Towards a Unified CPU–GPU code hybridization: A GPU Based Optimization Strategy Efficient on Other Modern Architectures

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Abstract. In this paper, we suggest a different methodology to shorten the code optimization development time while getting a unified code with good performance on different targeted devices. In the scope of this study, experiments are illustrated on a Discontinuous Galerkin code applied to Computational Fluid Dynamics. Tests are performed on CPUs, KNL Xeon-Phi and GPUs where performance comparison confirms that the GPU optimization guideline leads to efficient versions on CPU and Xeon-Phi for this kind of scientific applications. Based on these results, we finally suggest a methodology to end-up with an efficient hybridized CPU–GPU implementation.

Keywords. Parallel code optimization, vectorization, hybrid code, GPU, Xeon-Phi.

1. Introduction

The recent development of Graphic Processing Units (GPU) and Xeon-Phi (X-Phi) accelerators now offers a large panel of solutions for an extensive increase of computing performance without requiring heavy structures of supercomputing centres. However, the adaptation of existing codes on accelerators may remain tricky. For example, the *SeisSol* [4] software for seismic simulations based on a Discontinuous Galerkin (DG) numerical scheme, has been severely optimized for the Xeon-Phi Knights Landing (KNL) architecture. Since 2013, complex optimization works were made to optimize DG computations on GPU architecture: [5] introduced an auto-tuning mechanism to improve an already optimized generic GPU implementation. In 2016, a semi-Lagrangian DG method applied to plasma physics applications was developed and implemented on Xeon proces-

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