Model Based Design: development of Electronic Systems

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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

Main Goal:
To validate the functional requirement before using them in the project development.

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: ECPS (SYNERGY)
Functional Requirements
Organizations

Vehicle Function
AREA

Comfort & Convenience

External Signaling
And Lighting

Infotainment

Vehicle Function
GROUP

Electric Sun Roof

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.

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**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
  - MS Excel
  - DOORS

- **Simulation Model**
  - Matlab
  - Simulink
  - Stateflow

- **Rapid Prototyping Environment**
  - CAN

Textual Specification Validated + Validation on real prototype

Functional Requirements Completely Validated
Virtual Component Simulator (VCS)

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

- Functional Logics
- I/O management

- NBC
- NPG
- dSPACE
- NPP
- NVB

- dSPACE autoBOX
- CAN TX / RX
- Functional Logics

- No Functional Logics
- I/O management

Thank You!

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