Embedded control systems and Mechatronics

Martin Törngren

KTH - Royal Institute of Technology, Stockholm
http://www.kth.se/itm/centra/ices/

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Martin Törngren - brief CV

- Mechanical engineering (BSc)
  - Mechatronics (MSc)
    - Embedded control systems (PhD, 1995)

  Modeling and design of distributed real-time control applications
- Full professor in 2002; Embedded control systems
- Post-doc period 1998, EC JRC, Ispra, Italy
- 1995-1997; Created spin-off company www.fengco.se
- Industrial assignments (e.g. Smart spacecraft)
- Embedded control systems group – Research
  - Full supervisor for 5 finalized PhDs, cosupervisor for 2
  - Now supervising 8 PhD students. Two upcoming PhD theses
- ICES – The KTH Embedded systems centre
- KTH faculty board, Education and a little more

Innovative Centre for Embedded Systems

A KTH-based centre and network

- ABB, Enea, Ericsson, Scania, Stoneridge, ÅF
- KTH schools:

  Electrical engineering, Computer science, Electronics, Industrial engineering
- Embedded systems engineering and science
- Research, education and innovation catalyst
- Seminars, mobility, projects, demonstrators, information dissemination

Focus of research groups in ICES

Mechatronics
Model-based engineering, Architecting, Real-time

Formal methods, Software engineering, Data bases

Sensor Processing
Recognition, Scene analysis, Grasping, Sensor fusion

Optimimization theory, industrial matematics

Automatic Control
Networked control, Wireless sensors

Signal processing, wireless Requirements engineering

Human Computer Interaction
Interaction Design Usability, Evaluation

Mikrosystemteknik, Elmotorteknik, Elkraft, vehicle technology

Components&Platforms
SoC, FPGA, MPSoC, Link Level Communication (Radio, wire), Sensors, Actuators

ICES competences and focus

Focus areas

System design, Architecting, Methodology

Embedded system properties

Real-time, Energy efficiency, Reliability, Safety

Characteristics

Networked, Autonomous, Configurable, Resource constrained

Applications

Automation, Med-tech, Telecom, Automotive – given by members

The context: Mechatronic products

Communication

Computer *software*

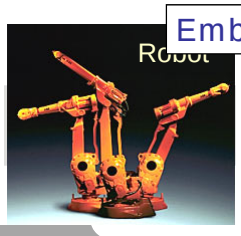
Actuators

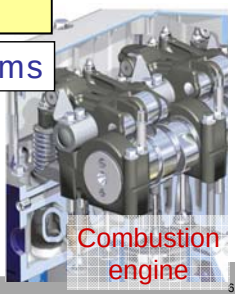
Control

Sensors

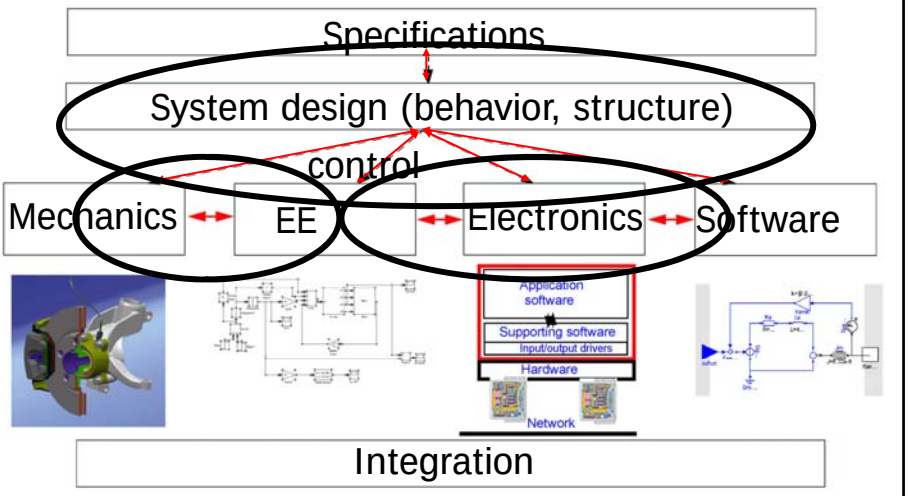
Mecha-nics

Embedded Control Systems



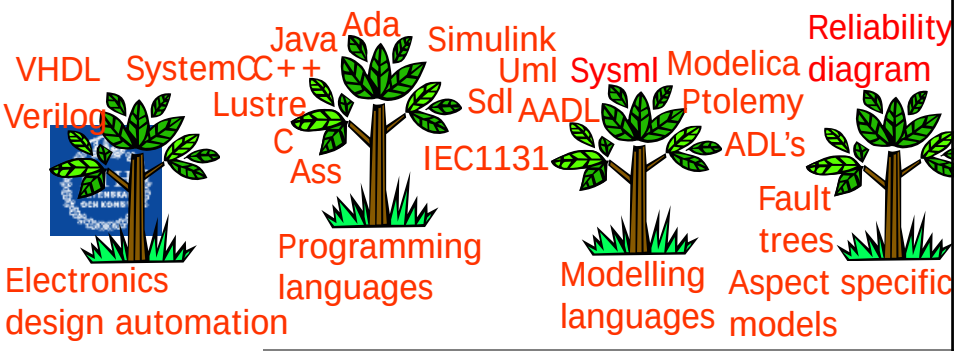


Research at the Mechatronics lab/KTH



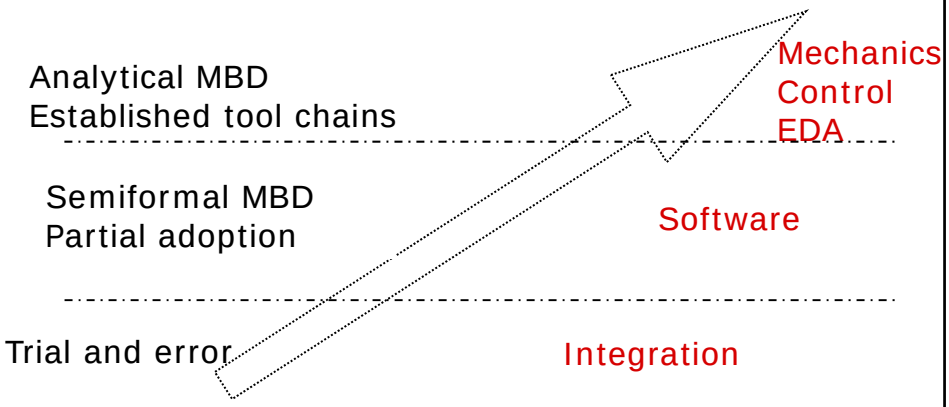
Components, tools, people and processes

Embedded systems heterogeneity



Component interactions, distributed functions
Product lines, Life cycle, Evolving technology!
Distributed and dependent info (word, code, models, ...)
Complex organizations

Maturity of model based development



Conceptual modeling, creativity, user aspects

Embedded Control System group

www.md.kth.se/RTC

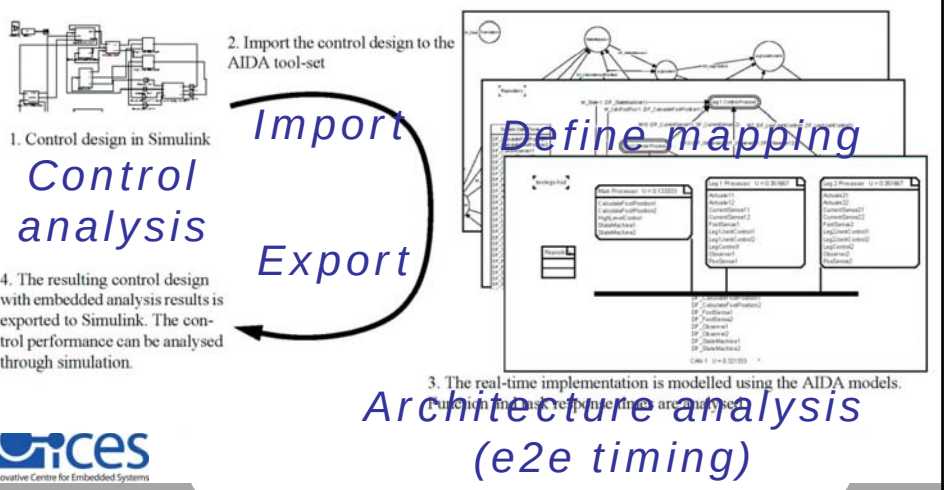
Embedded control systems science and engineering

Research themes:

- Control and computer system co-design
- Architectural design, trade-off analysis
- Model and component based development
- Methodology
  - Cost-efficient systematic design and verification

ArtistDesign, Artemis, ICES

Example co-design tool-set: AIDA



Some current topics

- Self-configuring automotive embedded systems
  - Variability, Config. management, metadata, QoS
- State of the art and evaluations
  - Modelica, Simevents, Simulink, Sysml/UML incl. Parametrics, Ptolemy, Bond graphs, VHDL-AMS,
  - Modeling languages for embedded systems
  - Trade-off analysis techniques
  - Model transf. Techniques, survey
- EAST-ADL – Architecture description language for embedded systems
  - Integrating safety analysis with MBD; Behavior
- Tooling (Eclipse plug-ins)

Suggestions for CAMPaM topics

- Formalism taxonomy / framework
  - Multitude of existing and new ”formalisms” and supporting technologies!
  - Terminology
    - Behavior, structure, properties
    - Design context: LoA, qualities, analysis, tasks
    - Technology: E.g. different types of model transformations
- Model/tool integration and management
  - Mechanics, electronics, software, systems
  - Roadmap
  - Bottlenecks, research focus
  - Industrial and scientific perspectives