra test scenarios presented in Figure 2 below.



(a) (b)

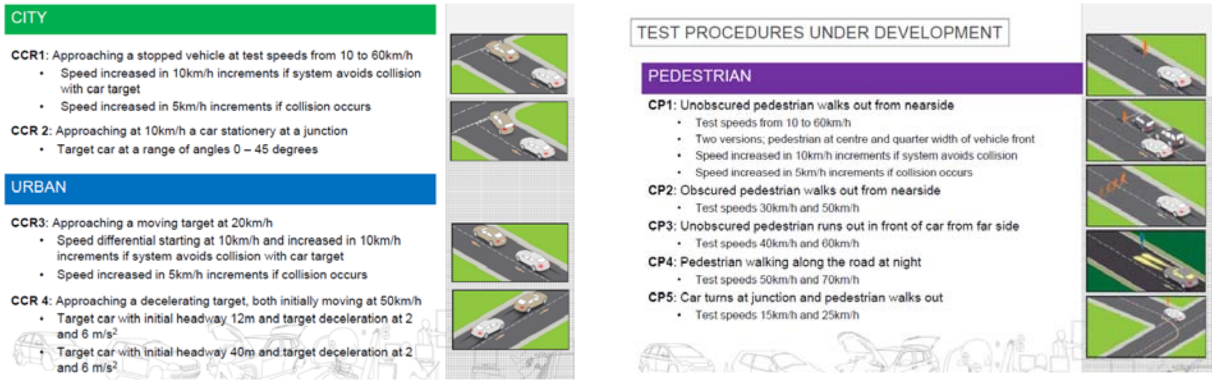
Figure 2 The brake assist (a) and false alarm (b) test scenarios of the ADAC test procedure

ADAC has made a test programme where their target and test procedure were used. Six different AEBS equipped cars were tested and the report [ADAC2011a] shows that it was possible to differentiate the performance of different cars.

3.1.2 AEB

Mr. Mats Petersson from Volvo Car Corporation was acting as stand-in for Mr. M. Avery (Thatcham) during the presentation of the AEB (Autonomous Emergency Braking) initiative [AEB2011]. Besides Thatcham, the members of AEB are insurance companies, OEMs, Tier1 suppliers and Loughborough University.

The objective of the AEB initiative is to “design and implement test procedures reflecting real world data that can encourage the development of autonomous braking technology that can help prevent or mitigate the effects of car-to-pedestrian and car-to-car crashes”. To succeed, it is necessary to define scenarios, measurement equipment as well as test metrics and a rating process. AEB defines three types of crashes: city, urban and pedestrian, where the former is high in volume and the two latter in injury risk. The proposed scenarios are shown in Figure 3. Targets and test procedures have been evaluated using commercially available AEBSs having different sensing techniques (stereo camera, camera-radar fusion, radar fusion, lidar and radar).



(a) (b)

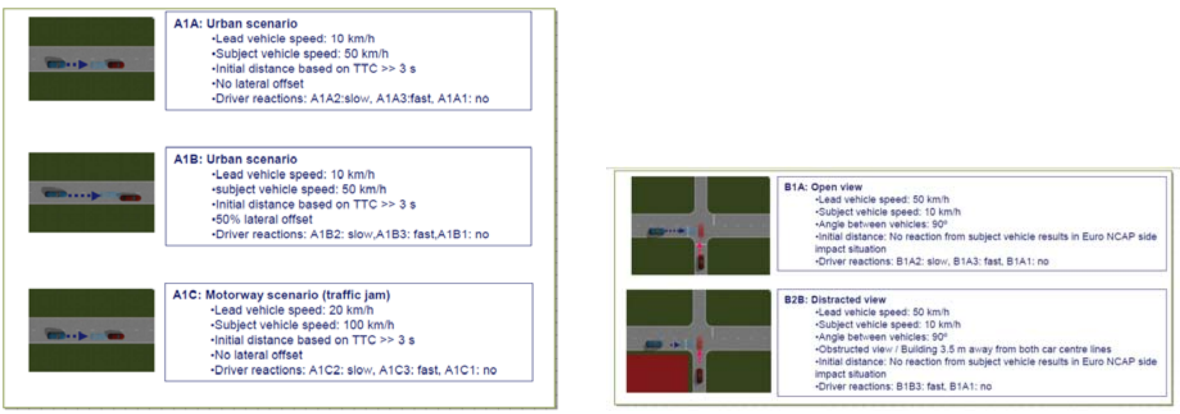
Figure 3 Car-to-car (a) and car-to-pedestrian (b) test scenarios proposed by AEB

AEB has made a proposal for a scoring of the performance in a specific test scenario. The scoring is a combination of avoidance and mitigation points where the avoidance points have the greater impact of the two.

AEB has also made an estimation on the potential crash savings that would be possible if AEB systems are fit at the same rate as ESC was. The result is that the number of crashes could be reduced by 800.000 during the period 2012 – 2018.

3.1.3 ASSESS

Mr. Andrés Aparicio from IDIADA presented [ASS2011a] the ASSESS project, which is a EU FP7 project. The main objective of the ASSESS project is to "develop harmonised assessment procedures and related tools for integrated safety systems". In ASSESS the focus is on longitudinal active safety systems. Driver behavior, pre-crash system performance and crash performance shall be evaluated and socio-economic implications assessed. Based on analysis of accident data from Germany, France, Austria and Sweden, a number of base rear-end and junction scenarios were identified as most relevant from a frequency and injury cost point of view. Examples of selected rear-end and junction scenarios are shown in Figure 4.



(a) (b)

Figure 4 Examples of rear-end (a) and junction (b) scenarios selected by ASSESS

As can be seen in the figure, each scenario shall be performed with different driver reactions (no, slow and fast). To be able to quantify these reactions, driver behaviour has been studied both in simulators and on test tracks. This issue was discussed in detail in the driver aspects presentation (see Section 3.5.1).

One of the main tasks in the ASSESS project is to specify and design a standardized test target object. The target, ASSESSOR, is presented in Section 3.3.2.3.

