Validation of Field Measurements based on Verification Test Criteria for Value Added Functions

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Validation of Field Measurements based on Verification Test Criteria for VAF

AS

PS

DA

Autonomous Driving

Simulation

Image Processing

Invented for life

BOSCH
Validation of Field Measurements based on Verification Test Criteria for VAF

Agenda

→ Introduction
  → Problem Description / Challenges
  → VAF Explanation
→ Field Measurements
  → Test Criteria’s of Typical VAF
  → Example to show the deviation
  → Process improvements by inclusion of checks.
→Capabilities of MATLAB and GUIDE
  → Tool Implementation using MATLAB GUIDE
→ Conclusion and Future Scope
Validation of Field Measurements based on Verification Test Criteria for VAF

Introduction

→ Field measurements play a vital role to test the Automotive Software and Functionality

→ Huge cost and Effort involved in vehicle Testing

→ We always need several quick checks to validate the Field measurements

→ Goal is to achieve accuracy and save cost & Effort by avoiding rework

→ Need an automated way to validate the measurements, manual analysis always a tedious job.

→ User friendly environment is required to test the measurements
Motivation

→ Several functions require calibration parameters that are based on vehicle parameters during “normal” driving.

→ In order to obtain these parameters, field measurements have to be set up in a way that necessary situations are covered (E.g. a certain velocity range has to be maintained).

→ In order to verify that the theoretically derived requirements are a) correct and b) fulfilled, the field measurements have to be evaluated from the first test on!

→ The new GUI tests each individual drive once it is done, and can also be used as a final evaluation once all measurements are completed.
Value Added Functions

1. APB → Automatic Parking Brake

2. HHC → Hill Hold Control

3. DDD → Driver Drowsiness Detection

4. ACC → Adaptive Cruise Control
What is Parking Brake?

The parking brake, also called hand brake, emergency brake, or e-brake, is a latching brake usually used to keep the vehicle stationary. It is sometimes also used to prevent a vehicle from rolling.

The most common use for a parking brake is to keep the vehicle motionless when it is parked

**Mechanical** force to hold the wheels for Braking

Applies mechanical Brakes in **Rear Wheels**
Validation of Field Measurements based on Verification
Test Criteria for VAF

Conventional Parking Brake

→ A Lever which controls the parking Brake
→ Have only limited functionalities
→ Completely Manual working mechanism
→ No interface* with other Value added functions

Automated Parking Brake

→ A button which controls the parking Brake
→ Has Additional Functionality: e.g. Controlled Deceleration
→ Automatic mechanism and manual action supported
→ Mechatronic systems (Cable Pulling/ Motor on Caliper)
Example Test Criteria of Typical VAF to perform Field Measurements

→ Duration of Measurements
→ Yaw rate and lateral acceleration values
→ Vehicle drive speed
→ Steering angle position and duration
→ Brake pressure information
→ Controller actuation
Example to show the deviation of velocity
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Process improvements by inclusion of checks

1. Requirement Analysis
2. Perform Vehicle Test to generate Field Measurements
3. Self Evaluation tool to validate the Accuracy of Field measurements
4. Field Measurement Evaluation Completed

Validation

Test Passed

Test Failed
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Capabilities of MATLAB and GUIDE

→ MATLAB has the capability to handle the huge data set with variable sampling rate.

→ Less time to convert measurement files to various formats (MAT, MDF, & D97 etc.)

→ Availability of advanced functions (Resampling, Interpolation and Matrix Handling etc.)

→ Easy Derivation of Graphical User Interface

→ Robust, fast time-to-market

Tools Used: MATLAB R2012b 64bit, MATLAB® GUIDE®.
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Tool Implementation using MATLAB GUIDE

Steps after opening the tool from Executable

1. Click on the “Select Maneuver” select the MDF/D97/MAT - file.
2. Select Plot- File required.
3. Press Start button.
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Steps:

1. Click the Executable to open the Tool
2. Load the measurements and select to evaluate and press Start
3. Consolidated results will be shown to validate the criteria with red and green dots
Future Scope

→ Integrate the Self Evaluation Tool (Real Time) into the measuring Equipment

→ Reduces Time and Cost further

→ Automate the Process to get the End Results
Conclusion

→ MATLAB tool with GUI are very simple to process and does not require expert Calibration Engineers can use this tool as Self Evaluation Tool

→ Engineers are able to validate field measurements

→ Accuracy of the test measurements w.r.t. requirements are met

→ Simple to Debug
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Thank You for Your Attention!
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Back up Slides
### Validation of Field Measurements based on Verification Test Criteria for VAF

#### DDD- Driver Drowsiness Detection

<table>
<thead>
<tr>
<th>Function</th>
<th>Benefits</th>
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<tbody>
<tr>
<td>→ Detects driver drowsiness by analyzing the driving behavior</td>
<td>→ Reduction of sleep related accidents</td>
</tr>
<tr>
<td>→ Warns the driver in case of high risk of falling asleep</td>
<td>→ Communication of drowsiness level</td>
</tr>
<tr>
<td></td>
<td>→ Adaptation of vehicle to drowsiness level</td>
</tr>
</tbody>
</table>

#### Input

- → High resol. steering angle signal
- → Or: Electric Power Steering
- → Additional information, e.g. vehicle speed, turn indicator from vehicle data bus

#### Output

- → Drowsiness index
- → Driver Warning
- → Additional Information
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### HHC- Hill Hold Control

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</table>
| ➔ HHC prevents the car from rolling backwards after the brake pedal is released by the driver. | ➔ If the car is skidding with locked wheels the brake will be released to maintain steerability.  
 ➔ Avoid accidents even for inexperienced drivers. |

### Input

- Standstill detection
- Slope estimation
- Brake pressure monitoring
- Gear and Clutch Status
- Parking Brake Switch

### Output

- HHC maintains the brake pressure which was applied by the driver (no active pressure buildup).
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ACC- Adaptive Cruise Control

Function

→ Cruise control maintains a set, constant vehicle speed under varying road conditions

Benefits

→ Adaptive Cruise Control reduces the strain on the driver. Because ACC maintains a safe distance to the vehicle immediately ahead, the driving is much more relaxed, with reduced symptoms of fatigue.

Input

→ Steering Wheel System
→ Vehicle speedometer system
→ Clutch pedal switch system
→ Brake pedal switch system

Output

→ Maintain a preset distance
→ ACC distance alert
→ partial braking phase
→ full braking emergency phase