Sunwoo **Lee**

Assistant Professor
Department of Computer Engineering
Inha University, South Korea

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Research Interest

- Large-Scale Distributed Deep Learning
- Communication-efficient Federated Learning
- Machine Learning systems
- Applied Machine Learning (E.g., Physics + ML)

Education

Northwestern University — Evanston, IL USA
Ph.D. in Computer Engineering — Sep 2020
Advisors: Prof. Alok Choudhary and Prof. Wei-keng Liao

Hanyang University — Seoul, South Korea
B.S. and M.S. in Computer Engineering — Feb 2009
Advisor: Prof. Minsoo Ryu

Employment

Inha University — Incheon, South Korea
Assistant Professor of Computer Engineering — Sep 2022 – now

University of Southern California — Los Angeles, CA USA
Postdoctoral Researcher — Oct 2020 – Aug 2022
Advisor: Prof. Salman Avestimehr

Samsung Electronics, Memory Solutions Lab. — May 2013 – Jan 2015
System Software Researcher

Humax — Feb 2009 – Mar 2013
Software Engineer (Alternative Military Service)

Research Internship

Lawrence Berkeley National Laboratory — Berkeley, CA USA
Research Intern — Jun 2020 – Aug 2020

Fermi National Accelerator Laboratory Batavia, IL USA
Research Intern Jul 2019 – Sep 2019

Argonne National Laboratory Lemont, IL USA
Research Intern Jun 2018 – Aug 2018

Teaching Experience

Inha University
- CSE3209: System Programming Fall 2022
- CSE3313: Linux Programming Fall 2022

University of Southern California
- AEOP Scholarship Program in Data Science Summer 2021

Northwestern University
- CE501: Social Media Mining Spring 2020
- CE303: Advanced Digital Design Fall 2019

Honors & Awards

FL-AAAI Workshop Best Paper Award 2022
- SSFL: Tackling Label Deficiency in Federated Learning via Personalized Self-Supervision

IEEE HiPC Best Paper Finalist 2017
- Parallel Deep Convolutional Neural Network Training by Exploiting the Overlapping of Computation and Communication

Publications

1. **Sunwoo Lee**, Jaeyoung Jeon, Kitae Eom, Chaehwa Jeong, Yongsoo Yang, Ji-Yong Park, Chang Beom Eom, and Hyungwoo Lee, Variance-aware Weight Quantization of Multi-level Resistive Switching Devices based on Pt/LaAlO3/SrTiO3 Heterostructures. *Scientific Reports*, **12**, 1-10, (2022)

2. Kewei Wang, **Sunwoo Lee**, Jan Balewski, Alex Sim, Peter Nugent, Ankit Agrawal, Alok Choudhary, Kesheng Wu, and Wei-keng Liao, Using Multi-resolution Data to Accelerate Neural Network Training in Scientific Applications. *International Symposium on Cluster, Cloud and Internet Computing (CCGrid)*, 2022

3. **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. *Journal of Distributed and Parallel Computing*, **159**, 10-23, (2022)

4. **Sunwoo Lee**, Kai-yuan Hou, Kewei Wang, Saba Sehrish, Marc Paterno, James Kowalkowski, Quincey Koziol, Ross Robert, Ankit Agrawal, Alok Choudhary, and Wei-

keng Liao, A Case Study on Parallel HDF5 Dataset Concatenation for High-Energy Physics Data Analysis. *Parallel Computing*, **110**, 102877, (2022)

5. Kai-yuan Hou, Qiao Kang, **Sunwoo Lee**, Ankit Agrawal, Alok Choudhary, and Wei-keng Liao, Supporting Data Compression in PnetCDF, *International Conference on BigData,* December 2021 (19.9%)

6. **Sunwoo Lee**, Qiao Kang, Kewei Wang, Jan Balewski, Alex Sim, Kesheng Wu, Ankit Agrawal, Alok Choudhary, Peter Nugent, and Wei-keng Liao, Asynchronous I/O Strategy for Large-Scale Deep Learning Applications. *International Conference on High-Performance Computing, Data, and Analytics (HiPC)*. December 2021 (22.9%)

7. Reda Al-bahrani, Dipendra Jha, Qiao Kang, **Sunwoo Lee**, Zijiang Yang, Wei-keng Liao, Ankit Agrawal, and Alok Choudhary, SIGRNN: Synthetic minority Instances Generation in imbalanced datasets using a Recurrent Neural Network. *International Conference on Pattern Recognition Applications and Methods*, February 2021

8. **Sunwoo Lee**, Qiao Kang, Ankit Agrawal, Alok Choudhary, and Wei-keng Liao, Communication-Efficient Local SGD for Scalable Deep Learning. *International Conference on Big Data*, December 2020 (15.7%)

