

Ilias Gerostathopoulos, PhD Thesis

Model-Driven Development of Software-Intensive Cyber-Physical Systems

Assessment

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The thesis addresses an important and up-to-day challenge – how to successfully design and develop software-intensive cyber-physical systems (in the thesis the term siCPS) is used. The emphasis here is on software-intensive systems, meaning that the design concerns a design of software that will be deployed on (existing) platform that a CPS provides. Since the application of siCPS increases enormously in practically any area, and software brings great possibilities for new functions, but at the same time increases the complexity of such systems, the question how to efficiently design such systems with assurance of important properties, such as dependability, is not only very important but also difficult to answer. This thesis gives a contribution in that direction.

The thesis work is expressed in terms of identification of the main challenges for software engineering methods for siCPS, the research goals and the contributions. The two main research goals are defined (the first goal is “to propose an appropriate design process for open-ended siCPS” using model-based approach, and the second goal is “to map the proposed design models to implementation level abstractions to allow for model-driven development and early experimentations in siCPS.” These goals are then broken in several subgoals, and for each subgoal a contribution is presented. The contributions are of different form – a theoretical foundation constructions and implementation.

The thesis consists of six chapters. Chapter 1 introduces the objective of the thesis, the research goals and a list of all publications that contribute to the research results. Chapter 2 gives a state of the art with the reference to “Requirements Modeling and Analysis for siCPS” and “Software Development Methodologies and Implementation Abstractions for siCPS”. Chapter 3 is the main part of the thesis and it presents the contributions as the original papers published before. Chapter 5 discusses and presents the evaluation of the results, and finally Chapter 6 concludes the thesis with a conclusion and future work.

The thesis is well written and well structured. The published papers are presented in their original form and to link them together an extensive introduction and state of the art are presented, as well as an evaluation strategy was shortly discussed.

The contributions are clearly stated and together they show an implementation of a sound approach, namely, use of model-based and model-driven techniques.

The thesis includes seven peer-reviewed papers published in reputed conferences (one of them on a workshop). In addition Mr. Ilias Gerostathopoulos is a co-author of 11 publications, directly or indirectly related to the thesis. This is an impressive number. All papers have several co-authors, and for this reason it was important and good that Mr. Ilias Gerostathopoulos explicitly declared his contribution in the included papers.

If we refer to some weaker parts of the thesis than we could note that writing a thesis as a set of papers is always challenging as there is a risk that the flow is somewhat scattered, and that the parts are too loosely coupled. In general this is avoided in the thesis, but to some extent particular papers do not look like part of an integrated approach. This however does not disturb the overall impression of the thesis. The thesis has a state of the art of particular areas, and this is Ok. The thesis would be even stronger in the related work is referred to in a common section, not only in the particular papers. A thesis usually includes a section about used research methods: in this case the methods are implicitly described through the direct work on the contributions. The Evaluation Strategy chapter (as a part of the research method) could be more detailed, as it has just brief overviews of the work done. However, most of the papers have evaluation parts, which “covers” the shortness of this chapter. Finally, CPS can be very different systems from different domains with different concerns. A discussion about the scope and limitation of the methods and types of CPS that the method is applied to would increase the value of the thesis. However all these weakness are of minor character.

Based on the produced results in the publications, and based on the thesis content, the motivated challenges and presented contributions, I find that the thesis satisfies all criteria to be approved as a PhD thesis, and the thesis shows clearly the author’s ability for creative scientific work.



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