FORSCHUNGSINITIATIVE
KO-FAS

Test Methods for Efficient Verification of Advanced Driver Assistance Systems

Testmethoden zur wirtschaftlichen Absicherung aktueller Fahrerassistenzsysteme

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Continental Safety Engineering International GmbH

Supported by:
Federal Ministry of Economics and Technology
on the basis of a decision by the German Bundestag

Agenda

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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**

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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

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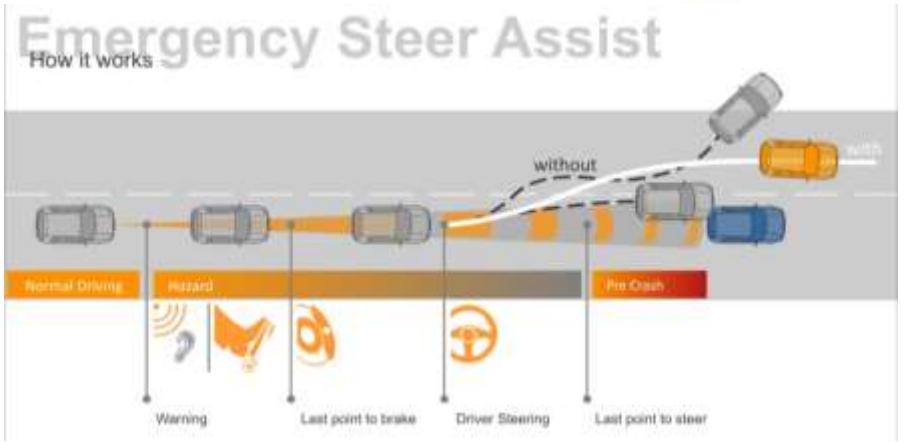

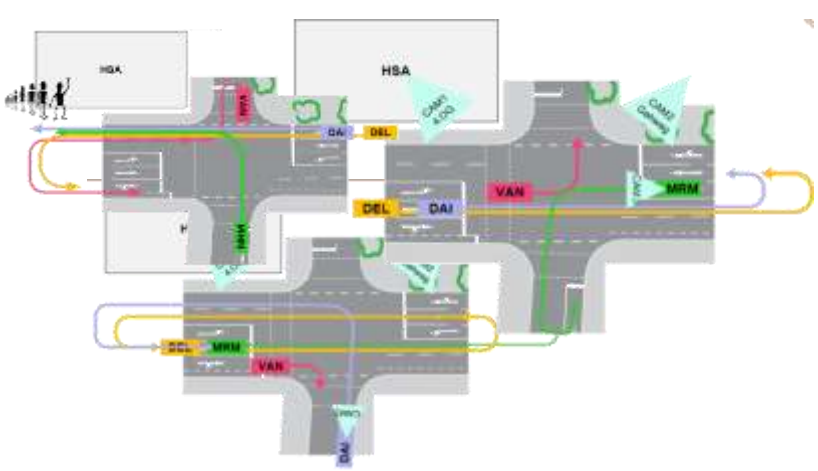

Nr.:	Testunternehmen	Abstand m	V-Ego km/h	V-Co km/h	TTC Sek:	Bremsverzögerung m/s²
1	AEB	250	60	20	-	-
2	AEB	250	60	40	-	-
3	AEB	250	80	20	-	-
4	AEB	250	80	40	-	-
5	AEB	60	80	80	-	-3
6	AEB	60	80	80	-	-5
7	AEB	150	80	40	-	-3
8	AEB	150	60	40	-	-3
9	NCAP	150	72	0	2,7	-
10	NCAP	30	72	72	2,4	-3
11	NCAP	150	72	32	2,1	-
12	Continental, Bosch, AEB	250	50	20	-	-
13	Continental, Bosch, AEB	250	100	60	-	-
14	Continental, Bosch, AEB	60	80	80	-	-3
15	Continental, Bosch, AEB	40	60	60	-	-3
16	Continental, Bosch, AEB	15	30	30	-	-9
17	USA NCAP	150	72	72	2,7	-

