Testing ADAS using virtual drives

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April 16, 2015
Agenda

- Challenges
- Automotive Simulation Models tool suite
- Example applications
- Forward look into the future
Challenges with virtual test drives

- Real-time capable simulation models for vehicle dynamics, sensors, driver, road networks, traffic environment, …

- Creation of test scenarios for all kinds of traffic situations

- Test of perception and application algorithms by means of closed-loop simulation

- Integration concepts of sensor technologies in HIL simulation
Automotive Simulation Models
tool suite
Real-time capable simulation models …

Automotive Simulation Models (ASM) tool suite

ModelDesk

MotionDesk

Engine Diesel

Engine Gasoline

Engine Gasoline In-Cylinder

Engine Diesel In-cylinder

TurboCharger

DrivetrainBasic

Diesel Exhaust

Electric Components

Truck

Trailer

Pneumatics

Traffic

Vehicle Dynamics

Brake Hydraulics

Environmental

Vehicle Dynamics
Real-time capable simulation models …

Automotive Simulation Models (ASM)

Real ECUs or virtual ECUs

Open Simulink® models

Actuator models

Sensor models

Vehicle model

Virtual driver

Road, environment, driving maneuvers
Creation of test scenarios …

ASM Road – Where to drive …

- Road networks consisting of roads and junctions
- Independent height and surface definition
- Lanes with smooth transitions and specific line definition
Creation of test scenarios … – Integrate real-world road networks

Real intersection

Conversion from

• Google Maps, ADAS RP, …
• OpenDrive standard
  (http://www.opendrive.org/)
• GPS or X,Y,Z measurement data
• OpenStreetMap

Road conversion

ModelDesk

MotionDesk

Automatic generation of road side structures
Creation of test scenarios …

ASM Traffic – Simulation of objects in ADAS maneuvers

- Library with objects for vehicles, pedestrians, houses, traffic signs, …
  - 3-D dimensions, contour lines
  - Custom-specific object parameters
ASM Traffic and sensor models

- Sensors
- Perception Fusion
- Application
- Actuators

List of detected objects and associated attributes

- Geometric sensor approach
- Sensor models for 2-D contours, 3-D objects, object-specific attributes, traffic signs and lanes
- Object specific sensor activation
- Combination of different sensor models
Example applications
Lane departure warning tests at MAN

ModelDesk

ASM

PC with graphics card and MotionDesk

Camera-in-the-loop simulation box

Optical lens to adjust the camera’s focus

Residual bus simulation

Vehicle CAN

Automated evaluation of outputs in HMI

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Autonomous emergency braking tests at MAN

- ModelDesk
- ASM
- PC with graphics card and MotionDesk
- Camera-in-the-loop simulation box
  - Optical lens to adjust the camera's focus
- Residual bus simulation
- Vehicle CAN
- Measurement/stimulus CAN
- Radar sensor in simulation mode
- Automated evaluation of outputs in HMI

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Virtual AEB tests according to Euro NCAP protocols

- Automatically execute Euro NCAP tests and generate score results
- Efficiently test ECU software by simulating faster than real-time

Automated parameterization, execution and evaluation of Euro NCAP tests

Controller software: AEB, …
Virtual AEB tests with pedestrian detection and camera-in-the-loop HIL set-ups

- Realistic animation of pedestrians, cyclists, wheelchair users, animals, ...

- Library with different objects, e.g., with adults and children with different clothing
Forward look into the future
Test of perception and application algorithms by means of close-loop simulation

- Generic model providing reflection points of traffic environment with high 3D angular resolution
- Additional properties depending on reflecting objects
Advanced ASM sensor model for functional tests

- Flexible sensor configurations
- More realistic scope zone configurations
- More realistic sensor timing
- Artificial electronic horizon provider
- Road extension with preview points
  - Slope, curvature, speed limits, lane information
- Flexible preview parameterization (time or distance based)
Validation of ADAS requires virtual test drives

Simulation models, sensor integration concepts and test scenario generation are key points

dSPACE

- offers a complete tool-chain

- further invests ...
Thanks for listening!