In terms of crash evaluation, ASSESS will provide tools and methods to efficiently evaluate injury risks in the case when active safety systems are present in the vehicle. The pre-crash safety systems, will affect the impact conditions, e.g. due to pre-crash braking, and the efficiency of passive systems, e.g. due to earlier activation of restraint systems.

3.1.4 vFSS

Mr. Heike Schebdat from Opel presented the German vFSS (Advanced Forward-Looking Safety Systems) initiative [vFSS2011]. The objective of the vFSS initiative is to “develop test procedures for driver assistance systems (in particular advanced emergency braking systems) in order to ensure a robust assessment of such systems”.

Analysis of accident data (from GIDAS) has shown that nearly 75% of accidents involving pedestrian are due to road crossings. vFSS has proposed the test scenarios in Figure 5.

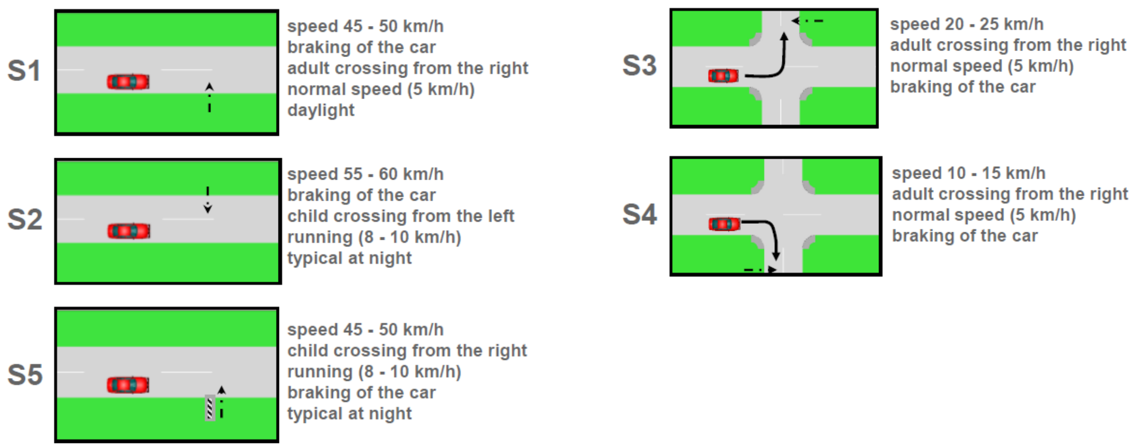
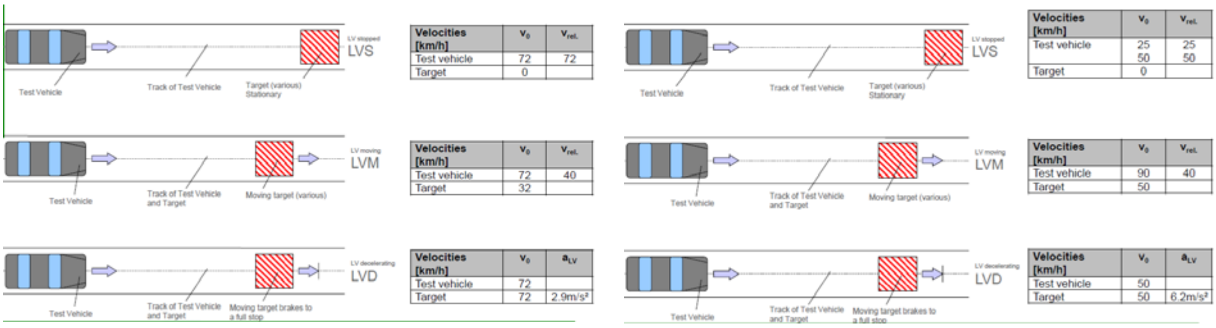


Figure 5 Proposed pedestrian test scenarios by vFSS

To be able to perform these scenarios, test equipment has been designed. A ropeway is used to move a dummy across the road. The movement is initiated when a photoelectric is interrupted, and the dummy is pulled up (out of harm’s way) by a spring when a second beam is interrupted.

Test scenarios have also been proposed for assessment of FCW and AEB systems with respect to vehicle targets. These scenarios are shown in Figure 6.



(a) (b)

Figure 6 Proposed FCW (a) and AEB (b) test scenarios by vFSS

Several test sessions have been performed in order to evaluate different static and moving target systems for these test scenarios. Three target systems have been selected for further optimization.

vFSS has identified the need for collaboration and three harmonization platforms have been set-up between the ASSESS, AEB and VFSS projects. The focus areas of these platforms are scenario definition, target development and effectiveness evaluation.

3.1.5 interavtIVe (subproject Evaluation)

Mr. Felix Fahrenkrog from ika presented subproject, SP7, “Evaluation and legal aspects” [int2011] which is part of the EU FP7 interactIVe project. Part of the interactive vision is “active safety systems in all vehicles”, and one relevant project objective is to “further encourage the application of standard methodologies for the evaluation of ADAS.

SP7 is a horizontal subproject within interactIVe and its role is:

- Definition of a test and evaluation framework for each application with respect to human factors and technical performance
- Development of test scenarios, procedures, and evaluation methods
- Provision of tools for evaluation like equipment, test catalogues, questionnaires or software and support for testing
- Definition of test and evaluation criteria
- Analysis of legal aspects for broad exploitation of the applications

Evaluation is divided onto technical, user-related and impact assessments. The assessments are performed for whole functions ant not components. The evaluation methodology is mainly based on the one of the PReVAL project. In the technical assessment, the technical performance is assessed (e.g. performance and safety logic). During the user-related assessment, driver behavior, function usage and trust/acceptance are evaluated. The change in traffic safety with respect to the number of fatalities and reduction of the severity of injuries is assessed in the impact assessment. Some of the challenges faced by SP7:

- Reduction of the vast amount of test cases (prioritization needed)
- Limited time and resources for testing

- Interaction between the function and the driver

The assessment methodology will be described in the SP7 deliverable D7.4 “Test and evaluation plans”.

3.1.6 AsPeCSS

Mr. Mario Nombela from IDIADA presented the AsPeCSS research project [AsP2011]. AsPeCSS, which is a sister project to ASSESS, is an EU FP7 project. The AsPeCSS project was recently started (September 2011). As a consequence, no results could be presented but rather objectives and the project structure. The main goal of the project is to “develop harmonised test and assessment procedures (and related tools) for the assessment of integrated pedestrian safety systems**.** There are work packages dealing with a methodology for assessment, a technology-independent test procedure and an injury assessment.

3.2 Session II – Scenarios Discussion

The second session was focused on requirements on test tracks with respect to longitudinal scenarios, and a simulation study which analysed the criticality (in terms of expected impact speed) of different test scenarios. The session ended with a round table discussion where e.g. the harmonization of test scenarios was brought up.

3.2.1 Longitudinal Test Scenarios – Test Track Needs

Anders Axelsson from Volvo Cars Corporation presented a specification of a tentative test track in Sweden for active safety testing. Among the interesting track parts were a city environment (several blocks) and vehicle dynamics area with three entrances where two of them facilitate acceleration of commercial vehicles up to highway speeds. As a consequence high-speed on-coming scenarios can be performed on this track. A country road track with a hidden entrance from the outside “real world” was also specified.

3.2.2 Potential Results of AEB Systems in Rear-End Scenarios

Carmen Rodarius from TNO presented Matlab simulation results performed within the ASSESS project in order to evaluate which test scenarios that are most critical (i.e. are likely to cause the highest impact speed) [ASS2011b]. All rear-end scenarios defined by the ASSESS project, except those with a partial lateral overlap, have been simulated. Publically available information regarding the performance (warning and intervention timing as well as brake levels (decelerations)) of the Daimler FCW/AEB system was used. Driver behaviour data (e.g. typical reaction times) was achieved from the corresponding ASSESS study, see Section 3.5.1. Some variability (noise) is added to the simulated speeds and decelerations. The simulation study gives as result a recommendation to the order (increased expected impact speed) that test scenarios shall be performed.

3.2.3 Round Table Discussion

There were some interesting discussions triggered. One was the difference between commercial vehicles and cars with respect to scenarios and test targets. The former ones could be the same, but targets developed for testing of cars may not be suitable for trucks (e.g. outriggers on the support vehicle is too low). The upcoming regulation on AEB for trucks and buses were discussed. Harmonized testing FCW/AEB procedures for cars in Europe were expected, and for FCW it is already in place in the US. Detection of two-wheelers is not prioritized since from an accident statistics view they have low representation. At the end there was a discussion on definition and semantics of false alarms and the need for driver models. The term false alarm is a bit vague. Maybe terms such as false positives and nuisance alarms are better and more descriptive. The need for more drive behaviour research was identified. Especially to understand how drivers react to different warnings and interventions.

3.3 Session III – Test Targets

The third and last session of the first day was dedicated to test target specifications, designs and a static display of existing targets.

3.3.1 System requirements

Mr. Maminirina Ranovona from Toyota presented the requirements on a rear-end target from a millimetre radar sensor detection point of view. Measurements were made to compare the reflection from the target and that of a real car (Toyota Yaris). Horizontal and vertical rounding of the shape were identified as a key property in order to get similar reflections. The vertical rounding is necessary to compensate for pitch movement of the sensor. However, despite the improved shape, there are still some discrepancies at 70 m distance.

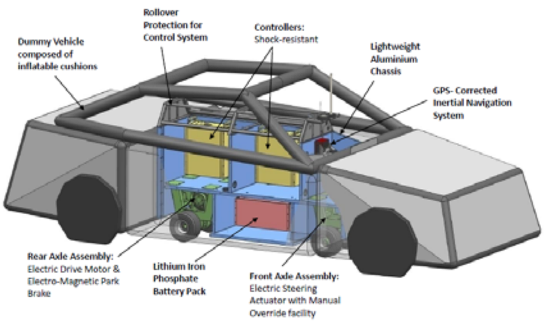
3.3.2 Test Targets and Propulsion Systems Presentations and Static Display

During this session, all target or propulsion system providers were given a short time slot during which they could present their design choices and the capabilities of the targets. Following that there was an outdoor static display (Figure 7) where the workshop participants could get “hands-on” experience of the targets as well as pose detailed questions to the designers.

Figure 7 Static display of test targets and propulsion systems

3.3.2.1 ABD – Soft Crash Vehicle

Mr. Andrew Pick presented the soft crash car from ABD (Anthony Best Dynamics) [ABD2011]. The target uses a 250 kg drive box for self propulsion and self navigation (position and speed). To protect the test vehicle and the drive box, the drive box is surrounded by inflatable cushions. The target has a top speed of ca 65 km/h, can brake with up to 0.5g and withstand impacts of up to 50g. The robot can be remotely controlled or have its motion synchronized with those of robot controlled vehicles. The soft crash target is shown in Figure 8.



(a)

(b)

Figure 8 Cut-away view (a) and outside view of the soft crash target

3.3.2.2 ADAC

Mr Dino Silvestro presented the target(s) designed and used by ADAC [ADAC2011b]. The ADAC target is towed by a support vehicle, which also is used to transport the target to/from the test site. Two generations of the target exist (see Figure 9 and Figure 10). The first generation was a bit overdesigned from a radar reflection aspect. The maximum impact speed was also raised from 40 km/h to 50 km/h in the second generation.