Cornerstone Specification

Test Scenarios and Test Conditions

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Measurement Precision:

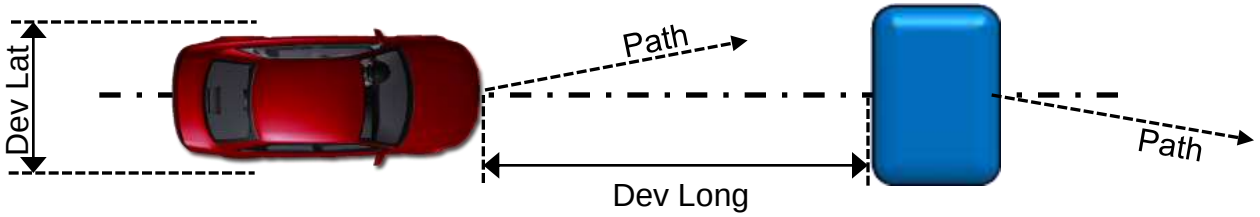
- Vehicle and target speed to 0.1 km/h
- Vehicle and target lateral and longitudinal position to 0.03 m
- Vehicle and target yaw rate to 0.1°/s
- Vehicle and target longitudinal acceleration to 0.1 m/s²
- Steering wheel velocity to 1.0 °/s

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



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AEB Test Tools
MTD - Moving Target Device

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The MTD is designed for

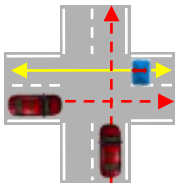
- Intersection Assist (ISA)
- Forward Collision Warning (FCW)
- Rear Cross Traffic Alert (RCTA)

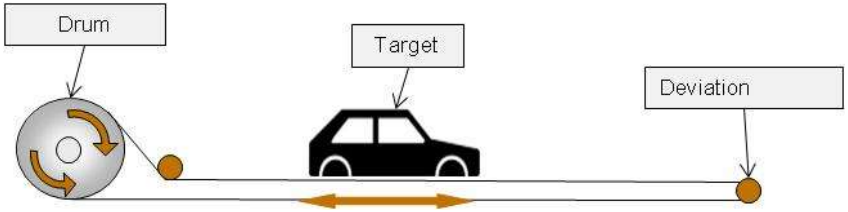
Technical Specification

- Acceleration: +/- 10 m/s²
- Test Track: 150 m
- Speed: 80 km/h
- Accuracy: +/- 5 cm

Test Variations

- Longitudinal scenarios (Autonomous Emergency Braking)
- Crossing scenarios





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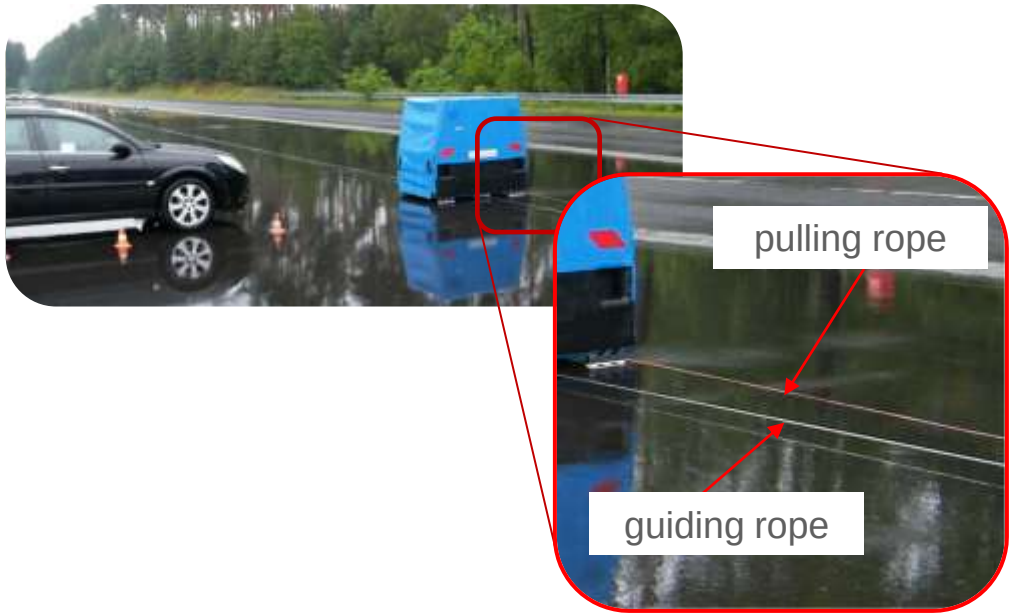
Ko-TAG Intersection Test



