Advanced Forward-Looking Safety Systems – Working Group

Introduction and Status update

Tagessymposium der GMTTB
7.12.2012

Frank Leimbach, DEKRA Automobil GmbH

Nomenclature and Members

vFSS – Advanced Forward-Looking Safety Systems
Focus: M1-Vehicles

Chairmanship: Frank Leimbach
Coordination: Jens König
Terms of Reference – Objectives (I)

The aim of the Working Group is the development of test procedures for driver assistance systems (in particular advanced emergency braking systems) in order to ensure a robust assessment of such systems.

- Ensure transparency with respect to legal requirements and consumer protection initiatives, incorporating harmonisation principles and accounting for related trade-offs.
- Focus on traffic accident priorities by means of an evaluation of the effectiveness in real world accidents, with the aim of reducing the number of road traffic casualties.
- Assessment of the technical feasibility (of the test procedure) and the definition of possible implementation strategies.
- Consideration of test procedures with respect to other assessments for both primary and secondary safety.
- Agreement on defined evaluation criteria (e.g. faulty activation rates, level of vehicle autonomous reaction, ...).

Terms of Reference – Objectives (II)

- Development scenarios for future consideration of driver assistance systems within insurance companies and their respective decision boards.
- Communication of the conclusions in relevant forums.
- Incorporation of conclusions into P-Safe and Euro NCAP working groups.
- Determination of a harmonised methodology for effective evaluation.

A comprehensive understanding of driver assistance systems will be established. Particularly agreement with respect to the performance and limits of the systems should be reached. To support this, relevant accident scenarios will be used to specify appropriate "injury/risk-curves".

With this knowledge the development of reasonable test criteria is achievable, taking into account future technical enhancements (especially sensor technology). This is true not only for Germany but also for the whole world, hence conflicts with other evaluation methods should be anticipated.
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**Workpackages**

- **WP1 Accident Analyses**
  - Worldwide monitoring of activities (e.g. CAMP-CIB, Beyond NCAP, AEB-Group)
  - Accident research
  - Effective range analysis for pedestrian safety systems
  - Effective range analysis for longitudinal traffic safety systems
  - Accident scenario definition contributing to casualty reduction and injury mitigation
  - Derivation of scenarios contributing to material damage reduction
  - Development of an assessment scale for material damage weighting and personal damage (fatally injured/severely injured) weighting related to M1-vehicles
  - Evaluation of the technical feasibility defined in WP1
  - Assessment of system limits
  - Generation and collection of pedestrian safety testing methods

- **WP2 Pedestrian Safety**
  - Evaluation of the technical feasibility defined in WP1
  - Assessment of system limits
  - Generation and collection of pedestrian safety testing methods

- **WP3 Longitudinal Traffic Safety Systems**
  - Evaluation of the technical feasibility defined in WP1
  - Assessment of system limits
  - Generation and collection of longitudinal traffic safety systems testing methods

**Coordination**

**Status of work WP2**

74.3% of pedestrian accidents are road-crossing events (GIDAS)

Road-crossing event:

- Position of Pedestrian
- TTC: Time to Collision
- Possible trajectories of pedestrian from driver’s perspective

Relevant use case:
Pedestrian crossing, car going straight.
Transferring accident scenarios to test scenarios

S1  S3  S4  S2  S5  
pedestrian not obstructed  ped. not obstr.  ped. obstructed

Boundary conditions
- system is working symmetric
- variation of size\(\text{ped}^0\), speed\(\text{ped}^0\), TTC
- obstruction possible

S – Accident Scenario
TS – Test Scenario

TS1  TS2  TS3  TS4
running child from the right  walking adult from the right  running child from the right  walking adult from the right

Velocities:
vehicle: 11.1 m/s  adult dummy: 1.4 m/s
child dummy: 2.8 m/s  adult dummy: 1.4 m/s
Distances from point of first visibility to collision point:
vehicle: 14.5 m  adult dummy: 3.8 m
child dummy: 3.6 m  adult dummy: 1.8 m

S6 excluded
Easy to detect
High speed (> 70 km/h)

Properties of pedestrian dummies
Dummy: Adult  Child
Height: 1.80m (5’9)  1.20m (3’9)
• Realistic clothes
• Reflectivity in IR-Range 10-30%
• Radar backscatter similar to human body
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Transformation to Laboratory Test

Principle
• moving vehicle
• moving dummy target
• perpendicular moving directions
• continuous velocity measuring for vehicle and dummy target

Relevant values
• vehicle velocity at point of first visibility of the dummy target ($V_{\text{Vis, Veh}}$)
• vehicle velocity at the collision point ($V_{\text{Coll}}$)
• vehicle’s speed reduction is the relevant value to assess the system performance

Testing
• 4 different test scenarios
• 10 test cycles for each scenario

Ideally the tests should be performed contactless to avoid damage of sensor systems

Test Scenarios With Obstructed Pedestrians

Scenario 1: running child from the left

- $V_{\text{Veh}} = 40 \text{ kph}$
- $V_{\text{Ped}} = 10 \text{ kph}$

- $d_{\text{Coll, Long}} = 14.5 \text{ m}$
- $d_{\text{Coll, Lat}} = 3.6 \text{ m}$

e.g. typical time to collision is $TTC = 1300 \text{ ms}$
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Test Rig – Possible Layout

Available vFSS Protocols Pedestrian Safety

- vFSS test protocols describe in detail the procedure for
  - Entrance tests
  - Quality tests

- Content
  - Test Conditions
  - Dummy
  - Vehicle
  - Measuring Technology
  - Test Procedure
  - Description of test scenarios
  - Evaluation of Results
Status of work WP3

1.-step: primary interest

- conflict with a vehicle in front (vif)
  - vif is using the same lane since several seconds

2.-step: secondary interest

- conflict with a vehicle in front (vif)
  - vif is “suddenly” entering the lane

→ exchange with ASSESS project

Background WP3

- vFSS-working group initiative to compare different crash-targets used by OEMs and research institutes
- Several rounds of tests on Daimler test facility in Papenburg and IDIADA, 2010-2012

- Focus:
  - Evaluation of target-systems regarding applicability, handling, durability
  - Discussion regarding the opportunity of a harmonisation of crash target systems
  - Test of practicability of draft protocols
Status of work WP 3
Test Events

- Subjective and objective assessment of target systems

Test Vehicles

- Audi A8, Audi A4: radar and camera
- Audi A8: PMD
- Mercedes-Benz E: short-, mid-, long-range radar
- Porsche Panamera: radar
- Ford Galaxy: radar
- Honda Accord: radar
- Toyota Prius: radar
- VW Passat CC: radar and lidar?
- Volvo V60 (Thatcham): radar and camera
DEKRA jubilee crash Test 18 May 2010

Retarded impact with forward-looking safety system
Initial speed 64 km/h
Impact speed 40.4 km/h
Crash according to EuroNCAP specification
BMW series 5 – latest generation, equipped with prototypical PreCrash-System and eCall
Crash test facility responds to automatic vehicle braking

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<th>Stationary Targets</th>
<th>Moving Targets</th>
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<td>Overall assessment of radar characteristics</td>
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<td>Overall assessment of characteristics regarding PMD technology</td>
<td>mechanical properties and target handling</td>
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*) rated by 1 OE only
**Harmonisation Platforms - Objectives**

**HP 1 - Scenarios -**
- Chair: C. Pastor, BASt
- Expert exchange for technical agreement
  - Identification of similarities and differences in group’s approaches.
  - Definition of joint standards for concurrent perspectives.
  - In case of disagreement initiation of project studies to achieve common agreement.

**HP 2 - Targets -**
- Chair: P. Lemmen, Humanetics
- Executive Board
  - Executive review of platform’s output.
  - Approval on joint standards.
  - Coordination of project studies.
  - Reporting to safety advocates.

**HP 3 - Effectiveness -**
- Chair: A. Aparicio, IDIADA

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**Interlink with EC-Projects**

![Interlink with EC-Projects](image)
Interlink with EC-Projects

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Memorandum of Cooperation NHTSA-BASt

Signed 26 April 2010
Thank you very much for your attention