

Sunwoo Lee

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Research Interests

- Scalable Machine Learning / Deep Learning algorithms
- High-Performance Computing: Parallel I/O and parallel computing on accelerators

Honors and Awards

W. J. Cody Associate at Argonne National Laboratory	2018
Best Paper Award Finalist	2017
IEEE HiPC 2017 best paper finalist for Parallel Deep Convolutional Neural Network Training by Exploiting the Overlapping of Computation and Communication	
Travel Grants	
• IEEE International Conference on BigData 2019 Travel Grant	2019
• Northwestern Student Travel Grant	2016, 2018, 2019

Education

Ph.D. in Computer Engineering, Northwestern University	2015 ~ Present
• Thesis Advisors: Prof. Alok Choudhary and Prof. Wei-keng Liao	
M.S. in Computer Engineering, Hanyang University, Seoul, Korea	2008
• Thesis Advisor: Prof. Minsoo Ryu	
B.S. in Computer Engineering, Hanyang University, Seoul, Korea	2006

Research Experience

Northwestern University, Research Assistant

Mar 2015 ~ Present

- RAPIDS: Designed a parallelization strategy for deep learning-based image restoration: collaboration with ANL and ORNL (<https://rapids.lbl.gov/home>)
- ECP: Implemented pipelined two-phase I/O in ROMIO (<https://www.exascaleproject.org>)
- Designed parallelization techniques for K-means data clustering algorithm on Intel Xeon Phi coprocessor

Fermi National Laboratory, Summer Research Intern

Jul 2019 ~ Sep 2019

- SciDAC: Designed a parallel data aggregation strategy (HDF5 file concatenation) for High-Energy Physics data analysis (<https://www.scidac.gov/>)

Argonne National Laboratory, W. J. Cody Associate

Jun 2018 ~ Aug 2018

- Developed parallel neural network training software using DIY, an object-parallel communication library

Professional Experience

Samsung Electronics, Memory Division

2013 ~ 2015

- Worked at Memory Solutions Lab. (MSL) researching on memory management and I/O for SSD-based high-performance storage server

Humax (*alternative military service*)

2009 ~ 2013

- Worked at Software Lab. developing device driver and bootloader for LINUX-based embedded systems (digital set-top box)

Teaching Experience

Northwestern University, Teaching Assistant

2019

- CE303: Advanced Digital Design

Publications

1. **Sunwoo Lee**, Qiao Kang, Sandeep Madireddy, Prasanna Balaprakash, Ankit Agrawal, Alok Choudhary, Richard Archibald, and Wei-keng Liao. Improving Scalability of Parallel CNN Training by Adjusting Mini-Batch at Run-Time. IEEE International Conference on BigData, December 2019 (19.3%)
2. **Sunwoo Lee**, Qiao Kang, Reda Al-Bahrani, Ankit Agrawal, Alok Choudhary, and Wei-keng Liao. Improving Scalability of Parallel CNN Training by Adaptively Adjusting Parameter Update Frequency. (Preprint, will be submitted to IEEE Transactions on Parallel and Distributed Systems Journal)
3. **Sunwoo Lee**, Kai-yuan Hou, Kewei Wang, Saba Sehrish, Marc Paterno, James Kowalkovski, and Wei-keng Liao. A Case Study on Parallel Data Aggregation for High Energy Physics Data Analysis. (Preprint, will be submitted to Elsevier Parallel Computing Journal)
4. Sandeep Madireddy, Ji Hwan Park, **Sunwoo Lee**, Prasanna Balaprakash, Shinjae Yoo, Wei-keng Liao, Cory D. Hauck, M. Paul Laiu, and Richard Archibald. In Situ Compression Artifact Removal in Scientific Data Using Deep Transfer Learning. (Under review by Neural Networks Journal)
5. Qiao Kang, **Sunwoo Lee**, Kai-yuan Hou, Robert Ross, Ankit Agrawal, Alok Choudhary, and Wei-keng Liao, Improving MPI Collective I/O Performance with Intra-node Request Aggregation. (Under review by IEEE Transactions on Parallel and Distributed Systems)
6. **Sunwoo Lee**, Ankit Agrawal, Prasanna Balaprakash, Alok Choudhary, and Wei-keng Liao. Communication-Efficient Parallelization Strategy for Deep Convolutional Neural Network Training. In Workshop on Machine Learning in High-Performance Computing Environments (MLHPC), held in conjunction with International Conference for High Performance Computing, Networking, Storage, and Analysis (SC), November 2018
7. **Sunwoo Lee**, Dipendra Jha, Ankit Agrawal, Alok Choudhary, and Wei-keng Liao. Parallel Deep Convolutional Neural Network Training by Exploiting the Overlapping of Computation and Communication. In Proceedings of the 24th International Conference on High-Performance Computing, Data, and Analytics (HiPC), December 2017 (22.8%)
8. **Sunwoo Lee**, Wei-keng Liao, Ankit Agrawal, Nikos Hardavellas, and Alok Choudhary. Evaluation of K-Means Data Clustering Algorithm on Intel Xeon Phi. In Workshop on Advances in Software and Hardware for Big Data to Knowledge Discovery, held in conjunction with the IEEE International Conference on BigData, December 2016
9. Diana Palsetia, William Hendrix, **Sunwoo Lee**, Ankit Agrawal, Wei-keng Liao, and Alok Choudhary. Parallel Community Detection Algorithm Using a Data Partitioning Strategy with Pairwise Subdomain Duplication. In the 31st International Supercomputing Conference (ISC), June 2016

Skills and Qualifications

Programming Language:
C/C++, Python

Deep Learning Software Framework:
Caffe, TensorFlow, PyTorch, Horovod

Parallelization Library:
MPI, OpenMP, Pthreads

Compiling, Debugging, and Analyzer:
GNU and Intel compilers, Intel VTune

I/O Library:
MPI-IO (ROMIO), HDF5, PNetCDF

Container
Docker

Contributions to Open-Source Software

[PCNN]: A software framework for distributed Convolutional Neural Network training

[ph5concat]: Developed a parallel HDF5 file concatenating program

[ROMIO]: Developed a pipelined two-phase I/O for lustre parallel file system