AEB Test Tools
ETD - EBA Towing Device

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Testing of

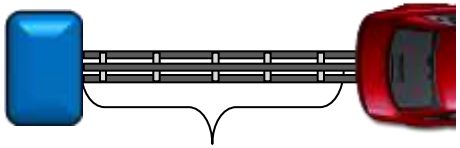
- Autonomous Emergency Braking (AEB)
  e.g. EuroNCAP Safety Assist
- Emergency Steer Assist (ESA)
- Forward Collision Warning (FCW)

Test Variations

- Longitudinal scenarios
  (Emergency Brake Assist)
- Offset Collision

Test Vehicle

Target



15m

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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Technical Specification

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Maximum Braking

Collision

AEB Test Tools
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Technical Specification

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Lane Change

AEB Test Tools
Automatic Lateral Guidance

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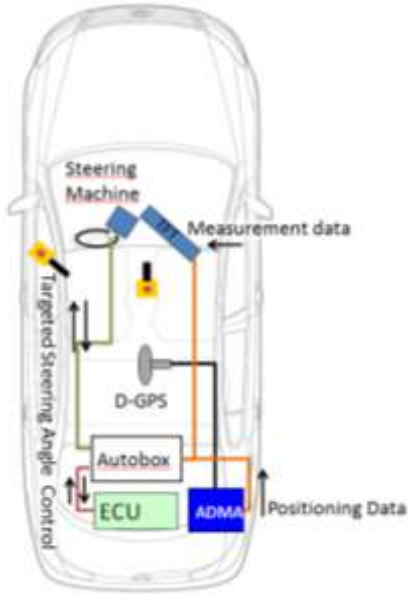
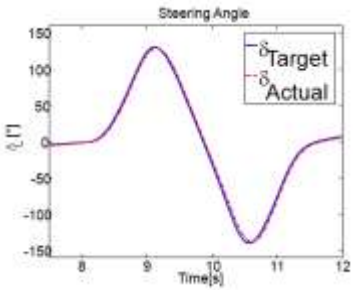
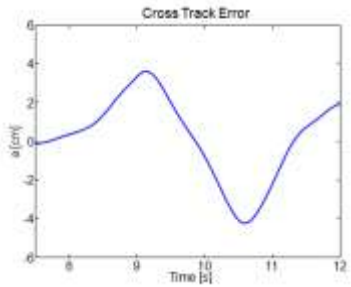
- High dynamic path-following close to stability threshold with high repetition accuracy
- Conduction of false-positive avoidance tests

- 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



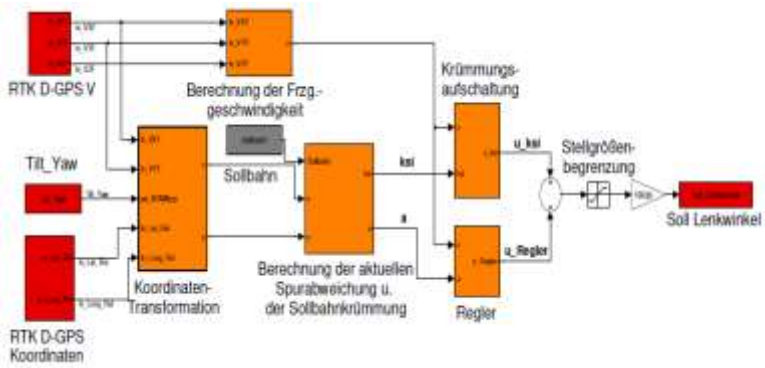
AEB Test Tools
Automatic Lateral Guidance





