Multiple Property-based Partitioning for Embedded Applications
Gaetana Sapienza
Licentiate Thesis, June 10 2014
ABB
Gaetana Sapienza is a scientist currently working at ABB Corporate Research, Sweden. Her research interests are the modeling and architectural design of embedded systems.

In 2007, she received the MSc degree in Computer Science Engineering (2007) from the University of Catania, Italy. She joined ABB in 2006. Since then, she had the possibility to work in different departments, positions and projects mostly related to research activities. She started her carrier at Corporate Research, Sweden (2006) where her main research area was focused on modeling and design of mechatronics systems. In 2007-2011, she joined to the R&D Electronics Department at ABB Control Products, Sweden to work as responsible for the simulation platform related to the design of motor control system algorithms. Since 2011, she is back to ABB Corporate Research, where she is involved in several research projects including Artemis JU projects (iFEST and EMC2). At the end of 2011, she started an Industrial PhD at the ITS-EASY Industrial Research School at Mälardalen University Sweden. Her research is focused on hardware and software design methodologies which aim to improve of the embedded systems development process.

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Abstract

The new development of different types of computation units, such as FPGAs and multicore CPUs, enables a tremendous improvement in performance of applications that utilize the dedicated types of computations. For complex applications this however introduces a new challenge - what is the optimal deployment configuration of their components?

Today the application deployment is based on ad-hoc architectural decisions taken in an early design phase, when many design details are unknown, and as a consequence they often change in a later phase, increasing so the development costs. In addition, the decisions are taken based on a limited number of requirements, mostly related to runtime properties such as performance, resource utilization and power consumption, but do not consider many other aspects related to lifecycle properties, or to the project constraints. This approach increases the risk that a decision has a negative impact on a runtime or a lifecycle system property and may lead to the mentioned changes.

This thesis addresses the problem of optimal hardware/software deployment of an application. The main objective is to define a process in which the deployment decisions are taken in a systematic way in a later phase of the design process, and the partition decision process takes into account all artifacts on which the decisions have direct impact. These artifacts include the application’s runtime properties, the properties related to the application lifecycle, the business goals, and the development project constraints.

To achieve this objective we have a) defined a development process model that addresses the deployment explicitly in the late design phase, b) designed a metamodel of component-based applications deployed as hardware or software executable units, and c) analyzed the suitability of Multiple Criteria Decision Analysis methods for providing partitioning decisions based on a large number of criteria. In addition we have analysed which properties are affected by the partitioning decisions in the Control and Automation domains. The feasibility of the proposed process is demonstrated throughout an industrial case study.

Partitioning Process Design

![Partioning Process Flow Diagram](image)

Simplified Overview
Publications Included in the Licentiate Thesis

These publications are included in the Licentiate Thesis


Related Publications

These publications are selected among the other not included publication, since they are related to the thesis. They contributed to the thesis results.


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**Industrial Software Engineering Research Group**

The research group Industrial Software Engineering, led by professor Ivica Crnkovic, is focusing on engineering of complex software-intensive embedded systems, covering the entire lifecycle and including technologies, methods and processes. Particular emphasis on component-based software engineering and component-models for embedded systems.
ITS-EASY is an industrial research school in Embedded Software and Systems, affiliated with the School of Innovation, Design and Engineering (IDT) at Mälardalen University (MDH) as an integrated part of the MDH strategic research area Embedded Systems (ES).

ITS-EASY is funded by the Knowledge Foundation (KKS), and the nine participating companies. ITS-EASY started October 1st 2011, and will continue until September 30th 2020. During that period the PhD stu¬dents will complete their studies and obtain the doctoral degree in Com¬puter Science.

ITS-EASY is a large organization: it counts 22 PhD students, 14 main advisors from IDT, 18 co-advisors from IDT and the partner companies, and more than 25 associated members; senior researchers and industrial specialists. The board, led by Helena Malmqvist, ABB, has five members, and the industrial committee where all participating companies are represented, has 11 members. The management team of the research school consists of five members. All in all, about 85 persons are directly engaged in ITS-EASY.

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The ITS-EASY post graduate school for Embedded Software and Systems

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