TU WIEN Informatics

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To

Dean's office, Research affairs,
Ph.D. study department

FIT VUT Brno

Thesis Review

Doctoral thesis (title of the thesis): FAULT-TOLERANT SYSTEMS DESIGN AUTOMATION

Name of the doctoral student (name and surname): Ing. Jakub LOJDA

Name and institution of the reviewer (full name of the reviewer, full name and country of the institution):

Dr. Andreas Steininger, Assoc. Prof. at the Institute of Computer Engineering, TU Wien, Austria

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I. Doctoral Thesis

Appropriateness and Relevance

The topic of automating the implementation of fault tolerance in a computer system has been a hot topic throughout decades and is still largely unsolved. It is getting extra importance nowadays where systems are getting so complex that manual design and verification become infeasible and automated methods need to be employed to avoid human error. In this sense the topic of the thesis is very relevant and it is appropriate for the field of Computer Science.

A summary of the Contributions of the Thesis

The overarching goal of the thesis is to elaborate an automated design flow that can augment a given hardware design with fault-tolerance enhancements in an optimized way. The steps the author takes towards this goal form the contributions of the thesis:

Firstly, the design description needs to be extended by the fault-tolerance enhancements in an automated way. This is indeed accomplished for descriptions given in C++ language and for VHDL designs.

Secondly, the efforts taken for fault-tolerance improvement need to be balanced with respect to the related overheads. This optimization part of the work it is mapped to a special type of Knapsack-Problem, which makes it possible to apply existing solutions for the latter. Ultimately, an algorithmic solution is given.

Thirdly, as a prerequisite for the optimization, an efficient method for assessing the fault-tolerance gain obtained through a certain combination of measures needed to be elaborated.

Each of these goals has been achieved and the proposed solution demonstrated at example designs. This is a remarkable achievement, since the problems are quite hard. Still, however, in several places I would have loved to see the author dig deeper, beyond showing the basic feasibility: Where are limits/limitations of the respective method? How do the approaches behave with more complex target designs? How does the workflow compare to related approaches from the literature?

Given the large breadth of the work, it is understandable that not each aspect could be elucidated in full depth – narrowing the focus a bit would have made that easier. Even the title of the thesis is already very broad, e.g.

Novelty and Significance:

The key contributions of the work have been published in reviewed journals and conferences, which confirms their novelty. The author has throughout been very careful in identifying real-world problems and showing that the proposed solutions indeed work in practice. To this end he has taken high efforts in implementing the concepts and studying them in actual use cases. So the solutions are definitely valuable in practice, and, as mentioned, they address a very relevant problem in the community.

Evaluation of the Formal Aspects of the Thesis:

The thesis is formally structured as a cumulative thesis. The first 79 pages describe scope, related work, methodology and contributions of the thesis, and they put the original publications – which follow in the second part of the thesis, in context with the goals. This is as expected and usual.

The structure is good, albeit a bit non-linear in some places, and easy to follow. The language is English

Quality of Publications

The key contributions of the research underlying this thesis have been published, and this is nicely laid out in the thesis. In fact, the candidate has a remarkable number of publications on the thesis topics. In all the publications that are part of the submitted thesis, he is the first author. This is very positive.

However, in none of the publications he is the only author. This may be seen as a positive sign for him being a team player – which is important for research – but at the same time dilutes his personal contribution a bit.

Among the publication contained in the thesis there is one in a respected journal (albeit not top class in the community), the other papers are from conferences. Again, most of those are respected but definitely not flagship venues in the community. That's a pity – the work would have deserved more spotlight.

Still, in summary, the publication output is respectable and appropriate.

II. Candidate's Overall Achievements

Overall R&D Activities Evaluation:

Beyond the necessary theoretical "scientific" concepts, ideas and background, the thesis has a particular strength in the practical "engineering" aspects: All the concepts presented have been developed with the practical use and constraints in mind, and they have been put into practical demonstrators and evaluated there. Managing this duality is an important asset of the candidate, especially in the field of computer engineering, and it requires a lot of experience and creativity at

the same time. His publication list, beyond the thesis, seems to confirm this. Obviously, also considering his long research record, Jakub has found his place in the research community.

Assessment of Other Candidate Characteristics (optional):

For a future career as a scientist, I would recommend the candidate to seek publications outside his usual “pool” of venues, preferably in the flagship conferences and journals. That might require diving deeper into theoretical aspects at some places, or regularly compiling a “bigger picture” into a kind of milestone publication.

III. Conclusion

The thesis addresses a very important and relevant topic in computer engineering. It suffers a bit from the over-ambitious goal and large breadth, which naturally leads to several avenues being taken but not fully explored. Still, without doubt, the presented research offers several novel contributions that give evidence for the author’s creativity, knowledge of the field and ability to conduct scientific analyses.

In conclusion, judging the doctoral thesis and the candidate’s public webpage with the publication list, I see Jakub Lojda qualified for the award of a Doctoral degree, according to the relevant regulations.

Vienna, 11.7.2023

Signature of the reviewer: