



Opponent Review of Doctoral Dissertation

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| Applicant: | Roman Mego |
| Title of Dissertation: | Parallelism in digital signal processing |
| Opponent: | Roman Wyrzykowski |
| Opponent's Department: | Czestochowa University of Technology, Department of Computer Science |

In accordance with the Study and Examination Rules of BUT, in his/her review the opponent will mainly comment on:

- a) the topicality of the dissertation,*
- b) whether the dissertation achieved its given objective,*
- c) the problem-solving procedure and the results of the dissertation along with the concrete contribution of the doctoral student,*
- d) the significance for practical application or the progress in the field,*
- e) formal and language qualities of the dissertation,*
- f) whether the dissertation fulfils the conditions of Section 47 (4) of the Act,*
- g) whether the student proved his/her creative abilities in the given research field and whether the work does or does not comply with the standard requirements placed on the dissertations in the given field. The review is not valid without this conclusion.*

It is necessary to add a concise commentary to each of the points below.

Ad a) Topicality of the dissertation

The topic of the dissertation is very topical.
Comment:
The chosen topic of the dissertation is up-to-date since efficient usage of parallel computing architectures is critical for achieving the high performance required in many application domains, including digital signal processing (DSP), considered in this work.

Ad b) Objective of the dissertation

The objective of the dissertation was achieved.

Comment: The main objective of the dissertation was to develop a tool that can be used to implement DSP algorithms on VLIW processors with the efficiency provided by low-level programming languages, but with advantages provided for programmers by using high-level programming languages.

Ad c) Problem-solving procedure and the results of the dissertation and the concrete contribution of the doctoral student

The problem-solving procedure and the results of the dissertation are above average.

Comment:

The main result of the dissertation is the software that uses a dataflow graph approach to describe algorithms. This approach allows efficient mapping of DSP algorithms onto architectures of VLIW processors and generating low-level assembly codes. Such a problem-solving procedure deserves a high rating as adequate to the problem being solved and ambitious enough.

Ad d) Significance for practical application or progress in the field

The significance for practical application or progress in the field is above average.

Comment:

Despite some limitations, the developed tool can be used to create optimized parts of real-life codes in the assembly language for VLIW processors. These processors are efficient multicore architectures for digital signal processing, embedded computing, and other application domains. Recently, an increase in the popularity of VLIW processors can be observed, and the developed approach and tool meet this trend.

The reviewer would also like to draw attention to the original and important from the practical point of view results in the area of evaluation and optimization of the energy efficiency of computation.

Ad e) Formal and language qualities of the dissertation

Formal and language qualities of the dissertation are above average.

Comment:

The formal and linguistic aspects of the work do not raise any major objections. The English language is correct, the content is well understood. The key conclusions are supported by experimental results.

Ad f) The dissertation fulfils the conditions of Section 47 (4) of the Act

The dissertation fulfils the conditions of Section 47 (4)*) Act No. 111/1998 Sb. Higher Education Act: YES

*(*4) Studies are duly finished with a doctoral state exam and dissertation defence, which prove the ability and readiness to work independently in the field of research or development, or in theoretical and creative arts. The dissertation must comprise original and published results or results accepted for publication.*

Ad g) Creative abilities of the student in the given research field. Compliance with the standard requirements placed on the dissertations in the given field.

The doctoral student did prove his/her creative abilities in the given research field and the work does comply with the standard requirements placed on the dissertations in the given field.

Comment:

The problem solved in this dissertation is up-to-date and sufficiently complex. Its efficient solving with the proposed approach and tool proves (i) the doctoral student's creative abilities and (ii) complying the reviewed work with the standard requirements placed on the dissertations in the given field.

Overall evaluation:

In this dissertation, the doctoral student solved a complex and important scientific problem achieving original and technically sound results. The work comply with the standard requirements placed on the dissertations in the given field.

Opponent's questions:

1. A definite insufficiency is caused by the very limited characteristics of VLIW processors developed in the world and available on the market. Practically, only one architecture is described - produced by Texas Instruments. Meanwhile, there are many VLIV processors at the moment.
2. The result of the shortcoming in point 1 is the lack of experimental confirmation of the effectiveness of using the proposed tool for other VLIW architectures.
3. The signal graphs of the algorithms considered in the paper are sufficiently regular. Is it possible to effectively use the developed tool for algorithms with less regular graphs?

4. Please comment Fig. 3.4, where the speedup is always less than 1, and for a single thread is equal to zero. How it is possible ?
5. Pg. 5: the x86-32/64 architecture is, in fact, not a pure CISC solution. It represents a mixture of CISC and RISC approaches since instructions from a CISC instruction set are decoded to a limited number of instructions executed in RISC fashion.
6. The reviewer would like to ask the doctoral student to present at least one diagram showing energy consumption over time for the cases considered in chapter 4.

I **recommend** **do not recommend** **the dissertation for the defence.**

Date: 24.03.2023

Signature:

