MeMVaTEx Overview

Méthode de Modélisation pour la Validation et la Tracabilité des Exigences
Modeling methods for validation & requirements traceability

23 mai 2007

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Agenda

- Motivations
- Partners
- Objectives
- Influences
- Technical organization
- Deliverables & Automotive demonstrator
- Perspectives
Motivations

- **Heterogeneous environment**
  - Insufficient SW requirements traceability
  - Integration difficulty

- **Products functionality and complexity increase**
  - Strong realtime impact
  - Dynamic constraints & low resources

- **Quality concerns**
  - Early validation by explicit low level models
  - Optimization between safety and performance

- **Diversity & reuse increase**
  - Product line consideration
Partners

- **Industrial partners**
  - Siemens VDO
  - MondiTech

- **Academic partners**
  - CEA LIST
  - INRIA/UNSA
  - UTC/HEUDIASYC

- 3 years project duration, starting in January 2006
- 2.5 M€ (included 1 M€ ANR Funding)
- 21 Person years
Objectives

- Top-down software design methodology
  - Validation & traceability of requirements
  - Based on heterogeneous models
  - Supported by heterogeneous tools
  - Fill gap between architecture and behavior model
  - Real time impact
Influences

Projects in RTE domain

- EAST-ADL
- MARTE
- A-ADL

System & Software engineering

Realtime models

Standards and Organisations

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Related projects & initiatives

- **Usine Logicielle – System@tic Paris Region project**
  - model based software engineering solutions which allows standardizing and automating the design, the integration, the validation and the maintenance of the software embedded in these high technology products

- **ATESST – European project**
  - system modelling techniques that will deliver an automotive architecture description language

- **TOPCASED**
  - System/Software IDE based on Eclipse allowing model transformation
    - **GENEAUTO** – ITEA project: certified C-code automatic generation for embedded critical real-time systems.
    - **TRAMWAY**: an open-source requirement management tool

- **EICOSE – ARTEMIS cluster**
  - « European Institute for Complex & Safety Critical Embedded Systems Engineering » that is the first innovation cluster of ARTEMIS
Technical organization

SP0 T2 Dissemination and Standardization

SP1 T1 State of the Art

Homogeneous tools

SP1 T3
Platform architecture

SP1 T2
Requirement Modeling

SP1 T4
Variability

SP1 T5
Requirement Validation

Heterogeneous tools

SP1 T3
Platform architecture

SP1 T2
Requirement Modeling

SP1 T4
Variability

SP1 T5
Requirement Validation

SP1 T6 Method and tools evaluation

SP0 T1 Project Management

36 months

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**Objectives:** This task aims to suggest an UML requirements modelling method in the upstream phases of the development process and with the associated mechanisms of traceability, from specifications to allocation.

**Organization of works:**
- Requirement expression
- Requirements in relation with models
- UML Model definition for each EAST-ADL level
- Traceability management:
  - In model development
  - In requirement considerations with requirement documents and models
Integration of architecture constraints

Functional Requirements
- Algorithms
  - Control
  - Data
  - Modes

Non-Functional Requirements
- EAST-ADL, MARTE, SysML Models
- Safety Constraints
- Hardware Resources & OS
- Logical & physical time (clock, event, delay)

Integration of architecture constraints
- Multi-Level Distribution & Scheduling Analysis

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Variability

- **Objectives:** This task aims to take into account the specificity of products line definition in an incremental modelling methodology.

- **Organization of works:**
  - Variability management in existing / past projects
  - Variability specificities for MeMVaTEx
  - First variability requirements in MeMVaTEx and related focus
  - Links to V&V to address variability continuity during MeMVaTEx process
**Objectives:** This task aims to propose a demonstration process of the requirements consideration on the whole execution process. This demonstration process will have to be in accordance with the applicable reference (CEI 61508 standard and/or its future evolution in the automotive domain).
Final Deliverables

- Unified methodology for RTE system development (guideline)
- UML2/SysML profile proposal for RTE domain
- Tooled prototype
- Demonstrator (EMS) with automotive case study
A Verification & Validation process that respect requirements

Book of specification

V&V(k) → Req.(k) → satisfy → V&V(k+1)
V&V(k+1) → Req.(k+1) → satisfy → V&V(k)

Verification

Model(k) → verify → Req.(k) → Model(k+1)
Verification

Validation

Functionnal tests Integration tests Unit tests

Property verifications Syntactical verifications Structural verifications Transformation verifications

Motivations Partners Objectives Influence Organization Deliverables Perspectives

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Unified methodology

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Domain specific Language

MeMVaTEx approach

- based on UML2 standard for defining models and to appropriate real-time specificities: MARTE profile
  - Using of a universally understandable language
  - Facility of using common tools
  - Easier connectivity for V&V
  - Easier updates and evolutions
  - Adaptable with profile definition

- adapted to the specific automotive domain
  - EAST-ADL meta-model
  - Integration of automotive DSL specificities
Tooled methodology

- **SysML and UML modeling**: Artisan Studio and EMF interfaces with Eclipse models (Papyrus, RSA)
- **Requirements traceability**: Tramway or Reqtify, specific model transformation rules
- **Real time modeling**: Matlab/Simulink, Scade, Scilab/Scicos, Papyrus
- **Real time implementation**: SynDEx
- **Profiles & Models**: MARTE, EAST-ADL, SysML, Autosar
Illustrating Engine Knock

**Desired Combustion**
- Spark Plug
- Cylinder Head
- Flame Front
- Fresh Compressed Mixture

**Knocking**
- Auto Ignition
- Knocking

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Engine Knocking Sequence Photograph

Abnormal combustion
- Characteristic noise
- Lost of efficiency – Torque
- Consumption increase

Destructive aspect
- Combustion chamber pitting
  - Piston fusion or jamming
  - Sparking plug fusion

*Necessity to prevent, detect & correct this phenomenon*
Perspectives

- **Methods and analysis**
  - For a seamless design flow
  - Consistency checks between models
  - Automatic models transformations

- **Tools**
  - An integrated environment for the MeMVaTEx methodology
  - Extension of the environment with the seamless design flow

- **Application domain**
  - Transfer of know-how for others application fields (avionics and hardware appliances...)

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Dissemination & Standardization

Web site: [http://www.memvatex.org](http://www.memvatex.org)

Conferences

- Poster Présentation Projet MeMVaTex, Colloque TIC, session Poster, Lyon, France, Sept. 06.

Standardization of MARTE at OMG

- Participation of INRIA & CEA, OMG conferences