Workshop A

Al Bustan Rotana Hotel, Al Rashidya Ballroom C

Ensuring Best Inspection Practice

Chaired by Juan Rodriguez

Member of CITA Bureau Permanent
Workshop A

Presentation 1

ADVANCED DRIVER ASSISTANCE SYSTEMS

Heiko Ehrich

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Advanced Driver Assistance Systems

CITA Conference

Dubai, April 2015

Heiko Ehrich, TÜV NORD Mobility
Content

- **Motivation for Assisted Driving**
  - Human capabilities and accident avoidance
  - Improvement of the ecological balance
- **Classification of Driver Assistance Systems**
  - Levels of automated driving
  - Conventional systems and systems with machine perception
- **System Overview**
  - Functional and sensor overview
  - Influences to the E/E system architecture
  - Challenges
- **Regulation, Type Approval and PTI**
  - Current situation
  - Challenges
Motivation for assisted driving

Traffic fatalities

Motorized vehicles in Germany

Fatalities according to accident type (2009)

Incidences of accident cause depending on driver age

Error Type
- Information
- Structural
- Diagnostic
- Goal Setting
- Action
- Control

- stationary object / vehicle leaves lane
- oncoming vehicle
- ahead or waiting vehicle
- vehicle driving in same direction
- turning or crossing vehicle
- pedestrian
- parking vehicle
- other
Motivation for assisted driving

Potential for accident prevention

- Perennially trial phase of BG Verkehr, BGL and KRAVAG showed that accident rate with heavy duty vehicles can be reduced by 34% with ADAS
  - 767 heavy duty vehicles equipped with ESP, LDW and ACC
  - 565 comparable vehicles without these assistance systems
- It is assumed that introduction of further ADAS (as Emergency Brake Systems) can prevent more than 70% accidents

Further studies

<table>
<thead>
<tr>
<th>Driver Assistance System</th>
<th>Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane Assistant</td>
<td>4,4% (GDV)</td>
</tr>
<tr>
<td>Emergency Brake</td>
<td>46,5% (GDV)</td>
</tr>
<tr>
<td>Adaptive Cruise Control</td>
<td>12%¹, resp. 19%²</td>
</tr>
<tr>
<td>Night Vision</td>
<td>3%¹</td>
</tr>
<tr>
<td>Lane Change</td>
<td>1,7% (GDV)</td>
</tr>
<tr>
<td>Park Assistant</td>
<td>31% (GDV), only parking accidents</td>
</tr>
</tbody>
</table>

¹ Accidents with injured and killed participants
² Accidents with driver injury
Motivation for assisted driving
Human capabilities for vehicle driving

Main Development Goal for ADAS
- Elimination of discrepancies between requirements of traffic situation and driver capabilities

Human Error
- In ~95% of all traffic accidents „Human Error“ is involved
- ~75% of traffic accidents are solely caused by human error

„Looked-but-Failed-to-See“
- Prevalently accident cause by human errors
- Vehicle or obstruction lied in the visual field of the accident causer, but hazardous situation was not detected
  - consequently accident-avoiding measures not performed
- Reasons
  - capacity limits of visual attention
  - selective process of visual scanning
  - faulty integration of relevant characteristics into scenery
- Increasing accident probability when requirements of the traffic situation exceed the performance capabilities of the driver
Motivation for assisted driving
Human capabilities for vehicle driving

Human information processing

- Translation of incoming signals (stimulus) at human receptor into cognitive representation and response

  Processing steps
  - Information reception (Perception)
  - Information processing (Cognition)
  - Information delivery (Motor skill)

No freedom of interference

- Limited resource capacity (sensory channels, working memory etc)
- Overabundance of stimuli exceeds human processing capacity
- Not all information at sensory receptor can be consciously perceived
- Targeted information selection and divided attention

Types of attention can be divided into two dimensions

Selectivity, human has to decide between two different, competitive information resources

Intensity of attention affects the activation level
- Reduced vigilance (low share of relevant stimuli)
- Duration of attention (high share of relevant stimuli)
Motivation for assisted driving
Improvement of the ecological balance

Increased energy demand for a vehicle equipped with driver assistance systems
- Exemplary estimation for a fully equipped vehicle
  - 0.2 l / 100 km at additional mass of 25 kg and energy demand of 250 W

Optimization of the drive-train to road conditions
- Improvement of the traffic flow and traffic jam avoidance
- Transmission strategy of automatic gearing
- Early speed adjustment according to the traffic situation
- Optimization of acceleration and braking phases
- Boost / cylinder deactivation of combustion engine related to
  - altitude profiles
  - speed limits
  - traffic situation
- Running engine in optimal operating point

Reduction of total fuel consumption by 10-20 % reachable with ADAS
Advanced Driver Assistance Systems

Classification

Assisted driving
- Redundant-parallel task execution by human and machine
- Interaction by Human-Machine-Interface

With (fully) automated driving
- Human excluded from active and passive driving tasks
- Vehicle solely takes over task execution

Levels of Driving Automation for On-Road Vehicles (source: VDA)

Types of driver assistance systems

Conventional Systems support the driver in situations that are easily measurable

Example:
- ABS controls when wheel threatens to lock up
  - Determination based on wheels speed sensors

Systems with Machine Perception support the driver in situations that have to be interpreted by machine

Example:
- Adaptive Cruise Control
  - Reflections of radar signals are interpreted as vehicles
Multiple sensors for capturing vehicle, driving and environmental data

- In-Vehicle Sensors and Actuators
  - Vehicle physics
  - Driver behavior
- Car Sensor Range
  - Vehicle surrounding
- Cooperative Services
  - Environmental conditions
  - Traffic situation
Advanced Driver Assistance Systems
Functional and Sensor Overview

Multiple sensors for capturing vehicle, driving and environmental data

- In-vehicle sensors and actuators
  - Vehicle physics
  - Driver behavior
- Car sensor range
  - Vehicle surrounding
- Cooperative services
  - Environmental conditions
  - Traffic situation

In-Vehicle Sensors & Actuators
Multiple sensors for capturing vehicle, driving and environmental data

- In-vehicle sensors and actuators
  - Vehicle physics
  - Driver behavior
- **Car sensor range**
  - Vehicle surroundings
- Cooperative services
  - Environmental conditions
  - Traffic situation

**Sensor Type**
- Long Range Radar
- LIDAR
- Camera
- Short/Medium Range Radar
- Ultrasound
Multiple sensors for capturing vehicle, driving and environmental data

- In-vehicle sensors and actuators
- Car sensor range
- Cooperative services
  - Environmental conditions
  - Traffic situation

**Traffic Information**
(DAB, TMC, GSM etc)

**Digital 2D/3D Map**
(Navigation & Route Information)

**Positioning**
(GPS, GLOSNASS)

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**Cooperative Services**
< 2 km

- V2I
  - Traffic Sign Recognition
  - Emergency Brake
  - Pedestrian Detection
  - Collision Avoidance

- V2V
  - Adaptive Cruise Control
  - Lane Departure Warning
  - Cross Traffic Alert

- Surround View
- Blind Spot Detection
- Park Assist
- Park Assist
- Rear Collision Warning
- Park Assistance Surround View

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TÜV NORD Mobility, Heiko Ehrich
CITA Conference 2015
April 2015
Driver Assistance Systems
E/E System Architecture

Influences to the vehicle system architecture
- Driver assistance systems actively control acceleration, braking and steering activities or supply information and warnings to the driver to set commands

Relevant functions implemented in ECUs of the E/E system architecture
- Sensing (capturing information)
  - Filtering and pre-processing of sensor data
  - Reading control elements
- Thinking (information processing and interpretation)
  - Calculation of warning criteria and control algorithms
  - Calculation of sensor data fusion
  - Diagnosis and calibration
  - Coding of country-specific features
- Acting (display, vehicle control)
  - Control of actuators
  - Display elements

Challenges
- Intelligent and efficient use of sensor information to realize wide-ranging driver assistance functions
- Increasing amount of functions and complexity in vehicle network require system management that prioritizes and controls competitive operation of different functions according to the situation

Vehicle system architecture
(source ISBN 978-3-8348-1457, section A.1 Figure 9-1)
Driver Assistance Systems
Challenges

Introduction of complex ADAS up to highly automated driving functions

- Automotive to robotics
  - Liability and legality
  - Acceptance and trust
  - Robot ethics
  - Changing Mobility Concept
- Complexity and efficiency
  - Car needs to be more intelligent than aircraft
  - Sensor fusion and complementary systems (as v2x)
  - Mass production, cost efficiency, short development cycles
- Increase of safety relevant systems
  - Redundancy
    - Fault tolerance, fail-safe, graceful degradation, self monitoring
    - Separation into non-safety and safety systems in terms of data security
    - Robustness of sensors and systems against environmental and climatic variety
- Human Machine Interface
  - Keep driver in the loop
  - HMI concepts to enable suitable reaction time
  - Information of other road users if vehicle drives autonomously
- Regulation, type approval and periodic inspection requirements
EU regulations 661/2009/EC, 347/2012/EC and 351/2012/EC

- Three important driver assistance systems European-wide for new vehicles mandatory

Electronic Vehicle Stability Control (EVSC) mandatory beginning with
- 1. November 2011 for all road vehicles with new type approval
- 1. November 2014 for all new road vehicles

Lane Departure Warning Systems (LDWS) and Advanced Emergency Braking System (AEBS) mandatory beginning with
- 1. November 2013 for all heavy duty vehicles (>3.5 tons) and busses (>9 seats) with new type approval
- 1 November 2015 for all heavy duty vehicles and busses
Advanced Driver Assistance Systems
Regulation, Type Approval and PTI

Current situation for introducing new ADAS
Role of type approval regulations for introducing new ADAS functions depending on regulated area (e.g. EU and UN-ECE regulations)
- Multiple safety relevant vehicle systems can be introduced without meaningful type approval because they are not regulated
- Example:
  - For vehicle light technology multiple requirements exists for homologation and periodic inspection
  - Which parameters are currently regulated for introducing adaptive cruise control, lane assist or emergency brake systems?

Distinction of type-approved ADAS products related to safety
- Requirements of lawmakers traditionally focus on passive safety
  - Limited regulations for innovations in active safety
    - Obsolete test and evaluation criteria
    - Subjective and fragmentary evaluation for complex ADAS products
- Existing type approval tests do not distinguish the different safety levels of ADAS products
Challenges

- Industry and science have to provide analyses and empirical data about reliability and technical challenges
- Regulation authorities, vehicle manufacturers and testing facilities have to work out
  - Homologation standards for ADAS performance
  - Validation standards for periodic inspection of ADAS

System parameterization and boundaries

- Hazard identification
- Reaction times
- Situation analysis and decision making
  - such as warning, automated speed reduction, steering intervention, emergency brake pressure etc

Type approval and periodic inspection process

- Validation of system functionality during type approval validation
- Periodic inspection process for ensuring that safety-relevant functionality is given over vehicle lifetime
Cars Are Becoming More …
- Connected
- Clean
- Automated

There's the old aviation joke about airplanes of the future having a dog in every cockpit, the pilot's job being to feed the dog and the dog's job to bite the pilot if he tries to touch anything.

Still a ways away from that scenario in road vehicles, but if you listen closely, you might be able to hear barking

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Workshop A
Presentation 2

Benefits of Consideration of the PTI in Homologation

Jörg van Calker

Central Agency for PTI, Germany
CITA Conference 2015

BENEFITS OF THE CONSIDERATION OF PTI IN HOMOLOGATION

Jörg van Calker - Dubai, April 15th 2015
AGENDA

1 – The problem
Recent and future challenges for the PTI

2 – The solution strategy
Homologation and PTI in the light of the challenges

3 – The implementation
Consideration of PTI in homologation
1

RECENT AND FUTURE CHALLENGES FOR THE PTI
CHALLENGES - OVERVIEW

A – (Testing of) sophisticated electronically controlled vehicle systems / functions

