

# Shenggan Cheng

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## EDUCATION

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Shanghai Jiao Tong University	(B.E. in Computer Science)	2015.9 – 2019.6
National University of Singapore	(Ph.D. in Computer Science)	2022.01 – now

## WORK & RESEARCH EXPERIENCE

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**National University of Singapore, HPC-AI Lab (Prof. Yang You)** 2021.10 – now

### **FastFold: Reducing AlphaFold Training Time from 11 Days to 67 Hours**

*FastFold is the first performance optimization method for the training and inference of protein structure prediction models. It significantly reduces the time and economic costs of AlphaFold model training and inference by applying large model training techniques such as parallelism strategies and communication optimization.*

- Performance optimization based on the AlphaFold-specific characteristic. Combined with kernel fusion, our kernel implementation of FastFold achieves significant speedups.
- We propose Dynamic Axial Parallelism and Duality Async Operation which has a lower communication overhead than other model parallelism methods. (DAP is used by BladeDISC example for AlphaFold model)

### **ATP: Adaptive Tensor Parallelism for Foundation Models**

*ATP is an adaptive tensor parallelism framework for foundation models, which can automatically select the optimal parallel strategy on different interconnections.*

- We propose column- and row-first tensor parallelism based on 2D device meshes and construct a search space. Combined with the hierarchical communication matrix, ATP can identify the optimal strategy in the search space.
- The theoretical model of ATP shows that the communication overhead of ATP decreases with scaling, indicating a qualitative leap forward.

**Center for HPC, Shanghai Jiao Tong University, Research Engineer** 2019.06 – 2021.04

### **Parallel Cosmology N-Body Simulation for HPC Cluster**

*Design and develop a cosmology N-body code with Tsung-Dao Lee Institute, SJTU and Xiamen University, which conducted Cosmo-pi simulation on a 2 PFlops Intel cluster with 20,480 cores with highly performance and scalability. Cosmo-pi simulation contains 4.4 trillion particles, break the world record of N-Body simulation.*

- Designed fixed-point compression to obtain the lowest memory consumption possible.
- High performance MPI-OpenMP hybrid Implement with compression-aware optimization.

**SenseTime Research Department, Research Intern** 2018.3 – 2019.4

### **Prediction of Pedestrians and Vehicle Trajectory**

*This R&D project is conducted by SenseTime which aim to design and develop a module to predict the trajectory of pedestrians and Vehicle. The prediction is based on the results of scene recovery and the results of prediction will be the input of Path Planning and Decision Module.*

## HONORS

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ASC18 Student Supercomputer Competition	First Prize (4th Worldwide)	2018.3
The 5th Student RDMA Programming Competition	First Prize	2017.10
The Interdisciplinary Contest in Modeling	Meritorious Winner	2017.2

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## PUBLICATION

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**Shenggan Cheng**, Xuanlei Zhao, Guangyang Lu, Jiarui Fang, Zhongming Yu, Tian Zheng, Ruidong Wu, Xiwen Zhang, Jian Peng, Yang You. *"FastFold: Reducing AlphaFold Training Time from 11 Days to 67 Hours"*. *arXiv 2022*

**Shenggan Cheng**, Ziming Liu, Jiangsu Du, Yang You. *"ATP: Adaptive Tensor Parallelism for Foundation Models"*. *arXiv 2023*

Ziming Liu\*, **Shenggan Cheng**\*, Haotian Zhou, Yang You. *"Hanayo: Harnessing Wave-like Pipeline Parallelism for Enhanced Large Model Training Efficiency"*. *SC 2023*

**Shenggan Cheng**, Hao-Ran Yu, Derek Inman, Qiucheng Liao, Qiaoya Wu, James Lin. *"CUBE-- Towards an Optimal Scaling of Cosmological N-body Simulations"*. *CCGRID 2020*

Li, Binrui, **Shenggan Cheng**, and James Lin. *"tcFFT: Accelerating Half-Precision FFT through Tensor Cores."* *CLUSTER 2021*

Zixuan Huang, Junming Fan, **Shenggan Cheng**, Shuai Yi, Xiaogang Wang, Hongsheng Li. *"HMS-Net: Hierarchical Multi-Scale Sparsity-Invariant Network for Sparse Depth Completion"*. *TIP 2019*

Kunyu Du, Ya Zhang, Haibing Guan, Qi Tian, **Shenggan Cheng**, James Lin. *"FTL: A universal framework for training low-bit DNNs via Feature Transfer"*. *ECCV 2020*