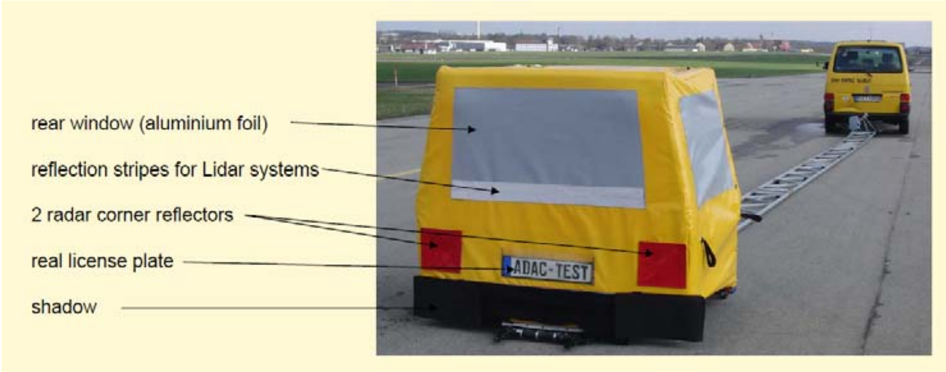


Figure 9 ADAC Target, first generation

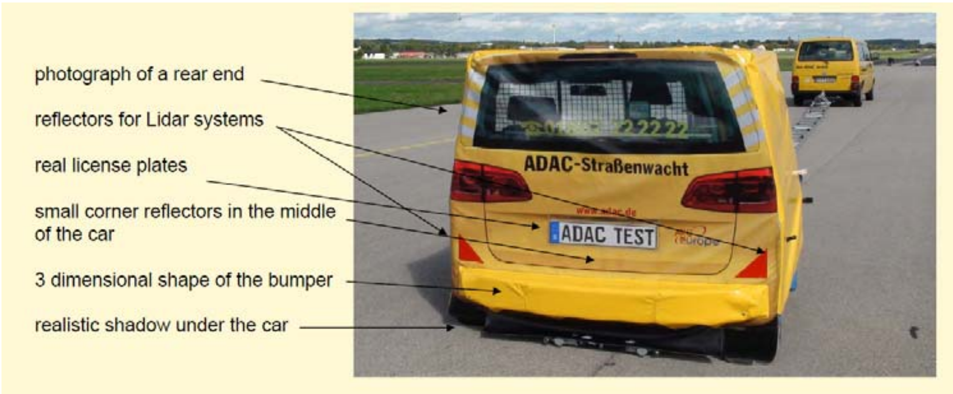


Figure 10 ADAC Target, second generation

3.3.2.3 ASSESS - ASSESSOR

Mr. Andrés Aparicio presented the test target of the ASSESS project, the ASSESSOR [ASS2011c]. The ASSESSOR consists of a number of vented boxes stabilized by air filled tubes. The 90 kg target can be used with different propulsion systems and its goal is to mimic the geometry and physical characteristics of a common mid-sized European car (e.g. Opel Astra). A lot of work has been spent on measuring and tuning the 360 degree radar cross section. The ASSESSOR is crash forgiving up to 50 km/h; above that, front-end damage to the test vehicle can be expected. The ASSESSOR is shown in Figure 11.

(a)

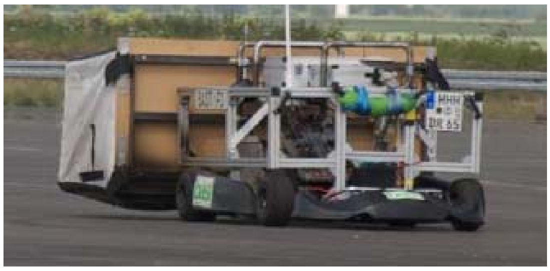
(b)

Figure 11 The ASSESSOR, standalone (a) and rear part mounted on propulsion system (b)

3.3.2.4 BASt – Marvin

The Marvin target propulsion system from BASt [BAS2011] weighs 250 kg when a soft crash target is mounted. A two-stroke 125 cc motor is used for propulsion, and the top speed is larger than 70 km/h. With a soft target, it is crash forgiving up to 40 km/h. The deceleration (up to 7 m/s^2) and lateral position is manually controlled by an operator. The velocity on the other hand is controlled by an on-board cruise controller and an on-board DGPS with IMU. The Marvin propulsion system is shown in Figure 12.

(a)



(b)

Figure 12 The Marvin propulsion system, without (a) and with (b) rear-end target

3.3.2.5 Bertrandt – b.rabbit

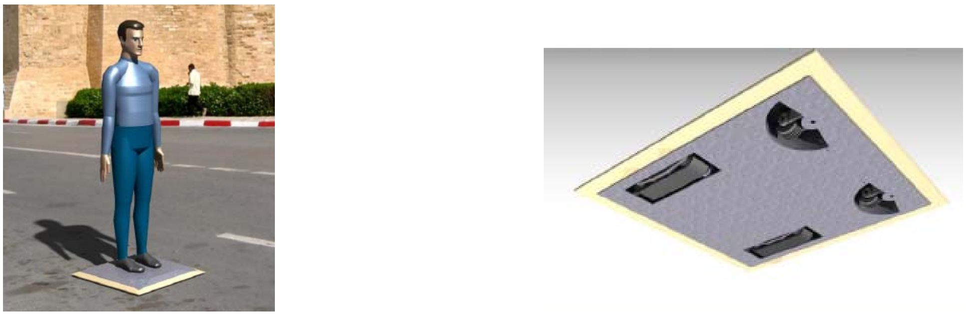
Mr. Kai Golowko from Bertrand Ingenieurbüro presented the b.rabbit target [Ber2011]. The target consists of a kart-based chassis and a rubber foam rear for impact absorption. The b.rabbit is pulled by a towing a vehicle and when released the steering, and braking can be remotely controlled. Fully functional brake lights are available on the naturalistic rear view. The b.rabbit is shown in Figure 13.

(a) (b)

Figure 13 Front (a) and rear (b) view of the b.rabbit target

3.3.2.6 AEDesign –AVCASS

Mr Zaafir Waheed from AEDesign presented the AVCASS pedestrian target [AED2011]. An overrunnable undercarriage carries and moves the pedestrian target. The AVCASS moves and steers using twin rubber tracks, and has autonomous control with inertial navigation and GPS guidance. The AVCASS (Figure 14) weighs 15 kg and has a top speed 30 km/h.



