Abstract

The world of embedded systems research is quite large. This document identifies the trends and hot topics in the world of embedded systems. Next it proposes a subset of this world as the working area for the Embedded Systems Institute.
Embedded Systems; From Small to Large
From Mono-Disciplinary to System Design

- System evolvability
- Process, organization, people
- System reliability
- System performance
- System cost
- Robustness
- Process issues

- Multi-objective design methods
- Performance and resource prediction
- Single aspect design method
- Hybrid methods

ESI focus

Legend:
- Well defined but soft
- Rather soft
- Well defined

Mechanical Engineering
Electrical Engineering
Software Engineering

Research Agenda for Embedded Systems
Gerrit Muller

version: 0.2
September 9, 2018
FIESAmethodLayers
Domains Mapped on CAFCR

Customer objectives

Application

Functional

Conceptual

Realization

market
business

application

functional

technology

health care
consumer electronics
office
semiconductor equipment
automotive

cardio/vascular
video entertainment
professional document
lithography
car navigation

persistent storage
search/query
wireless communication
image processing
motion control
print, display
workflow

DVD+RW, FLASH
DBMS
bluetooth, WLAN, UWB
MPEG 4
PID control
LCD, plasma, OLED
scheduling
VxWorks, RT-Linux,
Embedded Windows
Trends and Hot Topics in Embedded Systems

- Customer objectives
- Application
- Functional
- Conceptual
- Realization

hot topics
- interoperability
- reliability
- power consumption
- security

trends
- market dynamics
- creativity limit

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ESRAhotTopics
Performance and reliability
in relation with costs, interoperability, effort et cetera

Customer objectives
Application
Functional
Conceptual
Realization

Generalization over multiple market/business domains, application domains, and functional domains

Software, electronics, mechatronics, physics
1. *Methods* that fulfil *multiple objectives* exist to *create embedded systems*

2. These methods help to *speed up* the *creation* process, *reduce* the *risks*, and *increase* the *product quality*

3. These *methods* are *generic* for multiple *market/business domains*, *application domains* and *functional domains*

4. These *methods build upon* the *software* and *electronics technologies*, and to a lesser degree these methods build upon the more *conventional technologies*, such as *mechatronics* and *physics*.

5. These *methods* need an *intelligent adaptation* to the *specific domain*
The current working methods result in acceptable working systems, but:
- the integration and test phase is often too long and exceed the original planning
- too many product creations fail
- the qualities emerge more than they are designed in

Organizational focus is mono-disciplinary

Process and organization have a big impact on product creation

Many technical decisions are based on local technical considerations. Many business decisions are based on local business considerations. Technical and business decisions must be linked.
More Specific Assumptions

*CAFCR* and *qualities* are a useful framework for a further decomposition of methods.

The *working field* can be narrowed by focusing on a *subset* of *qualities*.

*ESI* must concentrate on *qualities* where *knowhow* is present in the *institute* and in the *network-partners*.

*ESI* must concentrate on *qualities* that are *challenging* from the *technology viewpoint*.

*ESI* must concentrate on *qualities* that are *valuable* from the *business viewpoint*.

The *value* of *ESI* is in the *multi-disciplinary* achievement of these *qualities*.

*Submethods* over all *CAFCR* views are needed to achieve the *qualities*.

This type of *research* requires *partners* that have the *in-depth technology domain know-how*.

This type of *research* requires *partners* that have the *in-depth application* and *business domain know-how*. 
Industry as laboratory

Method research requires practical experience

Application of the method is 80% of the effort, reflection and abstraction at most 20%

Industry as laboratory is a research method where the creation methods are applied in actual industrial context

The application of methods in the actual industrial context is necessary to:
1. build up experience
2. verify assumptions about improvements of methods

To research new methods a hypothesis is required about the method improvements