- Advanced driver assistance systems without Car2X
- Advanced driver assistance systems with Car2X
- (Partly) automated driving functions (with Car2X)
- Full automated driving (with Car2X)

B – Upcoming PTI objectives (e.g. data security, privacy)

C – Higher importance / responsibility of PTI
  (because of higher degree of automization)
CHALLENGES – EXAMPLES
A - ADVANCED DRIVER ASSISTANCE SYSTEMS
HIGHWAY CHAUFFEUR
CHALLENGES – EXAMPLES
A - ADVANCED DRIVER ASSISTANCE SYSTEMS
PLATOONING
CHALLENGES – EXAMPLES
B – NEW TESTING REQUIREMENTS
VEHICLE DATA PRIVACY
VEHICLE DATA PRIVACY
Effective PTI
Achieving the objectives
- Safety,
- Environmental protection,
- Security [future],
- Privacy [future]

Efficient PTI
as simple, quick and unexpensive as possible
HOMOLOGATION AND PTI IN THE LIGHT OF THE CHALLENGES
HOMOLOGATION AND PTI TODAY
HOMOLOGATION TODAY DOES NOT HELP WITH THE CHALLENGE

Homologation

Rules
- ECWVTA
- UNECE Reg.
- Standards

Tests, data, processes for Homol.

Technical services
Manufacturers

No support for PTI

PTI

Rules
- PTI-Legisl.
- (Standards)

Tests, data, processes for PTI

Vehicle life
UNSTANDARDIZED DATA DELIVERY BESIDES HOMOLOGATION
UNSTANDARDIZED DATA DELIVERY BESIDES HOMOLOGATION DOES HARDLY HELP WITH THE CHALLENGE
FULL CONSIDERATION OF PTI IN HOMOLOGATION
FULL CONSIDERATION OF PTI IN HOMOLOGATION DOES HELP WITH THE CHALLENGE

- Technical services
- Manufacturers

- Homologation

- Tests, data, processes for Homol.
- Tests & data for PTI

- PTI

- Tests, data, processes for PTI

- PTI organisations

- Vehicle life

Rules
- ECWVTA
- UNECE Reg.
- Standards

Rules
- PTI-Legisl.
- (Standards)
CHANCES OF THE FULL CONSIDERATION OF PTI IN HOMOLOGATION

Effective PTI
Achieving the objectives
- Safety,
- Environmental protection,
- Security [future],
- Privacy [future]

Efficient PTI
as simple, quick and unexpensive as possible
CHANCES - EXAMPLE
FUNCTIONAL TEST OF CAR2X ASSISTANCE SYSTEM
FUNCTIONAL TEST OF CAR2X ASSISTANCE SYSTEM
CONSIDERATION OF PTI IN HOMOLOGATION
RULES FOR HOMOLOGATION - OVERVIEW

EC Whole Vehicle Type Approval

UNECE Regulations

(ISO) Standards

Homologation

Rules
- ECWVTA
- UNECE Reg.
- Standards

Tests, data, processes for Homol.

Tests & data for PTI
RULES FOR HOMOLOGATION - NECESSARY AMENDMENTS

EC Whole Vehicle Type Approval

- General requirements regarding the necessary PTI test methods and PTI data, their documentation and verification

UNECE Regulations

- Technical requirements regarding the necessary PTI test methods and PTI data, their documentation and verification

(ISO) Standards

- Technical specifications of data formats and interfaces
OPTIONS FOR EXTENDING THE ECE-REGULATIONS IN VIEW OF THE ADVENT OF INTEGRATED / AUTOMATED VEHICLE FUNCTIONS

A – Horizontal regulation
B – Part of existing single-rules
C – Additional new regulation
NEXT STEPS AGREED BETWEEN AUTHORITIES, MANUFACTURERS AND TESTING ORGANISATIONS IN GERMANY

**EC Whole Vehicle Type Approval**
- Addition of test methods (using the vehicle interface) for automated driving functions
- Integration of the test method classes (identification, condition, function and efficacy)

