Test system for camera-based driver assistance systems
TESIS DYNAware GmbH / Bertrandt Ing.- Büro GmbH

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Agenda

1. Introduction – Presentation of the overall system, requirements
2. Overview of the test system
3. DYNA4 simulation environment for user-defined driving scenarios
4. Test scenarios for various driver assistance functions
5. Creation and adaptation of test scenarios
6. Return of simulation data
7. Integration of DYNA4 simulation environment into the test automation
8. Summary, outlook
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8. Summary, outlook
Camera-based driver assistance systems

- Driver assistance and safety enhancement by visual detection of the environment
- Capturing the vehicle environment with cameras (front, rear, side)
  - Display of captured video images
  - Analysis of the captured video images and output of additional information to the driver (optical, acoustic, haptic)
  - Integration of further sensor information (radar, ultrasonic, IR) into the video image

Surrounding cameras
Parking assistant
Lane detection
Traffic sign detection
High-beam assistant
"Night Vision"
Requirements to be met by the test system

- Fully automated and reproducible tests to ensure the functionality of camera-based driver assistance systems → “quick test”
- Creation of a sufficiently realistic environment simulation, provision of all necessary stimuli
- Reduce required vehicle infrastructure (ECUs, cameras) to a minimum, simulation of further vehicle components
- Manual operation with preselected control elements
- Interconnection with further test systems
- Realize cost and time savings by transferring complex testing catalogues to the laboratory
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Overview driver assistance test system
How to test camera-based driver assistance functions

- Online creation and visualization of driving scenes with required accuracy
- Possibility of direct intervention into the driving scene and supply of relevant status signals coming from the simulation
- Simultaneous stimulation of the ECU with CAN signals (including actual simulation data)
- Verification of the ECU reactions through by analyzing CAN feedback messages

Testing scenarios:
- Lane detection → lane departure warning
- Vehicle detection → high-beam assistant, collision warning
- Traffic sign recognition
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DYNA4 Driver Assistance Package

- Road course
- Driving lanes
- Lane marks
- Traffic signs

- Main vehicle
- Fellow cars
- Static objects
  - (Sensor models)

- Simulation models
- Visualization

Implementation and visualization of driving scenarios to test camera-based driver assistance systems.
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Test scenarios

- **Lane detection / Lane departure warning assistant**
  - Display of different road and lane patterns with different types of lane marks
  - Validation of the lane detection during execution of the scenarios
  - Verify warnings from the lane departure warning system when leaving the driving lane

- **Vehicle detection / Active safety systems**
  - Display of various driving scenarios with other vehicles entering and leaving the own lane
  - Validation of the response of the ECU during variations of the distances between the main vehicle and fellow cars
Test scenarios

- Traffic sign recognition
  - Display of different traffic signs and additional signs with variation of their positioning (left/right/above)
  - Testing of the traffic sign recognition function during execution of the scenarios

- Environment detection
  - Fusion of sensor data
  - Combination of camera-based and radar-based systems
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Implementation of test scenarios – Road course

- Visually supported creation of desired road course

- Lane markings

- Traffic signs
Implementation of test scenarios – Traffic situation

- Driving task for the main vehicle
- Driving tasks for the fellow cars
- Positioning of static objects
- Distance-based trigger conditions for the execution of driving tasks
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Status signals provided by simulation in for evaluation

- Main vehicle speed
- Speed of other vehicle(s)
- Distances between vehicles
- Relative velocities
- Types of lane marks
- Speed limits
- Overtaking yes/no
- ...
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Integration

**bertrandt**
- Test sequence control
  - *b.sequence*
  - Status of driving scene
  - Status evaluation
  - Configuration recording
  - Configuration system behavior
  - Configuration evaluation

**TESIS**
- Simulation of driving scene
  - Start/Stop simulation
  - Configuration driving scene
  - Configuration status signals

**vector**
- CAN simulation
  - veh. behavior + evaluation
  - Status signals
    - (speed, trigger points, ...)

**DUT**
- ECU + Camera
  - System behavior
  - Driving scene

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<th>Time-stamp</th>
<th>Data Driving scene</th>
<th>Data CAN</th>
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Summary, outlook

- Ensuring functional safety of camera-based driver assistance systems → “quick test”
- Reduction of extensive test drives by using simulation → saving valuable resources
- Designing arbitrary (also “rare”) test scenarios → tests can be performed at any time
- Creation of reproducible test scenarios → regression tests
- Fully automated tests and analysis → more convenience for the tester

Outlook:

- Integration of additional data sources for driver assistance systems (“data fusion”)
  - Integration of navigation data
  - Integration of various sensor data (e.g. radar sensor)
- Enhanced visualization of the simulated driving scenario
- Direct connection to the video interface of the control units
Contact and further information

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