- 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

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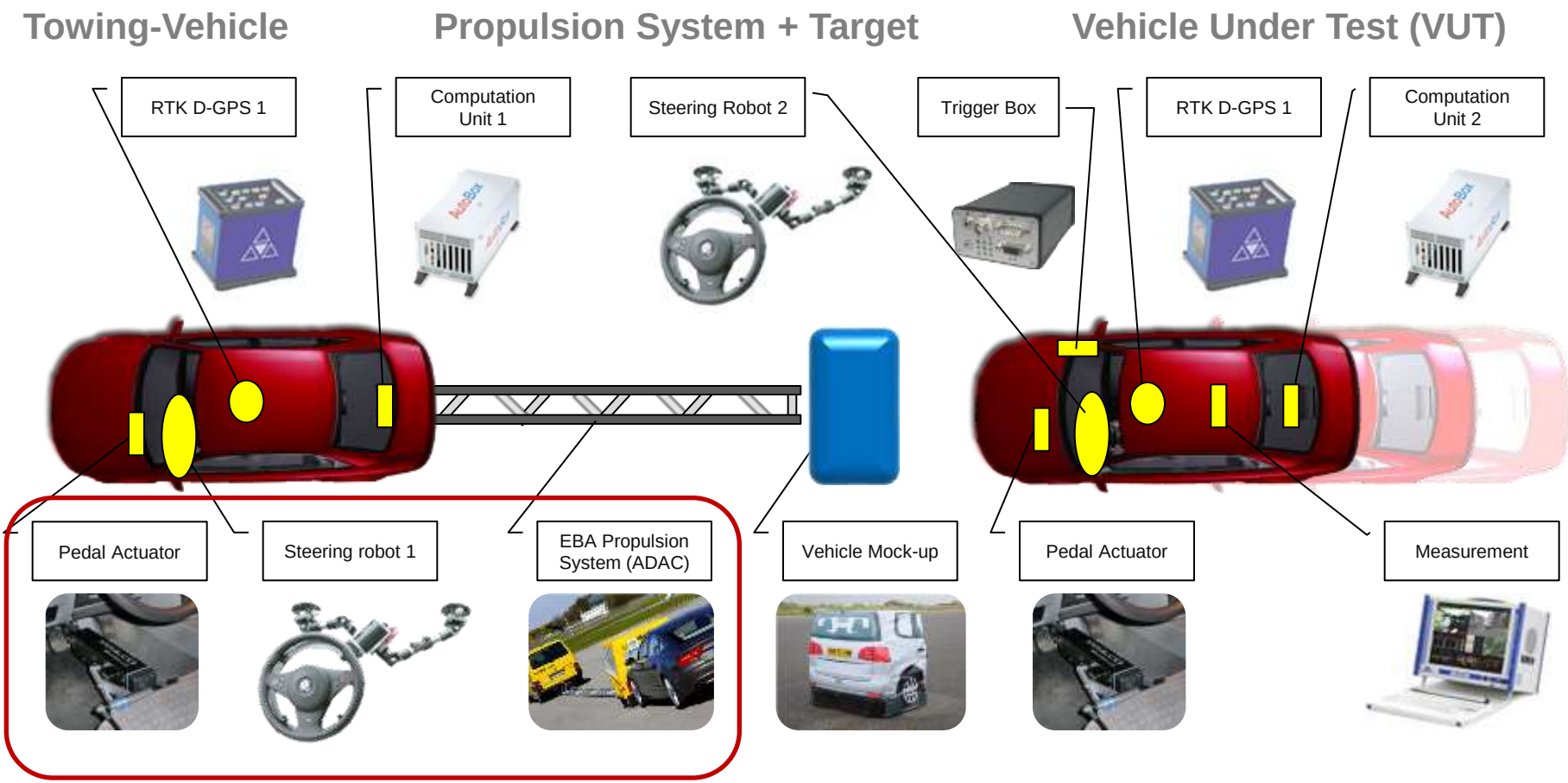
Currently envisaged Setup:



EBA Test Setup: Required Equipment

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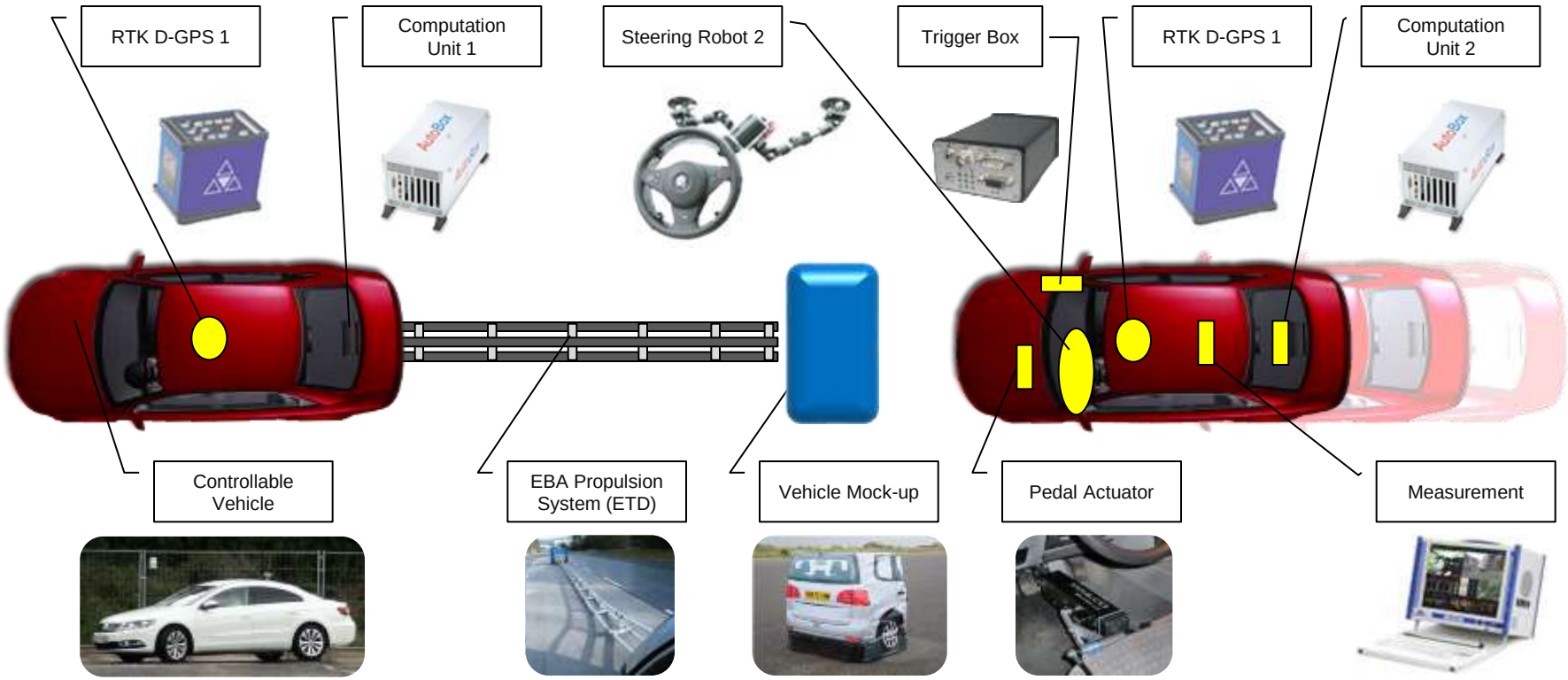
Recommended simplified Setup

Towing-Vehicle | **Propulsion System + Target** | **Vehicle Under Test (VUT)**



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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!

Continental

Mark Schulte