In: *Advances in Parallel Computing* vol. 27, pp. 103-112, DOI 10.3233/978-1-61499-621-7-103.
Proc. of ParCo-2015 conference, Edinburgh, UK, 1-4 Sep. 2015.

Optimized variant-selection code generation for loops on heterogeneous multicore systems

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Abstract. We consider the general problem of generating code for the automated selection of the (expected) best implementation variants for multiple multi-variant subcomputations on a heterogeneous multicore system, where the program's control flow between the subcomputations is structured by sequencing and loops. A naive greedy approach as applied in previous works on multi-variant selection code generation would determine the locally best variant for each subcomputation instance but might miss globally better solutions. We present a formalization and a fast algorithm for the global variant selection problem for loop-based programs. We also show that loop unrolling can additionally improve performance, and prove an upper bound of the unroll factor which allows to keep the run-time space overhead for the variant-dispatch data structure low. The method is implemented in a C-based run-time system that can be used for dynamic optimization. We evaluate our method in case studies using an ARM big.LITTLE based system and a Nvidia GPU based system where we consider optimization for both energy and performance, and show that the runtime overhead of our approach is low.

Keywords. Code generation, variant selection, heterogenous systems, GPU-based system, loop optimization, dynamic optimization

Note: This presentation will review and give an update on our recent paper with the same title, presented at the ParCo-2015 conference, Sep. 2015, Edinburgh, UK, whose proceedings appeared at IOS Press in April 2016. The full paper can be provided on request.