ECU Diagnostics in HIL Applications

Dr.-Ing. Jobst Richert · Section Manager SW Development
dSPACE GmbH · Technologiepark 25 · 33100 Paderborn
automotive testing expo · 6th of may 2008
Content

- ECU Diagnostics – Some Basics
- Automated Testing of ECU Diagnostics using HIL
- ECU Diagnostics as an Auxiliary Means in HIL
- Applying ASAM Diagnostics Standards in HIL
- Practical Problems
- Solution Approaches
- Summary and Outlook
Role of ECU Diagnostics

- Reading out Failure Memory
- Clearing Failure Memory
- Reading Measurement Values
- Testing of Actuators
- Flashing of new Software
- Coding of Variants
- Identification of assembled components
- Determination degree of damage and abrasion
- Activation of ECU internal test routines

Development → Production → Service

Test & Release  Customizing, Adaptation, EOL-Testing  Failure Detection, Failure Correction
Importance and Complexity of ECU Diagnostics

Diagnostics in Motronic-Systems covers …

- 40 % of Calibration Parameters
- 40 % of Functions
- 40 % of Lines of Codes
- 40-50 % of Processor Runtime


Percentage of ECU Diagnostics test …

- Up to 25 % of overall test costs
Automated Testing of ECU Diagnostics using HIL

- Test automation
  - Test Sequences
  - Test Parameter

HIL-Simulator

- Real-Time Model
- Failure Injection

PC

Diagnostics tool

Database

Diagnostics Interface

Cable Harness
Scenario 1: Putting into operation or reconstruction of a HIL simulator …

- Failure Memory Handling (reading and clearing)
  No failure memory entries == reference operation of HIL
- Coding of relevant variant(s) of System Under Test
- I/O check by activation of actuator test
- Adaptation of assembled sensors / actuators

Scenario 2: Manual or automated ECU diagnostics test …

- Identification of System Under Test
- Subsequent coding of relevant variant(s) of System Under Test
- Preparation of error-free starting condition of test sequence by clearing the diagnostic trouble codes
- Reading out measurement values
- Modification of calibration parameters
Retrospection: Diversity of proprietary Diagnostic Solutions

Excerpt from the palette of dSPACE solutions for ECU Diagnostics Interface (Mid 2000)
Existing Standards around ECU Diagnostics

- ASAM MCD-1MC (ASAP1)
  - ASAM MCD-1a (CCP, XCP)
  - ASAM MCD-1b

- ASAM MCD-2MC (ASAP2)

- ASAM MCD-3 (MC)
  - Measurement
  - Calibration

- ASAM MCD-3 (D)
  - Diagnostics

- Client Application

- Database

Bus

ISO 9141, ISO 14229, ISO 14230, ISO 15765

No ASAM Standard

ASAM MCD-2D (ODX)
Server side implementation of ECU Diagnostics Standards in CalDesk
Client side implementation of ECU Diagnostics Standards in AutomationDesk

**AutomationDesk**
- Graphical Testsequences
- Access to interfaces via block libraries
- Management of test projects
- Archiving test results, report generation

MC Tools
- INCA
- CANape
- ...

CalDesk

D Tools
- IN2SOFT
- DTS
- DSA
- T-Systems

D Tools
- RA-Consulting
- ...

dSPACE Simulator

3rd Party Simulators

Failure Injection Hardware

3rd Party Products

ASAM MCD-3MC

ASAM MCD-3D

dSPACE Products

ASAM standardized proprietary
Client side implementation of ECU Diagnostics Standards in AutomationDesk

ASAM MCD-2D (ODX)

MCD 3D Server

AutomationDesk

(D)COM

Host interface

HIL simulator

Analog I/O, Digital I/O, CAN

e.g. IN2SOFT, SOFTING, T-Systems, ...

ECU
AutomationDesk
1. Weak point: Diagnostics Data Bases Content
   - Still in practice: proprietary data bases
   - ODX complexity, incompatibilities resp. missing semantic clarity
   - Migration

2. Weak point: Diagnostics Data Bases Availability in time

3. Weak point: Automation Interface
   - Still in practice: proprietary APIs, using very different technologies
   - Very complex, very generic MCD-3D API – hard to use for ECU test developers

4. Weak point: OEM specific binaries

5. Weak point: Know-how hurdle between HIL- and ECU diagnostics area
Solution Approaches

- 1. Weak point: Diagnostics Data Bases Content
  - *Freeze ODX in its today’s version*
  - *ODX Authoring Guidelines*
  - *Best practise exchange between OEMs and Tier1*

- 2. Weak point: Diagnostics Data Bases Availability in time
  - *ODX Development to follow the entire software development cycle from specification to prototyping to implementation to test*

- 3. Weak point: Automation Interface
  - *HIL, i.e test-oriented convenience layer*
  - *new ASAM HIL-API project (DIAG Port)*

- 5. Weak point: Know-how hurdle between HIL- and ECU diagnostics area
  - *ASAM HIL API project (DIAG Port)*
ASAM HIL API project

Separated test systems today

ASAM HIL API Goal: Separation of Test HW and Test SW by means of standardized APIs

Future Standardization (under prep.): Exchange of test cases between different software systems by means of a standardized Test Exchange Format
Summary and Outlook

- ECU diagnostics is a very complex topic
- HIL technology is essential for ECU diagnostics testing
- ASAM Standards are indispensable for cost-effective test environments
- ASAM Standards are indispensable for ECU development processes
- Interaction of HIL and ECU diagnostics can be optimized
- Very promising new standardization project HIL API will lead to new solutions probably in 2009
Important Notice

© Copyright 2008, dSPACE GmbH. All rights reserved.

Brand names or product names are trademarks or registered trademarks of their respective companies or organizations.