9. Sandeep Madireddy, Ji Hwan Park, **Sunwoo Lee**, Prasanna Balaprakash, Shinjae Yoo, Wei-keng Liao, Cory Hauck, M. Paul Laiu, and Richard Archibald, In Situ Compression Artifact Removal in Scientific Data Using Deep Transfer Learning and Experience Replay. *Machine Learning: Science and Technology*, 2020

10. Qiao Kang, **Sunwoo Lee**, Ankit Agrawal, Alok Choudhary, and Wei-keng Liao, Improving All-to-many Personalized Communication in MPI I/O. *International Conference for High Performance Computing, Networking, Storage, and Analysis (SC)*, 2020

11. Qiao Kang, **Sunwoo Lee**, Kai-yuan Hou, Robert Ross, Ankit Agrawal, Alok Choudhary, and Wei-keng Liao, Improving MPI Collective I/O for High Volume Non-contiguous Requests with Intra-node Aggregation. *IEEE Transactions on Parallel and Distributed Systems*, 2020

12. Qiao Kang, Alex Sim, Peter Nugent, **Sunwoo Lee**, Wei-keng Liao, Ankit Agrawal, Alok Choudhary, and Kesheng Wu. Predicting Resource Requirement in Intermediate Palomar Transient Factory Workflow. *International Symposium on Cluster, Cloud and Internet Computing (CCGrid)*, 2020

13. **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 Size at Run-Time. *International Conference on Big Data*, December 2019 (18.7%)

14. **Sunwoo Lee**, Ankit Agrawal, Prasanna Balaprakash, Alok Choudhary, and Wei-keng Liao. Communication-Efficient Parallelization Strategy for Deep Convolutional Neural Network Training. *Machine Learning in High-Performance Computing Environments (MLHPC)*, November 2018

15. **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. *International Conference on High-Performance Computing, Data, and Analytics (HiPC)*, December 2017 (22.8%)

16. **Sunwoo Lee**, Wei-keng Liao, Ankit Agrawal, Nikos Hardavellas, and Alok Choudhary. Evaluation of K-Means Data Clustering Algorithm on Intel Xeon Phi. *International Conference on Big Data*, December 2016

17. 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. *International Conference on High Performance Computing (ISC)*, June 2016

18. **Sunwoo Lee**, Byung Kwan Jung, Minsoo Ryu, Seungwon Lee, Extending Component-based Approaches for Multi-threaded Design of Multiprocessor Embedded Software. *International Symposium on Object/Component/Service-Oriented Real-Time Distributed Computing*, 2009

Pre-prints

1. **Sunwoo Lee**, Tuo Zhang, Chaoyang He, and Salman Avestimehr, Layer-wise Model Aggregation for Scalable Federated Learning. *arXiv 2021* (*Under review in a top-tier ML conference*)

2. **Sunwoo Lee**, Anit Sahu, Chaoyang He, and Salman Avestimehr, Partial Model Aggregation in Federated Learning: Performance Guarantees. *arXiv 2022 (Under review in IEEE Transactions on Neural Networks and Learning Systems)*

3. **Sunwoo Lee**, Chaoyang He, and Salman Avestimehr, Achieving Small-Batch Accuracy with Large-Batch Scalability via Hessian-Aware Learning Rate Adjustment. (*Under review in Neural Networks*)

4. Chaoyang He, Zhengyu Yang, Erum Mushtaq, **Sunwoo Lee**, Mahdi Soltanolkotabi, Salman Avestimehr, SSFL: Tackling Label Deficiency in Federated Learning via Personalized Self-Supervision. *arXiv 2021* (*Under review in a top-tier ML conference*)

5. **Sunwoo Lee**, Jaeyoung Jeon, and Hyungwoo Lee, Probing Oxygen Vacancy Distribution in Oxide Heterostructures by Deep Learning-based Spectral Analysis of Charge Fluctuation. (*Under review in Materials Today Physics (MTP)*)

Invited Talks

- U.S. Department of Energy, SciDAC, RAPIDS Institute, Tech Talk: Asynchronous I/O Strategy for Large-Scale Deep Learning Applications, 12/01/2021

- HDF5 User Group Meeting: A Case Study on Parallel HDF5 Dataset Concatenation for Scientific Data Analysis, 10/21/2021

- U.S. Department of Energy, SciDAC, RAPIDS Institute, Tech Talk: Communication-Efficient Local SGD for Scalable Deep Learning, 7/7/2021

Service

- Program Committee member of Association for the Artificial Intelligence (AAAI) 2023
- Program Committee member of Federated Learning for Natural Language Processing (FL4NLP) workshop held in conjunction with Association for Computational Linguistics (ACL) 2022
- Program Committee member of International Conference on Learning Representations (ICLR) 2022

Skills and Qualifications

Programming Language
C/C++, Python

Deep Learning Software Frameworks
TensorFlow, PyTorch, Caffe

Parallelization Libraries
MPI, OpenMP, Pthreads

I/O Libraries
MPI-I/O (ROMIO), HDF5, NetCDF