

## Embedded Control System group

Systems engineering for embedded control system & mechatronics

Research themes:


- Architectural design
- Modeling languages, management, tool integration
- Systematic verification of embedded systems

Example projects

- ARTIST2, ATESSST and DYSCAS

Large emphasis on automotive embedded systems


- Scania, VCC, Volvo, Mecel, DC, Bosch, Siemens VDO and tool/SW-suppliers



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## The role of software and electronics

Powertrain - Suspension - Displays -  
 Comfort - Diagnosis - Braking -  
 Active & Passive Safety - Telematics  
 - Anti-Theft Systems - ...




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## Outline and messages

- Managing complexity:
  - Architecture, organization, process and tools
- Model based development
  - Separation of concerns, abstraction, early integration
  - Documentation, communication, analysis, synthesis
  - Challenge: Model management and integration
- Solution alternatives
  - Information model/ontology based with domain views


- Industrial case studies

Information management, Product variability  
 Refinement, composition and transformations – behaviors  
 UML semantics and legacy  
 Systematic and cost-efficient verification  
 Engineering: formats, tools, organizations, processes!

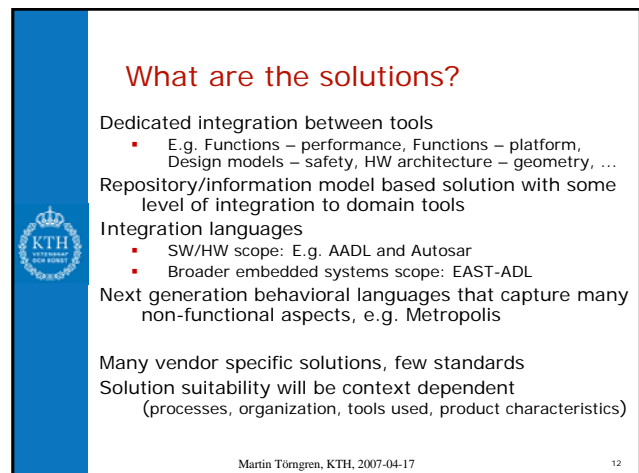
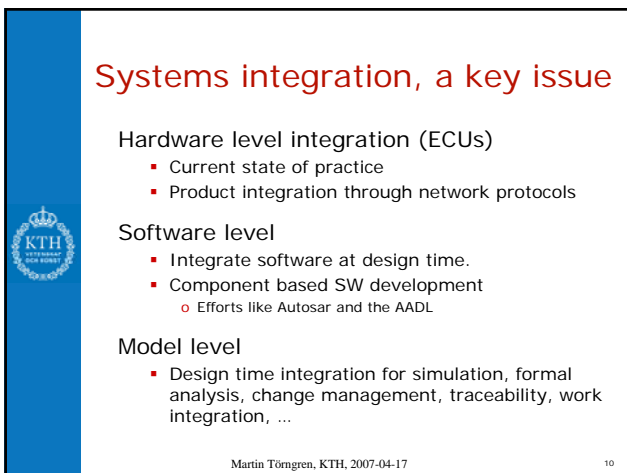
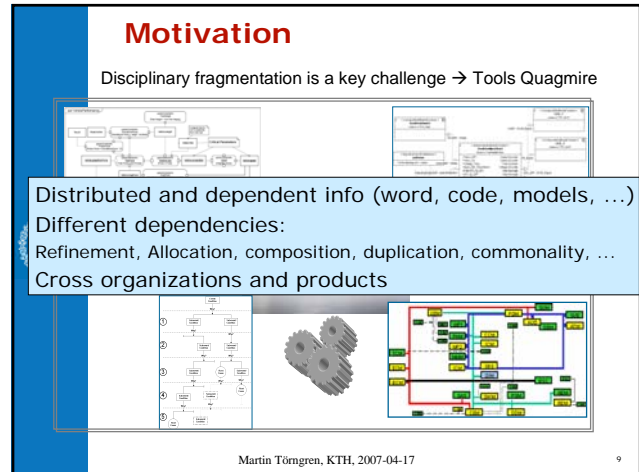
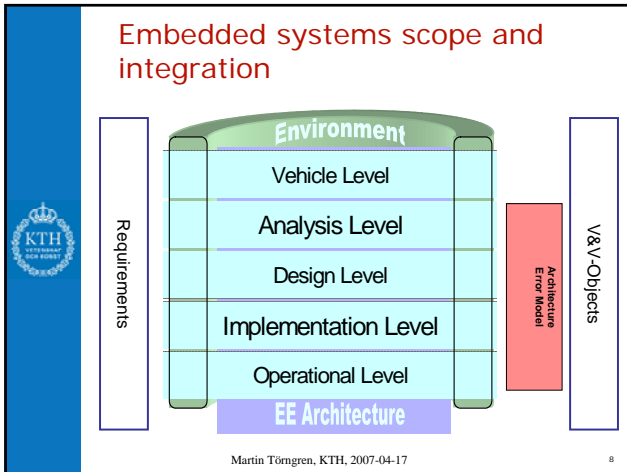


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## Mechatronics and co-design



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### Tooling ideas from early 90s

- *Early and detailed design*
- *Models, analysis, synthesis*
- *Methodology*

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### Example integration (Far project)

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### Example co-design tool-set: AIDA

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### AIDA2

Concept

- Multi-view modeling
- Model & tool integration
- Model data management
- PDM & SCM functionality

Instances

- Domain tools: Simulink, Dome, configuration tool
- Build and SW/HW configuration management

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## Advancing Traffic Efficiency & Safety through SW Technology: ATESSST

IST STREP project 2006-2008

- Volvo, VCC, Mecel, DaimlerChrysler, Etas, Carmeq, SiemensVDO, MentorGraphics, CEA, KTH, TUB

Architecture Description Language for Automotive Embedded Systems: EAST ADL 2.0

Integrated safety systems

Background: EAST-EAA project

[www.atesst.org](http://www.atesst.org)

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## EAST-ADL - an Information Model that captures engineering information

- Requirements and V&V
- Behavior: Vehicle system and environment
- Reuse and variability management
- Automotive domain adaptations
- Implementation: UML2 Profile definition
  - Includes Autosar and SysML constructs

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## Example - Error Modeling in ATESSST


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## What are the solutions?

- Dedicated integration between tools
  - E.g. Functions – performance, Functions – platform, Design models – safety, HW architecture – geometry, ...
- Repository/information model based solution with some level of integration to domain tools
- Integration languages
  - SW/HW scope: AADL, Autosar, ...
  - Broader embedded systems scope: EAST-ADL
- Next generation behavioral languages that capture many non-functional aspects, e.g. Metropolis

Many vendor specific solutions, few standards  
Solution suitability will be context dependent (processes, organization, tools used, product characteristics)

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## Outline and messages

- Complexity: Architecture, organization, process and tools
- Model based development / model level integration
  - Several research efforts
  - Information model/ontology based with domain views
    - Loose or tight integration
  - Introducing engineering solutions is a big challenge

- Product line architectural design

Systematic and cost-efficient verification  
Information management, Product variability  
Refinement, composition and transformations – behaviors  
UML semantics and legacy  
Engineering: formats, tools, organizations, processes!

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