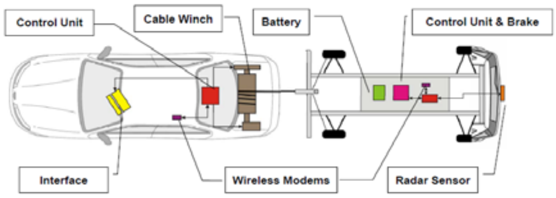
(a) (b)

Figure 14 Front (a) and worm's eye (b) views of the AVCASS target

3.3.2.7 EVITA

Mr. Alexander Weitzel from TU Darmstadt presented the EVITA target [TUD2011]. The EVITA (Experimental Vehicle for Unexpected Target Approach) target is linked to the tow car by cable and winch. Maximum speed is 100 km/h and the deceleration is adjustable up to 9 m/s^2. The test vehicle is not supposed to crash with the EVITA target; the target is equipped with a RADAR distance sensor, and if the test vehicle gets too close, the target is pulled away using the winch. The EVITA target (Figure 15) has real brake lights as well as distance indication lights to guide the driver of the test vehicle to the correct relative position.

(a)



(b)

Figure 15 The EVITA target (a) and its design (b)

3.4 Session IV – Physical Testing

The fourth session was dedicated to a dynamic display of targets and propulsion systems at the Aldenhoven test track.

3.4.1 Dynamic Display of Test Targets and Propulsion Systems

Four test targets/propulsion systems were demonstrated during the dynamic display:

- BASt Marvin-ASSESSOR combination, Figure 16 (a)
- ADAC generation 2, Figure 16 (b) and (c)
- EVITA, Figure 16 (d)
- Bertrand b.rabbit, Figure 16 (e) and (f)

Two test vehicles were used in the demonstrations, one Volvo XC60 with City Safety and one VW Passat CC with a research FCW/AEB system. Due to restrictions of the test vehicles and their systems, only low speed activations (< 20 km/h) and collisions (< 30 km/h) were demonstrated, The EVITA target was demonstrated at a higher speed, since it is inherently collision free.

(a)

(b)

(c)

(d)

(e)

(f)

Figure 16 The BASt-ASSESSOR (a), ADAC (b) and (c), EVITA (d), and b.rabbit (e) and (f)

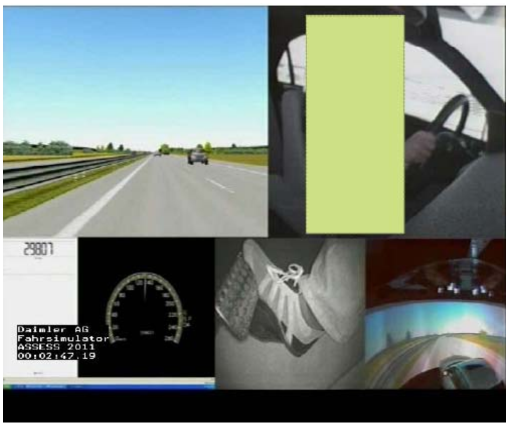
Some videos of the demonstrations can be viewed at the homepage of ActiveTest [ACT2011].

3.5 Session V – Overall Assessment

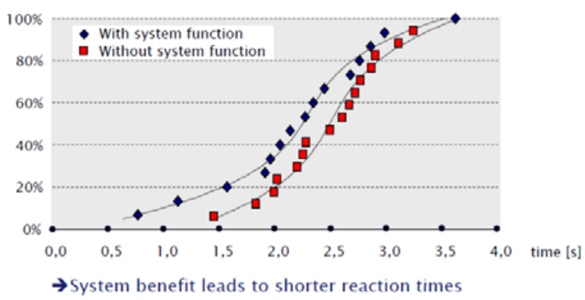
The final session included three presentations related to overall assessment (driver models, integrated safety and regulatory situation) as well as a final discussion.

3.5.1 Behavioural Aspects

Mr. Paul Lemmen from Humanetics presented the ASSESS work on studying driver behaviour [ASS2011d]. Two driving simulators (Daimler (Figure 17 (a)) and Toyota) were used for the study. Additionally field experiments were performed at the IDAIADA proving ground. A rear-end scenario where a vehicle in front starts to brake was used in all three experiment set-up. However there were some environmental and speed differences at the different sites. Right before the target started to brake, the driver was supposed to be distracted by a secondary task. A conclusion was that it is easier to distract the driver in the simulator compared to on the proving ground. A benefit in a reduced reaction time was observed (Figure 17 (b)); unfortunately an expectation effect was observed already at the second manoeuvre.



(a)



(b)

Figure 17 Example of log data (a) from Daimler simulator, and example of results (b),Toyota

3.5.2 Influences of Active Safety on Crash Assessment

Mr. Alois Sweewald from TRW gave a presentation on active passive safety integration [TRW2011]. One important enabler is the possibility of sharing sensor data and sensor fusion. The performance of passive restraint systems can be improved if sensor data from active safety functions becomes available. As an example, during an automatic braking manoeuvre, the driver position is not optimal. Using the data from the AEB system makes it possible to use pretensioning of the seat belt and as a consequence the out-of-position can be reduced. The out-of-position can also be reduced in e.g. curve combinations by having predictive belt functions based on GPS position data and a map with road curvature.

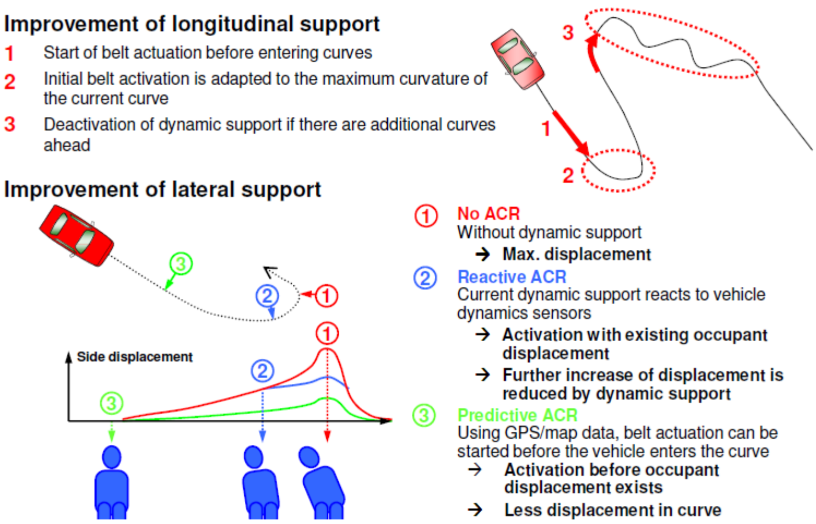


Figure 18 Description of GPS/map-based belt pretentioning, TRW

3.5.3 Regulatory Situation of Advanced Emergency Braking Systems

Mr. Kai Frederik Zastrow from PSA presented the regulatory situation of advanced emergency braking systems [PSA2011]. Type approval of a motor vehicle equipped with an AEBS is already possible today. The AEBS is considered to be a complex electronic vehicle control system and must comply with UNECE 13H Annex 8 or UNECE 13 Annex 18. It is possible to make an interpretation of the Vienna Convention which allows the AEBS to take control from the driver during certain circumstances (i.e. it is impossible for the driver to prevent a collision by his/her own actions). In November this year, a UNECE regulation on AEBS will be adopted for commercial vehicle > 8 t, buses and coaches. Among the general requirements are:

- ABS Anti-lock Braking System
- At least two warning modes out of haptic, acoustic and optical
- Warning phase followed by emergency braking phase ($a \geq 4$ m/s²)
- Possibility to override the system
- Warning in the case of system deactivation or failure
- Target: high volume series production passenger car of category M1 AA saloon or object representative of such a vehicle

There are also a number of performance requirements:

- Warning
  - First warning mode: at least 1.4s before emergency braking phase
  - Second warning mode: at least 0.8s before emergency braking phase
- Braking on stationary target
  - Automatic speed reduction: from 80 to 70 km/h
- Braking on moving target
  - With initial speed of 80 km/h, no collision on a target travelling with a constant speed of 32 km/h
- False reaction test
  - Two stationary passenger cars shall be positioned with a distance of 4.5 m between them in the same direction of travel as the subject vehicle.
  - When the subject vehicle travels centrally between them with a constant speed of 50 km/h, the AEBS shall neither provide any collision warning nor brake.

More challenging performance requirements are foreseen in a second step, which will be expected around 2016.

3.5.4 Final discussions

During the final discussion several questions were addressed. Coordination with Japan and the US for testing of AEBS was one topic. Another was how to rank the benefits of different systems (e.g. forward collision warning vs. autonomous emergency braking). Among future research needs, safety systems that detect two-wheelers and safety systems based on car-to-car and car-to-infrastructure (C2X) communication were identified. For safety systems based on C2X, there are also legal issues that need to be investigated.

4 Conclusions and future workshops

4.1 Technical conclusions

- There are different private and public initiatives addressing the definition of test and assessment methods for Collision Warning and Autonomous Emergency Braking systems.

- Each of these initiatives has its own entity and proposes specific test scenarios and evaluation criteria, but there is also the aim of exchanging information.

- The challenges are:
  - To define test scenarios. These scenarios have to be representative of the real accident conditions, with weighting of their relevance. They also have to be reproducible in current test labs, because there are limitations, and repetitive, in order to have robust results.
  - To develop a standardised test target. This test target shall represent a real vehicle and has to be compatible with current and future sensor technologies. An alternative to a specific test target is the definition of precise requirements to the test target, in terms of shape, size and reflectivity.
  - To estimate the impact of these systems towards road safety. There are estimations from past projects (FP6 TRACE and eIMPACT) about the benefit of driving assistance safety systems. Now, these systems are entering the market and the figures provided as estimations in the past need to be validated. For this, Field Operational Tests and cost benefit analysis can be performed.

  - To address driver behaviour. One (or a small number of) driver behaviour has to be selected for each test case to describe reaction, reaction time etc.

- These four aspects will allow the definition of robust test and assessment protocols for Collision Warning and Autonomous Emergency Braking systems.

- Additional aspects of these systems, such as the integration of passive safety systems together with the earlier detection of the accident during the pre-crash phase, can have also an important role for enhancing safety. But, they are not addressed by all the initiatives.

- The main focus of the passenger car industry, research centres and test houses is the development of test and assessment methods oriented for benchmarking purposes (further development and consumer testing organizations), while for heavy goods vehicles there is already a regulatory frame available, which will entry into force from June 2012 in Europe.

- The term Collision Warning and Autonomous Emergency Braking systems applies to both ‘vehicle to vehicle scenarios’ and ‘vehicle to pedestrian scenarios’. Most of the attendants showed special interest in ‘vehicle to vehicle’ scenarios, because systems are closer to market. Vehicle to pedestrian systems will become important in a close future.

4.2 Indications for future workshops

- Workshop 1 was oriented to Collision Warning and Autonomous Emergency Braking systems and was successfully implemented, with a total attendance of 60 people.
- The objective for next workshops will be to repeat a similar format (similar agenda, with several sessions and presenters and combining technical sessions with test activities), with different topics relevant for active safety.
- It has been decided to dedicate Workshop 2 to electronic chassis control systems. This workshop will be implemented at IDIADA in Spain in the February 2012 time frame. Relevant topics for this workshop will be the feasibility of an assessment programme for these systems and the feasibility of simulation techniques for homologation purposes of these systems.
- Workshop 3 will be implemented at SP in Sweden. ‘Vehicle to pedestrian’ scenarios could be a relevant topic for this workshop.

5 References

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[ACT2011] Homepage, http://www.activetest.eu

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[ADAC2011b] C. Gauss and D. Silvestro "ADAC Test Procedure for Advanced Emergency Braking Systems", presentation at the first ActiveTest Workshop, Aachen, Sept., 2011.

[AEB2011] M. Avery, "AEB – Autonomous Emergency Braking", presentation at the first ActiveTest Workshop, Aachen, Sept., 2011.

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[ASS2011b] S. De Hair and C. Rodarius, "Potential Results of AEB Systems in Rear End Scenarios – TNO Simulation Results", presentation at the first ActiveTest Workshop, Aachen, Sept., 2011.

[ASS2011c] A. Aparicio, "Assessment of Integrated Vehicle Safety Systems – Assessor Test Target", presentation at the first ActiveTest Workshop, Aachen, Sept., 2011.

[ASS2011d] T. Unselt et al., "Assessment of Behavioral Aspects in Integrated Safety Systems", presentation at the first ActiveTest Workshop, Aachen, Sept., 2011

[BAS2011] "BASt Approach", presentation at the first ActiveTest Workshop, Aachen, Sept., 2011.

[Ber2011] K. Golowko and J. Uftring, “Testing Tools for Active Safety Development”, presentation at the first ActiveTest Workshop, Aachen, Sept., 2011.

[vFSS2011] H. Schebdat, “Advanced Forward-Looking Safety Systems – Working Group – Introduction and Status update”, presentation at the first ActiveTest Workshop, Aachen, Sept., 2011.

[int2011] F. Fahrenkrog and A. Zlocki, “interactive – SP7 Evaluation and Legal Aspects”, presentation at the first ActiveTest Workshop, Aachen, Sept., 2011.

[PSA2011] K.-F. Zastrow, “Regulatory Situation of Advanced Emergency Braking Systems”, presentation at the first ActiveTest Workshop, Aachen, Sept., 2011.

[TRW2011] A. Seewald, “Active Passive Safety Integration”, presentation at the first ActiveTest Workshop, Aachen, Sept., 2011.

[TUD2011] A. Weitzel “Darmstädter Method with EVITA”, presentation at the first ActiveTest Workshop, Aachen, Sept., 2011.

Annex 1. Flyer of the workshop

Active Test

Workshop on collision warning and autonomous braking systems

27 and 28 September 2011

Institut für Kraftfahrzeuge (ika)
RWTH Aachen University
Germany

Introduction

ActiveTest – Dissemination of performance testing methods for active safety functions in road vehicles

The support action ActiveTest has the goal to increase road safety by supporting the introduction of active safety functions, which allow mitigation or even avoidance of accidents.

Several testing methods have been presented by standardisation, industry and research projects. ActiveTest will provide a forum for exchange of experiences. This forum will be independent and thus neutral ground to allow for informal discussions.

To provide a physical forum for exchange and foster the establishment of a network of experts in the field of active safety testing, dedicated workshops are organised by ActiveTest. They are directed towards industry, research, legislative and regulative bodies as well as consumer testing programmes.

You can find additional information on the project web site www.activetest.eu.

Attendees

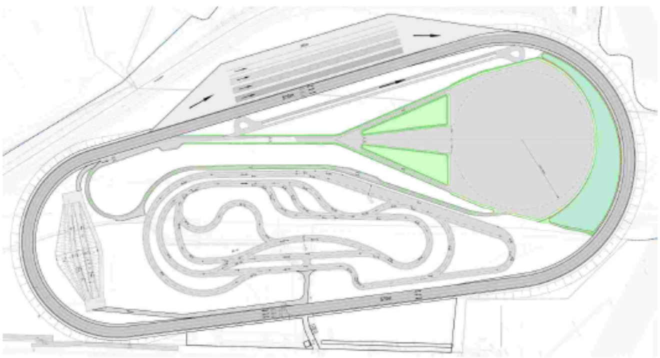
We would be very happy to welcome you to the **Workshop on collision warning and autonomous braking systems**, which will include technical sessions, demonstrations and open discussions.

Venue is the Institut für Kraftfahrzeuge (ika) – RWTH Aachen University, Germany.

In case you would like to attend the event, please reply to info@activetest.eu

On behalf of the the ActiveTest Consortium, best regards,

Jan Jacobson
Project Coordinator, ActiveTest



Agenda

Tuesday, 27th September 2011

Session I – Introduction and Initiatives

09:30 Coffees served

10:00 Welcome by the workshop host
Prof. Lutz Eckstein, ika

10:05 Role call

10:20 Active Test welcome and introduction
Jan Jacobson, SP

Initiatives

ADAC - Christof Gauss, ADAC

AEB - Colin Grover, Thatcham

ASSESS - Andrés Aparicio, IDIADA

vFSS - Heiko Schebdat, Opel

interactIVE (SP Evaluation) - Adrian Zlocki, ika

AsPeCSS - Mario Nombela, IDIADA

13:20 Lunch

Session II – Scenario Discussions

14:30 Longitudinal scenarios - What test track will be required?
Andres Axelsson - Volvo Cars

15:00 Potential results of AEB systems in rear-end scenarios
Carmen Rodarius, TNO

15:20 Round table discussion

15:50 Coffee break

Session III – Test Targets

16:10 System requirements
Maminirina Ranovona - Toyota

16:40 Test target and propulsion systems presentations/display
- ASSESS - Andrés Aparicio
- ADAC - Christof Gauss
- BASt - Patrick Seiniger
- Bertrandt - Kai Golowko
- DSD - Jürgen Gugler
- ABD - Andrew Pick

18:15 Closure of first day
Jan Jacobson, SP

20:00 Joint dinner

Wednesday, 28th September 2011

Session IV – Physical Testing

08:30 Pick-up of participants at ika
Bus transfer to Aldenhoven

09:00 Demo on test implementation
- ASSESS
- ADAC
- BASt
- Bertrandt
- DSD
- ABD

11:00 Bus transfer back to ika

11:30 Coffee break

Session V – Overall Assessment

12:00 Behavioural aspects
Paul Lemmen, Humanetics

12:30 Influences of active safety on crash assessments
Alois Seewald, TRW

13:00 Lunch

14:30 Regulation situation of Advanced Emergency Braking Systems
Kai Frederik Zastrow, PSA

15:00 Final discussions and conclusions

16:00 Closure of the meeting
Jan Jacobson, SP

Location

Recommended hotels

Mercure Hotel Aachen am Dom

Peterstraße 1
52062 Aachen
Tel. +49 241 18010
www.mercure.com
Single room from 99 €

Hotel Novotel Aachen City

Peterstraße 66
52062 Aachen
Tel. +49 241 51590
www.novotel.com
Single room from 110 €

Further information

Please note that the attendance is free of charge. We would be very happy to integrate your contribution. Please feel free to contact us in case you are willing to do so.

You may find additional information on the project web site www.activetest.eu and can contact us under info@activetest.eu.

ActiveTest is an initiative of SP Technical Research Institute of Sweden, Applus IDIADA Group and Institut für Kraftfahrzeuge of RWTH Aachen University (ika). It has the objective to provide a forum for exchange and harmonisation between the different initiatives in Europe, but also worldwide, and is funded under the Seventh Framework Programme of the European Commission.

