Bachelor’s Thesis or Master’s Thesis

Implementation and Evaluation of MLEM algorithm on Intel Xeon Phi Knights Landing (KNL) Processor

Background
In a current project the Chair for Computer Architecture analyzes modern HPC system with heterogeneous architectures towards exascale computing. Real-world applications which represent a class of typical HPC problems are an important element. One example is the maximum likelihood expectation maximization (MLEM) algorithm [KWS+09], which is used for image reconstruction in positron emission tomography (PET). PET visualizes functional processes by measuring the distribution of a tracer of radioisotopes injected into a subject's body. Clinical PET scanners for example assist in tumor diagnosis. PET research currently focuses on improving spatial resolution and sensitivity of the technique. Our research is done on small animal PET scanners for preclinical studies in cooperation with the Medical Institute Rechts der Isar (MRI). The MLEM algorithm is based on sparse matrix vector multiplication (SpMV). The efficient usage of heterogeneous systems with accelerator cards such as Intel Xeon Phi is still an open challenge. We have already developed an efficient implementation for MLEM on multicore architectures. In this work we seek for an efficient implementation of the MLEM algorithm on Xeon Phi (Knight's landing) using high-bandwidth memory (HBM). Verification is to be done by benchmarking against the Intel Math Kernel Library (MKL). A cluster system consisting of Xeon Phis is available at LRZ (CooLMUC3).

Requirements
- Experience with parallel programming, MPI, OpenMP
- C/C++ Programming skills
- Ideally experience with HPC, Accelerator Technologies e.g. GPGPU, Xeon Phi
- Knowledge in performance analysis is a plus
- Knowledge in a scripting language is of advantage

Work Packages
- Familiarization with programming the Intel Xeon Phi, SpMV and MLEM
- Designing an efficient, scalable MLEM Implementation on Xeon Phi
- Implementation
- Benchmarking and evaluation

Reference

Contact
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