Model Based Design: development of Electronic Systems

Stuttgart
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Agenda

- Model Based Design: purposes and process
- Model Based Design: vehicle development process
- Tools
- Functional Requirements:
  - Structure
  - Link to simulation models
- M.A.R.S.: a method to model and simulate
- Test Pattern: development and utilization
- Rapid Prototyping: purposes and process
- Rapid Prototyping: V.C.S. Project
Model Based Design: purposes and process (1)

- To validate Functional Requirements of the following Electrical and Electronic Systems:
  - Body Electronics
  - Infotainment
  - Driver Assistance
  - Integration of PowerTrain strategies
  - Integration of Chassis strategies
- To analyze the logics and strategies behavior in “typical” and “worst case” conditions
- To analyze and / or design the “diagnostic” and “recovery” strategies
- To develop new algorithms.
- To verify the integration of different functions
- To supply “executable models” to not-technical Fiat Auto departments (i.e. Marketing), in order to evaluate the behavior of the functionality.

Model Based Design: purposes and process (2)

Textual Specification
- MS Word
- MS Excel
- DOORS

Simulation Model
- Matlab
- Simulink
- Stateflow

Test Pattern:
- Development And Utilization

Textual Specification Validated
Executable Model
**Model Based Design:**

**Vehicle Development Process**

- **EE Platform definition**
- **Ptp1**
- **Ptp2**
- **Ptp3**
- **S.O.P.**

**Vehicle Development Process**

- **Project Definition (Concept)**
- **Project Development**

**Main Goal:**

TO VALIDATE THE FUNCTIONAL REQUIREMENT BEFORE USING THEM IN THE PROJECT DEVELOPMENT

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**Tools**

- **Database:** DOORS
- **Simulation Models:**
  - MATLAB
  - SIMULINK
  - STATEFLOW
- **Graphic Interfaces:**
  - ALTIA DESIGN
  - ALTIA DEEPSCREEN
- **Automatic Software Generation:**
  - REAL TIME WORKSHOP
  - R.T.W. Embedded
- **Rapid Prototyping:**
  - dSPACE
  - xPCtarget

**Change Management:**

- ECPG (SYNERGY)
Functional Requirements Organization

Vehicle Function AREA
- Comfort & Convenience
- External Signaling And Lighting

Vehicle Function GROUP
- Electric Sunroof
- Power Mirrors
- Power Windows
- Horn
- External Lights

Vehicle Function
- Rear Fog Light
- Main Lights
- Turn Lights

Functional Requirements: An example
Functional Requirement: Link to Simulation Models

Vehicle Function

AREA

Vehicle Function

GROUP

Vehicle Function

M.A.R.S.: Modeling Automotive Requirements Specification

Main Purposes:
- To define the validating process flow
- To define a common approach to model, simulate and validate the functional requirements.
- To define the set of tools used in the validating process
- To define which type of information is possible to exchange with the Supplier

Main Topics:
- Structure of the simulation model
- Basic blocks
- Styling rules
- Link to Functional Requirements
- Functional integration
- Functional partitioning
Test Pattern: Development & Utilization

The main purposes are:

- To verify and validate the logics / strategies modeled, at system (VFA) and sub-system (VFG) level.
- To verify the logics / strategies modeled from “user point view”
- To discover all working conditions of the logics / strategies.
- To defines the relationship between the logics / strategies with the environment (fault injection).
- To automate the application of the Test Patterns and the analysis of the results.

Test Pattern: Process Flow

The automatic activities are:

- Test Pattern Application
- Output Comparison
- Report Generation (from output comparison)
Rapid Prototyping Goals

- To verify/validate the functional logics/strategies modelled and simulated in a real environment (bench or vehicle).
- To verify the functional partitioning and integration.
- To validate the networks on vehicle.
- To evaluate functional logics present only in a real environment and not simulated on computer (i.e. debouncing, network management, output management, recovery logics, etc.).
- Not to generate software for production.

Rapid Prototyping: Process

Textual Specification

| MS Word | DOORS |

Simulation Model

| Matlab | Simulink | Stateflow |

Rapid Prototyping Environment

- CAN exist

Functional Requirements Completely Validated

Textual Specification Validated

Executable Model

Validation on real prototype
Virtual Component Simulator (VCS)

NBC: Body Computer Module
NPG: Driver Door Module
NPP: Passenger Door Module
NVB: Trunk Module

NBC: In, Out
NPG: In, Out
dSPACE: In, Out
NPP: In, Out
NVB: In, Out
B-CAN

dSPACE:
- dSPACE autoBOX
- CAN TX / RX
- Functional Logics

Nxx
- No Functional Logics
- I/O management

Thank You!

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