VIRTUAL ACTIVE HEADLAMP DEVELOPMENT WITH CARMAKER AND CANOE

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AGENDA

• Background - Virtual Development at Volvo Cars
• Virtual Active Headlamp Development with CarMaker
• Integration with hardware
• The software and electronics revolution in cars – what does it mean and how do we meet these new challenges?

• Simulation as a necessary to meet the future
BACKGROUND

• The software and electronics revolution in cars – what does it mean and how do we meet these new challenges?
• Simulation as a necessary to meet the future
Consumer Trends: Safe, Green & Convenient
Technology Trends: Automation, Connectivity & Electrification

Common statement: “More than 80 percent of automotive innovations are driven by electronics, and amongst them, 90 percent are supported by means of software.”

What can clearly be seen:
- Increased demands for more efficient vehicle development
- More vehicle variants in shorter time
- Functional growth (exponential?)

How do we meet these challenges?
Enables testing of solutions before hardware is built
Find issues early – front-loading
Enables fully automatic, repeatable and safe testing of real driving situations
Leverages computing power (n*24/7 versus 1*8/5)
Measure the immeasurable – all signals are available
ON-LINE STEERING SYSTEM OPTIMISATION

Steering System Verification Using Hardware-in-the-Loop
Linköping University, Vehicular Systems
Bjeljevac, Salko
Karlsson, Peter
ISRN: LiTH-ISY-EX--15/4831--SE
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BENEFITS OF VIRTUAL HEADLAMP DEVELOPMENT

- Decrease night testing and verification in real cars
- Advance testing and verification earlier in the projects
- More control over the testing sequences - repeatability
- Possibilities to develop and test new lighting algorithms and lighting functions
The lighting functions is build up of different beam shapes

Low beam is e.g. created by the “Foreground” and “Cut-off” beam shape
FRONT HEADLAMPS BASICS - FOREGROUND
FRONT HEADLAMPS BASICS – CUT-OFF
FRONT HEADLAMPS BASICS – LOW BEAM

[Diagram showing the principles of low beam headlights with arrows indicating light direction and intensity]
FRONT HEADLAMPS BASICS – LOW BEAM
FRONT HEADLAMPS BASICS – L-SHAPE
FRONT HEADLAMPS BASICS – HIGH BEAM
HEADLAMP BEAM SHAPES IN CARMAKER

• Illustrating the different beam shapes

Foreground light
Cut-off
Highbeam spots
L-shape
Foreground light
The beam shapes are each created from a specific ISO-Candela matrix into a PNG-file directly in IPG Movie converter.
TESTS AND FUNCTION DEVELOPMENT

• Headlamp leveling during loading/unloading
• Headlamp leveling during e.g. acceleration/braking
• Swiveling adaptive bending light
• Active High Beam Control-functionality

• Development of new functions
• Algorithm verification development
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EXAMPLE – ADAPTIVE BENDING LIGHT IN CARMAKER

• Bending Light
• Right curve with three oncoming cars
LIMITATIONS IN VISUALIZING LIGHT IN CARMAKER

• The created beam masks works mainly for planar projections
• Long distances from the car is more difficult to visualize
• When combining different beam masks the light does not appear fully realistic

Solution:
• Transparent cones were used to visualize each beam shape
• This was build up in .tclgeo
TRANSPARENT CONES TO VISUALIZE THE BEAM SHAPES
CREATING TRANSPARENT CONES

- Transparent cones is created in a .tclgeo-file
- This is made for each beam shape respectively
- Purpose to enhance the visibility of the beam shape functions in IPG Movie
EXAMPLE REVISITED - WITH TRANSPARENT CONES

- Right curve with three oncoming cars.
VOLVO SCENARIO WITH TRANSPARENT CONES

- Imported road into CarMaker
- AHBC verification
EXAMPLE OF ANALYSIS ENHANCED BY CARMAKER
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CANOE + CARMAKER INTEGRATION – FMI COUPLING

1. Export Client FMU from CANoe*
2. Import Client FMU to CarMaker

Network & I/O Simulation (CANoe)
Vehicle Simulation (CarMaker & Simulink)

Remote GUI Commands (Tcl) via TCP/IP
Signal Exchange (FDX via UPD/IP)

FlexRay
CAN/LIN
D/A IO

ECU

CANoe Client FMU

1. Export Client FMU from CANoe* 2. Import Client FMU to CarMaker
TEST AUTOMATION THROUGH VTESTSTUDIO

Upload Test Configuration

CANoe

Remote GUI Commands (Tcl) via TCP/IP

Signal Exchange (FDX via UPD/IP)

CarMaker

FDX Client FMU
INTEGRATION IN SIMULINK
SETUP OF THE EXTERIOR LIGHT TEST RIG

Vector VN8912 / 8970
CANoe RT

Body Control Module (BCM)

Instrument panel

Light stalk

Left Headlamp

Right Headlamp
SETUP OF THE EXTERIOR LIGHT TEST RIG
HIL – EXAMPLE OF THE ADAPTIVE BENDING LIGHT
Using virtual simulation in CarMaker enables:

• **Decreased** night testing and verification in **real cars**
• **Advance** testing **earlier** in the projects
• More **control** over the testing – **repeatable**
• **Innovation** of new lighting functions