**UNECE Regulations**
- Addition of test methods (using the vehicle interface) for automated driving functions
- Integration of the test method classes (identification, condition, function and efficacy)

**(ISO) Standards**
- Developments of standards for efficient and effective PTI test methods for automated driving functions
- Development of standards for PTI data and (vehicle, cloud) interfaces
VISION ZERO.
KEINER KOMMT UM. ALLE KOMMEN AN.
Workshop A

Presentation 3

HARMONISATION OF TEST PROCEDURE AND INTEGRATION OF TYPE APPROVAL

Frank Leimbach

Director DEKRA Technology Centre, DEKRA Automobil GmbH, Germany
Enhancing the Value of Vehicle Inspection

Harmonisation of test procedure and integration of type approval

DEKRA Automobil GmbH, Frank Leimbach, Director Technology Center
Harmonisation of test procedures

- In terms of:
  - type approval
  - insurance rating
  - NCAP test’s
  - periodical technical inspection (PTI)
  - and integration of testing of electronic components during type approval procedure
Advanced Driver Assistance Systems – state of the art

- Driver Assistance systems using the example of BMW 5 Series (F10):

  - Speed Limit Info
  - Surround View
  - Night Vision with Dynamic Light Spot
  - Lane Departure Warning
  - Active Protection
  - Active Cruise Control with Stop&Go function
  - Approach Control Warning with braking function
  - Tyre Pressure Display
  - Head-Up Display
  - Adaptive Headlights
  - Park Assistant

Quelle: bmw.com
Advanced Driver Assistance Systems – state of the art

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Advanced Driver Assistance Systems – state of the art
Advanced Driver Assistance Systems – expectations

- Smart ADAS prevent accidents or mitigate accidents
- Functionality of ADAS shall last the vehicle life cycle
- ADAS shall be standard for volume cars as well
Effects of harmonisation

- Harmonisation of requirements will lead to price reduction
- Minimize number of test criteria for a given ADAS in terms of:
  - markets (USA, Europe, Asia)
  - testing bodies
    » type approval
    » insurance rating
    » NCAP test's
    » periodical technical inspection

combine test procedures
Advanced Driver Assistance Systems - requirements

ADAS

- require maintenance
- have to be addressed within PTI procedures
- shall be integrated in type approval directive's
Pedestrian test scenarios

S1  
- speed 45 - 50 km/h
- braking of the car
- adult crossing from the right
- normal speed (5 km/h)
- daylight

S2  
- speed 55 - 60 km/h
- braking of the car
- child crossing from the left
- running (8 - 10 km/h)
- typical at night

S4  
- speed 10 - 15 km/h
- adult crossing from the right
- normal speed (5 km/h)
- braking of the car
- typical at night

S3  
- speed 20 - 25 km/h
- adult crossing from the right
- normal speed (5 km/h)
- braking of the car

S5  
- speed 45 - 50 km/h
- child crossing from the right
- running (8 - 10 km/h)
- braking of the car

S6 excluded

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

S – Accident Scenario
Pedestrian test scenarios

Boundary conditions
- system is working symmetric
- variation of size_{Ped}, speed_{Ped}, TTC
- obstruction possible

TS1
- running child from the right

TS2
- walking adult from the right

TS3
- running child from the right

TS4
- walking adult from the right

TS – Test Scenario
Pedestrian test
Impact on PTI

- Safety must be kept on an appropriate level
- Therefore ensure that vehicles on the roads are maintained to a high degree of technical roadworthiness
- Increasingly complex and dynamic functionality of vehicle systems
- Critical safety systems that only operate when the vehicle is in motion
  - such as ESC or AEBs
- Real testing of safety systems within PTI not feasible (time & costs)
Summary

- Accident statistic will be impacted by smart ADAS systems if they will be standard on the majority of vehicles
- If the systems keep stay in function
- Maintenance and inspection is mandatory to ensure functionality
- Integration of test procedure requirements may enable reasonable testing
Thank you very much for your attention!