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Review of the doctoral thesis *Procedural code integration in streaming environments* by RNDr. Michal Brabec

To whom it may concern,

Stream processing is a programming paradigm that exploits a limited form of parallel processing by restricting parallel computation by applying a series of operations to each element of a sequence of data. To ease the programming of streaming platforms this thesis presents a framework for automatic translation of applications written in a subset of C# to a complete application for the Bobox streaming platform.

The main contribution of this work is the Hybrid Flow Graph (HFG) – a novel program representation used as intermediate representation during the translation process. The HFG combines the program information which usually is kept separated in different graphs like the control flow and data flow graph, in a single directed graph. The semantics as well as transformations on the graph are specified using graph rewriting systems. The HFG is novel and creative scientific work.

The HFG is the basis for the analyses and optimizations of the compiler. Supported analyses are control flow analysis, loop analysis and data flow analysis. As no objects and only one dimensional arrays are supported an alias analysis is not necessary. Supported optimizations are component extraction, dead and empty node elimination, range extraction, array extraction, token extraction and vectorization.

To test the correctness of the compiler a huge set of test programs is automatically generated which test all parts of the compiler. The performance is evaluated with the case study of a version of the Levenshtein Distance Blocked Algorithm and small programs like convolution, Serpent cipher and filters. The experiments show the expected performance improvements resulting from the exploitation of the parallelism. It is demonstrated that with stream processing extraction of parallelism is simpler and more efficient for a limited set of applications than with a general programming paradigm. Sequential programs in C# are automatically transformed

into efficient streaming applications.

Part of the work has been published in conference and journal articles. The most relevant is "Transforming Procedural Code for Streaming Environments" which appeared at PDP'17, the 25th Euromicro International Conference on Parallel, Distributed and Network-based Processing, a well known IEEE conference. Here the main parts of the thesis (the HFG, the compiler and the experiments) have been presented.

For every chapter this thesis examines in detail the state of the art. The formal and experimental methodologies used are sound and reflect current scientific practice. Michal Brabec showed that he is able to develop new ideas and to advance the science. The thesis satisfies the conditions of a creative scientific work. Furthermore, Michal Brabec has published parts of his thesis work in 8 articles in peer reviewed conferences or journals which demonstrates the novelty and relevance of the work.

Therefore I conclude, this thesis can be defended.

Sincerely,

Andreas Krall