The research leading to these results has received funding from the European Community's Seventh Framework Programme (FP7/2007-2013) under grant agreement n° 269904.

Annex 2. List of participants

id	Last name	First name	Title	Organisation	Country	Note
1	Aparicio	Andrés	Mr.	Applus IDIADA Group	Spain	Speaker
2	Axelsson	Anders	Mr.	Volvo Car Corp	Sweden	Speaker
3	Bartels	Oliver	Dipl.-Phys.	Bundesanstalt für Straßenwesen	Germany	
4	Benmimoun	Mohamed	Dipl.-Ing.	Institut für Kraftfahrzeuge (ika)	Germany	
5	Blosseville	Jean-Marc	Mr.	IFSTTAR	France	
6	Christian	Frederic	Mr.	Ika	Germany	
7	Deng	Bing	Ph.D.	General Motors China Science Lab	China	
8	Deutschle	Stefan	Dr.-Ing.	Institut für Kraftfahrzeuge (ika)	Germany	
9	Eckstein	Lutz	Prof. Dr.-Ing.	Institut für Kraftfahrzeuge (ika)	Germany	Welcome
10	Ekström	Jonas	Mr.	Volvo Car Corp	Sweden	
11	Engelmann	Ronny	Mr.	Bertrandt Ingenieurbüro GmbH	Germany	
12	Eriksson	Henrik	Dr.	SP	Sweden	
13	Eriksson	Nils	M.Sc.	Scania	Sweden	
14	Etemad	Aria	Mr.	Ford Forschungszentrum Aachen GmbH	Germany	
15	Fahrenkrog	Felix	Dipl.-Ing.	Institut für Kraftfahrzeuge (ika)	Germany	
16	Gilbert	Mark	Mr.	University of Michigan	USA	
17	Golowko	Kai	Mr.	Bertrandt Ingenieurbüro GmbH	Germany	Speaker
18	Hérard	Jacques	Mr.	SP	Sweden	
19	Holl	Reinhard	Mr.	Uni Graz	Austria	
20	Jabobson	Jan	M.Sc.	SP Electronics	Sweden	Speaker
21	Jakobs	Bernd	Mr.	Bertrandt Ingenieurbüro GmbH	Germany	
22	Johansson	Stefan	Mr.	Saab Automobile	Sweden	
23	Karsunke	Jörg	Mr.	ADASENS Automotive GmbH	Germany	
24	Laxing	Robert	Mr.	Volvo Technology Corporation	Sweden	
25	LeBlanc	David J.	Ph.D.	University of Michigan	USA	
26	Lemmen	Paul	Dr.	Humanetics	Netherlands	
27	Lesemann	Micha	Dipl.-Ing.	Institut für Kraftfahrzeuge (ika)	Germany	
28	Lindeman	Mikael	Mr.	IceMakers AB	Sweden	
29	Lönn	Martin	M.Sc.	Saab Automobile AB	Sweden	
30	Magosi	Zoltan	Mr.	Magna Steyr Fahrzeugtechnik AG & Co KG	Austria	
31	McCarthy	Mike	B.Sc.	TRL	UK	
32	Nombela	Mario	Mr.	Applus IDIADA Group	Spain	Speaker
33	Okawa	Tatsuhiro	Mr.	Toyota Motor Europe NV/SA	Belgium	
34	Petersson	Mats	Mr.	Volvo Car Corp	Sweden	
35	Pick	Andrew	Dr.	Anthony Best Dynamics	UK	Speaker
36	Pütz	Andreas	Dipl.-Ing.	Institut für Kraftfahrzeuge (ika)	Germany	
37	Ranovona	Maminirina	Mr.	Toyota Motor Europe NV/SA	Belgium	Speaker
38	Riedel	Helmut	Dr.-Ing.	AUDI AG	Germany	
39	Rodarius	Carmen	Dipl.-Ing.	TNO	Netherlands	Speaker
40	Sacher	Alois	Mr.	ADAC	Germany	
41	Schafmann	Uwe	Dipl.-Ing.	AEDesign GmbH	Germany	
42	Schaub	Swen	Dr.-Ing.	TRW Automotive GmbH	Germany	
43	Schebdat	Heiko	Mr.	Adam Opel AG	Germany	

id	Last name	First name	Title	Organisation	Country	Note
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45	Seewald	Alois	Dr.-Ing.	TRW Automotive GmbH	Germany	Speaker
46	Seiniger	Patrick	Dr.-Ing.	Bundesanstalt für Straßenwesen	Germany	Speaker
47	Shah	Jitendra	M.Sc.	Ford Forschungszentrum Aachen GmbH	Germany	
48	Silvestro	Dino	Dipl.-Ing. (FH)	ADAC e.V.	Germany	Speaker
49	Stoll	Johann	Dipl.-Ing. (FH)	AUDI AG	Germany	
50	Ström	Magnus	Mr.	Volvo 3P	Sweden	
51	Tamura	Koichi	Mr.	MAZDA Motor Europe GmbH	Germany	
52	Uftring	Jochen	Mr.	Bertrandt Ingenieurbüro GmbH	Germany	
53	Waheed	Zaafir	Mr.	AEDesign GmbH	Germany	
54	Weitzel	Alexander	Dipl.-Ing.	Technische Universität Darmstadt	Germany	
55	Wells	Peter	M.Sc.	Volvo Technology Corporation	Sweden	
56	Will	Devid	Mr.	ika	Germany	
57	Willemsen	Dehlia	M.Sc.	TNO	Netherlands	
58	Wohllebe	Thomas	Dipl.-Ing.	Volkswagen AG	Germany	
59	Zastrow	Kai Frédérick	Dr.-Ing.	PSA Peugot Citroen	France	Speaker
60	Zimmermann	Falk	Mr.	MAZDA Motor Europe GmbH	Germany	
61	Zlocki	Adrian	Dr.	Institut für Kraftfahrzeuge (ika)	Germany	Speaker

Annex 3. Photos from the workshop








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