

University of Tsukuba | Center for Computational Sciences

Supercomputer at CCS: Cygnus

Multi-Hybrid Accelerated Computing Platform

- - GPU is still an essential accelerator for simple and large degree of parallelism to provide ~10 TFLOPS peak performance
 - programmability and speeded up based on pipelining of calculation
 - FPGA is good for external communication between them with advanced high speed interconnection up to 100Gbps x4 chan
- - Operation started in May 2019
 - Stratix10 FPGAs





OpenCL-ready High Speed FPGA Networking^[1]



Our proposed method

Pipelined communication experiment



Authentic Radiation Transfer^[2]

- Accelerated Radiative transfer on grids Oct-Tree (ARGOT) has been developer in Center for Computational Sciences, University of Tsukuba
 - ART is one of algorithms used in ARGOT and dominant part (90% or more of computation time) of ARGOT program
- ART is ray tracing based algorithm
 - problem space is divided into meshes and reactions are computed on each mesh
 - Memory access pattern depends on ray direction
 - Not suitable for SIMD architecture

- Problem space is divided into small blocks
- e.g. $(16, 16, 16) \rightarrow 8 \times (8, 8, 8)$
- PE is assigned to each of small blocks



kernels



with channels



Size	CPU(14C)	CPU(28C)	P100	FPGA
(16, 16, 16)	112.4	77.2	105.3	1282.8
$(32,\!32,\!32)$	158.9	183.4	490.4	1165.2
(64, 64, 64)	175.0	227.2	1041.4	1111.0
(128, 128, 128)	95.4	165.0	1116.1	1133.5

Reference

[1] Norihisa Fujita, Ryohei Kobayashi, Yoshiki Yamaguchi, and Taisuke Boku, Parallel Processing on FPGA Combining Computation in OpenCL Programming, 2019 IEEE International Parallel and Distributed Processing Symposium Workshops (IPDPSW), pp.479-488, May 2019 [2] Norihisa Fujita, Ryohei Kobayashi, Yoshiki Yamaguchi, Yuuma Oobata, Taisuke Boku, Makito Abe, Kohji Yoshikawa, and Masayuki Umemura: Accelerating Space Radiate Transfer on FPGA using OpenCL (Accepted), International Symposium on Highly-Efficient Accelerators and Reconfigurable Technologies (HEART 2018) Acknowledgment

This research is a part of the project titled "Development of Computing-Communication Unified Supercomputer in Next Generation" under the program of "Research and Development for Next-Generation Supercomputing Technology" by MEXT. We thank Intel University Program for providing us both of hardware and software.

___ ×

BE

BE

----- Ray Data



without channels