The Beacon Project: Experiences with the Intel® Xeon Phi™ Coprocessor

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Abstract

Results from the first year of the Beacon Project, a research project partially funded by NSF that explores the impact of emerging computer architectures on computational science and engineering, are presented. The presentations focus on the porting and optimization of several science codes to the Intel® Xeon Phi™ coprocessor. The focus on energy efficient computation which culminated in Beacon achieving the top spot on the November 2012 Green500 list is discussed.

Session 1:

- **Speaker:** *R. Glenn Brook* (glenn-brook@tennessee.edu), University of Tennessee,

  Title: Beacon: Application Experiences and Energy Efficiency

  Abstract: This session provides an overview of the Beacon Project, an ongoing research project partially funded by the National Science Foundation that is currently exploring the impact of the Intel® Xeon Phi™ coprocessor on computational science and engineering. The application experiences of a project team at the National Institute for Computational Sciences are presented, including work with model Boltzmann equations and work that led to Beacon taking the top spot on the November 2012 Green500 list.

- **Speakers:** *Homayoun Karimabadi* (homakar@gmail.com), University of California-San Diego,

  Kai Germaschewski (kai.germaschewski@unh.edu), University of New Hampshire,

  Title: Benchmark Analysis of Plasma Simulations on the Intel® Xeon Phi™

  Abstract: Particle simulations are used in plasma physics to model phenomena such as solar wind interaction with planetary magnetospheres, magnetic reconnection, and turbulence. We provide an overview of the algorithm for kinetic codes and compare and contrast the work required to adapt the code for GPUs versus Intel® Xeon Phi™ coprocessors. We focus on the effort required for parallelization/vectorization of the particle kernels and compare how compiler optimization approaches work in comparison to hand-tuned code. We also provide preliminary results of benchmarks for a representative production run.

- **Speaker:** *Bhanu Rekepalli* (brekapal@utk.edu), University of Tennessee,

  Title: The Role of Next Generation Architectures in Life Sciences Research

  Abstract: Due to revolutionary advancements in next generation sequencing technologies, genomic data has been growing at an exponential rate in recent years. This deluge of data in the life science domains threatens to overwhelm current computing architectures. This persistent trend necessitates the development of effective and user-friendly computational components for rapid data analysis and knowledge discovery. Successful development of these systems will have a direct effect on high-priority areas, such as human health and biofuels generation.

- **Speaker:** *Steven Gottlieb* (sg@indiana.edu), Indiana University,

  Title: Early Experiences with the Intel® Xeon Phi™ Coprocessor for Lattice QCD Code

Abstract: Lattice QCD is a compute intensive problem that uses very significant resources at supercomputer centers worldwide. Lattice gauge theorists are often among the first users of new computers and have even built their own computers to pursue their work. Intel®'s Xeon Phi™ processor represents a new challenge to the ingenuity of programmers because to achieve the best performance it is necessary to exploit parallelism on three levels. We report on our efforts to port code to the Intel® Xeon Phi™.