Distributed Pararell Processing Laboratory

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Refereed Journal Papers

[nakasato-01:2013] 扇谷豪, 三木洋平, 朴泰祐, 森正夫, and 中里直人. 計算宇宙物理のための GPU クラスタ向け並列 Tree Code の開発と性能評価. **情報処理学会論文誌コンヒューティ ンクシステム** *(A,*, 6(3):58–70, 2013.

「ツリー法」は高効率に粒子間の重力計算を行うことのできるアルゴリズムであり，計算天文学の分野で広く用いられる．本研究では，GPU（Graphics Processing Unit）によってツリーコードを加速する方法を検討する．本論文では，Warp 分岐回数を減少させ，メモリ空間上での粒子データの配置に工夫をすることで高速化を可能にする手法を提案する．これらを実装し，先行研究の提案手法を用いた場合に比べてカーネル関数を 4 倍高速にした．さらに，これを MPI を用いて並列化することで，10 個以上の粒子を用いた大規模計算の実行を可能とする計算性能を達成した．

Refereed Proceeding Papers

[hitoshi-01:2013] Hitoshi Oi and Sho Niboshi. Power-Efficiency Study using SPECjEnterprise2010. In *Proceedings of the IEEE International Systems Conference 2013 (SysCon 2013)*, pages 812–817, April 2013.

In this paper, we present a case study of the power consumption and performance trade-offs in Java application servers. We use the industry-standard benchmark for the Java application servers, SPECjEnterprise2010, on two platforms with different CPUs, AMD Phenom II and Intel Atom, We investigated the performance and power consumption behaviors against the increasing system size and the relative performance between Phenom vs Atom. Phenom is capable of dynamic frequency scaling (DFS) and we studied the effects of clock frequency control parameters on the performance and power consumption. In terms of the maximum system sizes with valid quality of service (QoS) metrics, Phenom could handle 9.7 times more transactions than Atom. In terms of dynamic power consumption normalized to the system size, Atom was 2.5 times more power-efficient than Phenom. Increasing the sampling rate, one of the DFS parameters, was effective in reducing the power consumption in low load level regions. It reduced the dynamic power up

to 7.7 Watt, about 40% lower than the default setting.
Keywords: Workload Analysis, Performance Evaluation, Power Consumption, Measurement, SPECjEnterprise2010.
Best Paper Award (Honorable Mention).
http://dx.doi.org/10.1109/SysCon.2013.6549977

[nakasato-02:2013] Go Ogiya, Masao Mori, Yohei Miki, Taisuke Boku, and Naohito Nakasato. Studying the core-cusp problem in cold dark matter halos using N-body simulations on GPU clusters. In *Journal of Physics: Conference Series 454 (2013) 012014*, pages 1–10, 2013.

The discrepancy in the mass-density profile of dark matter halos between simulations and observations, the core-cusp problem, is a long-standing open question in the standard paradigm of cold dark matter cosmology. Here, we study the dynamical response of dark matter halos to oscillations of the galactic potential which are induced by a cycle of gas expansion and contraction in galaxies driven by supernova feedback. We developed a fast tree-code for PC clusters with GPU which displays high performance and high scalability. We perform large scale N-body simulations to follow the dynamical evolution of dark matter halos under the effect of oscillating gravitational potential. Furthermore, we compare the results of simulations with an analytical model of the resonance between particles and density waves to understand the physical mechanism of the cusp-core transition.

[nakasato-03:2013] F. Yuasa, T. Ishikawa, N. Hamaguchi, T. Koike, and N.Nakasato. Acceleration of Feynman loop integrals in high-energy physics on many core GPUs. In *Journal of Physics: Conference Series 454 (2013) 012081*, pages 1–10, 2013.

The current and future colliders in high-energy physics require theorists to carry out a large scale computation for a precise comparison between experimental results and theoretical ones. In a perturbative approach several methods to evaluate Feynman loop integrals which appear in the theoretical calculation of cross-sections are well established in the one-loop level, however, more studies are necessary for higher-order levels. Direct Computation Method (DCM) is developed to evaluate multi-loop integrals. DCM is based on a combination of multidimensional numerical integration and extrapolation on a sequence of integrals. It is a fully numerical method and is applicable to a wide class of integrals with various physics parameters. The computation time depends on physics

parameters and the topology of loop diagrams and it becomes longer for the two-loop integrals. In this paper we present our approach to the acceleration of the two-loop integrals by DCM on multiple GPU boards.

Academic Activities

[hitoshi-02:2013] Hitoshi Oi, Since 2009.

Academic member of the T-Engine Forum (representative for the University of Aizu). http://www.t-engine.org/

[hitoshi-03:2013] Hitoshi Oi, Since 2005.

Professional Member, ACM

[hitoshi-04:2013] Hitoshi Oi, Since 2005.

Member, IEEE/Computer Society

[hitoshi-05:2013] Hitoshi Oi, Since 2006.

Academic Member, EEMBC http://eembc.org/

[hitoshi-06:2013] Hitoshi Oi, Since 2009.

Senior Member, IACSIT http://www.iacsit.org/

[hitoshi-07:2013] Hitoshi Oi, Since 2010.

Officer. SIGEVA was merged to SIGIOT in 2013.

[hitoshi-08:2013] Hitoshi Oi, April 2013.

Session chair for "Critical Systems."

[hitoshi-09:2013] Hitoshi Oi, 2013.

Program committee member.

[hitoshi-10:2013] Hitoshi Oi, 2013.

Organizer for the special session at ISIC 2014, Performance and Power Issues in Multi/Many Core Architecture.
http://p2m2ca.oslab.biz/
http://www.isic2014.org/

[nakasato-04:2013] N. Nakasato, November 2013.

Primary Session Leader, Birds of Feather Session on High Precision Compuring, Supercomputing '13

[nakasato-05:2013] N.Nakasato, December 2013.

Local Chair, 10th International Conference on Mobile and Ubiquitous Systems: Computing, Networking and Services (MobiQuitous2013)

Ph.D and Others Theses

[nakasato-06:2013] Takafumi Suzuki. Master Thesis: OpenCL Implementation of Exact String Matching, University of Aizu, 2013.

Thesis Advisor: N. Nakasato

[nakasato-07:2013] Kousuke Nakamura. Master Thesis: Acceleration of High Precision Numerical Computations, University of Aizu, 2013.

Thesis Advisor: N. Nakasato

[nakasato-08:2013] Tsuyoshi Watanabe. Master Thesis: Hybrid Tree Algorithm for Collision-less N-body Simulation Implemented on GPU Clusters, University of Aizu, 2013.

Thesis Advisor: N. Nakasato

Others

[hitoshi-11:2013] Hitoshi Oi.

Journal reviewer for Microprocessor and Microsystems (Elsevier), Parallel and Distributed Computing and Networks (ACTA Press / IASTED) and International Journal of High Performance Systems Architecture (Inderscience Enterprises)