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## Review of the PhD Thesis

PhD student: **Ing. Miloš Minařík**

Department of Computer Systems, Faculty of Information Technology, Brno University of Technology

Title: **Concurrent Evolutionary Design of Hardware and Software**

The thesis deals with the problem of concurrent evolutionary design of hardware and software systems (HW&SW). In the first part the author presents some relevant works and results of other authors. The main part of the thesis presents an original methodology for co-design of HW&SW. The proposed methodology is explained and demonstrated on several practical applications as: finding maximum value, parity experiment, sigmoid function approximation, combinatorial approximation and image filter design. The proposed evolutionary design methodology was able to solve the mentioned problems with success and it shows that the presented idea of concurrent HW&SW co-design is perspective for the future design of computational systems. The thesis represents a considerable contribution to new design approaches of computational systems.

I have following critical remarks to the text of the PhD thesis:

1. The text of the PhD thesis is too general and too brief for sufficient understanding of the proposed methods. There are many references to literature instead of direct and detail explanations, which makes difficult the sufficient understanding of the proposed methodology. It was necessary to read also the author publications to better understand some important details.
2. The representation of the individual of the population is missing in all experiments. The phenotype-genotype mapping is important for better understanding and for future reproduction of the proposed methods. Next, more details about genetic operators mutation and crossover are not explained. Details are in the authors publications, mainly in ICES 2013. Also more information about fitness function evaluation is explained in this publication in comparison to the PhD text. Graphs of fitness function evolution are missing in results of all experiments. A single case where such a graph is presented is the author publication in EUROGP 2014.

I have following questions or requirements to the author:

1. You state: "To the best of our knowledge, there is currently no such framework supporting concurrent evolution of hardware and software." You mentioned at least 8 references in your thesis [3-9, 11] where HW&SW co-design was introduced. How should I understand this statement?
2. Please show some good demonstrative example of an individual with concurrent HW&SW co-design (with HW part and SW part). Show the fitness evaluation of such individual. Show examples of various types of mutations of this genotype.
3. I guess there are problems with premature convergence in your HW&SW co-evolution, as it is in the majority of other complex evolutionary designs. You mentioned that the success rate of your experiments was 19 %, 2.5 % etc. How it is possible to increase the success rate of your methodology in the future?
4. I guess there can be problems with bloat in the HW&SW co-evolution too. What is your experience in connection to this question?

**Conclusion:**

The thesis represents a considerable scientific contribution in the area of new design approaches of computational systems. After sufficient answering of the above mentioned four questions/requirements I propose to accept the PhD thesis of Miloš Minařík and to graduate him with the title: „Philosophiae doctor“ – PhD.

In Bratislava, December 22th 2017

Ivan Sekaj