Test Methods for Efficient Verification of Advanced Driver Assistance Systems

Testmethoden zur wirtschaftlichen Absicherung aktueller Fahrerassistenzsysteme

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| 1 | Testing: Scenarios and Test Conditions |
| 2 | Test Tools and Steering Robot |
| 3 | Test Setup: Required Equipment for integrated Safety Testing |
| 4 | Conclusion |
Ko-KOMP stands for ‘Cooperative Components’

In the scope of Ko-KOMP

• Information, generated from the surrounding field of the vehicles and their sensors, about the driving periphery and driving dynamics, are used for the triggering of preventive safety measures

• Functional intervention to the longitudinal and lateral guidance of the vehicles is studied and implemented in the experimental vehicles

• The protective potential of the cooperative vehicle safety systems, in due consideration of different prophylactic protective measures, are evaluated and required methods are developed

• The quality and availability of communication circuits, between road users in a realistic environment, are studied
Test Scenarios and Test Conditions

Emergency Steer Assist

Cornerstone Specification
Test Scenarios and Test Conditions

Measurement Precision:
- Vehicle and target speed to 0.1 km/h
- Vehicle and target lateral and longitudinal position to 0.03 m
- Vehicle and target yaw rate to 0.1 °/s
- Vehicle and target longitudinal acceleration to 0.1 m/s²
- Steering wheel velocity to 1.0 °/s

Test Tolerances:
- Speed of Vehicle and target ± 1.0 km/h
- Lat. deviation from test path 0 ± 0.1 m
- Relative distance vehicle and target 0 ± 0.5 m
- Yaw velocity 0 ± 1.0 °/s
- Steering wheel rotation 0 ± 15.0 °/s

Handling:
- Simple and accurate handling of the systems
- Robustness under test conditions
- Short setup times and applicable universally in different vehicles
Agenda

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AEB Test Tools
MTD - Moving Target Device

The MTD is designed for
• Intersection Assist (ISA)
• Forward Collision Warning (FCW)
• Rear Cross Traffic Alert (RCTA)

Test Variations
• Longitudinal scenarios
  (Autonomous Emergency Braking)
• Crossing scenarios

Technical Specification
• Acceleration: +/- 10 m/s²
• Test Track: 150 m
• Speed: 80 km/h
• Accuracy: +/- 5 cm
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Ko-TAG Intersection Test

pulling rope
guiding rope
Testing of
- Autonomous Emergency Braking (AEB)
  e.g. EuroNCAP Safety Assist
- Emergency Steer Assist (ESA)
- Forward Collision Warning (FCW)

Test Variations
- Longitudinal scenarios
  (Emergency Brake Assist)
- Offset Collision

Technical Specification
- Towing Device: 15 m
- Deceleration: up to 8 m/s²
- Speed: 80 km/h
- Accuracy: Depends on towing vehicle
- Set up and handling by one person
AEB Test Tools
ETD - EBA Towing Device

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Lane Change
AEB Test Tools
Automatic Lateral Guidance

- High dynamic path-following close to stability threshold with high repetition accuracy
- Conduction of false-positive avoidance tests

- Positioning via RTK D-GPS
- Setup time + parameter setting app 2h
- PC based Track Design
- Applicable to any vehicle
- 0.8g lateral acceleration
- Very high repetition accuracy
- Lane accuracy of ±2cm
• The steering angle can be set by the system with a very small delay
• The difference during the evasion process with 0.8g is only ± 4 cm, as shown in the graph

• The actuator determines the control input from the difference between the actual and the targeted position
• The steering wheel is automatically turned to the right direction via a map-based control system
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EBA Test Setup: Required Equipment

Currently envisaged Setup:

Towing-Vehicle
- RTK D-GPS 1
- Pedal Actuator
- Steering robot 1

Propulsion System + Target
- Computation Unit 1
- Steering Robot 2
- EBA Propulsion System (ADAC)
- Vehicle Mock-up

Vehicle Under Test (VUT)
- RTK D-GPS 1
- Computation Unit 2
- Pedal Actuator
- Measurement
EBA Test Setup: Required Equipment

Recommended simplified Setup

Towing-Vehicle
- RTK D-GPS 1
- Controllable Vehicle

Propulsion System + Target
- Computation Unit 1
- Steering Robot 2
- EBA Propulsion System (ETD)
- Vehicle Mock-up

Vehicle Under Test (VUT)
- Trigger Box
- Pedal Actuator
- RTK D-GPS 1
- Computation Unit 2
- Measurement
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Conclusion

• With the test tools developed, new possibilities were created to perform tests up to a collision safely
• A complete setup was created to fulfill the current test requirements for driver assistance system tests
• The systems have already been used in serial as well as pre-serial developments
• Through the simulation techniques, also used in the Ko-KOMP studies, a basis for an extensive coverage of the systems was created
Thank you for your attention!

Mark Schulte