LI ZENG

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EDUCATION

M.S. in Computer Science, ShanghaiTech University, Shanghai, China 2021.09 - Present
GPA: **3.78/4**, Major Courses: Numerical Analysis (4.0), Matrix Computations (4.0), Convex Optimization (4.0), Machine Learning (4.0), etc.
Topic: Federated Learning
Advisor: Prof. Yuanming Shi and Prof. Dingzhu Wen

B.E. (Hons.) in Computer Science, ShanghaiTech University, Shanghai, China 2017.09 - 2021.06
GPA: **3.63/4**, Ranking: **19/143**
Thesis: Over-the-Air Computation for Wireless Federated Learning
Advisor: Prof. Yuanming Shi

PUBLICATIONS

Journal Paper

[J1] Y. Shi, **L. Zeng**, J. Zhu, Y. Zhou, C. Jiang, K. Letaief, " Satellite Federated Edge Learning: Architecture Design and Convergence Analysis," submitted to *IEEE Trans. Wireless Commun.*, Dec. 2023.

[J2] **L. Zeng**, D. Wen, G. Zhu, C. You, Q. Chen, Y. Shi, "Federated Learning with Energy Harvesting Devices," *IEEE Trans. Green Commun. Netw.*, Aug. 2023, doi: 10.1109/TGCN.2023.3310569.

Conference Paper

[C1] **L. Zeng**, D. Wen, G. Zhu, C. You, Q. Chen, Y. Shi, "Joint Bandwidth Allocation, Computation Control, and Device Scheduling for Federated Learning with Energy Harvesting Devices," in *Proc. Asilomar Conf. on Signals, Systems, and Comput.*, Pacific Grove, CA, USA, Oct. 2022, pp. 1164–1168.

RESEARCH PROJECTS

Federated Learning over LEO Mega-Constellations, *ShanghaiTech University*

- In [J1], to address the communication bottleneck and data privacy issue in satellite big data analysis, we tailored a FL framework for the modern LEO mega-constellation network, including designs of both the FL algorithm workflow and the efficient model transmission scheme.
  - *Topology-aware fast convergent FL algorithm*: Motivated great difference in data rates and stability between ground-satellite links and intra-orbit inter-satellite links (which is superior), we proposed to modify vanilla FedAvg to increase the model sharing frequency internal each orbit (device cluster) and decrease the model sharing frequency between satellites and ground server, thus curtailed the training latency.
  - *Topology and link characteristics-aware efficient transmission scheme*: 1) Capturing the ring topology inside each orbit, we proposed a ring all-reduce based transmission scheme for model aggregation and broadcast inside each orbit, achieving the minimum latency. 2) As for the global model aggregation from satellites to ground server, we designed a network flow-based model transmission scheme to minimize the overall transmission latency.

Communication Efficient Over-the-Air Federated Learning, [Slides Available], *ShanghaiTech University*

- Based on the critical finding that across the continuous several rounds in FL training, the gradient information illustrates temporal correlation and sparsity, we explore to utilize this property to compress the number of gradient parameters to be transmitted. In the over-the-air FL system which requires signal alignment, we proposed a probabilistic scheduling scheme to determine the parameters to be communicated in each round.

Federated Learning with Energy Harvesting Devices, [Finished], *ShanghaiTech University*

- Research work [C1] and [J2] first mathematically proved that the data utility (used training samples) per round in FL typically affects the training performance, and then **proposed a joint device selection, communication and computation resource allocation scheme** for maximizing the data utility in energy harvesting devices powered wireless FL systems (which is mixed integer-valued and non-convex).
- Although the problem was mix-integer and non-convex, the proposed scheme was proved to be **optimal**, with **low complexity**, and **did not require global CSI at FL server** which saves signaling overheads.

HONORS & AWARDS

- Merit Student Award in 2022-2023 Academic Year, *ShanghaiTech University* 2023.12
- Outstanding Graduate Honor, *ShanghaiTech University* 2021.06
- Merit Student Award in 2018-2019 Academic Year, *ShanghaiTech University* 2019.12
- Merit Student Award in 2017-2018 Academic Year, *ShanghaiTech University* 2018.12
- The 2nd Prize in National Physics Competition for College Students, *Shanghai Physics Academy* 2017.12

EXPERIENCE

Teaching Assistant, *ShanghaiTech University*

- SI120 Discrete Mathematics (Taught by Prof. Liangfeng Zhang), Spring 2019, Spring 2020
- SI141 Probability and Statistics (Taught by Prof. Ziyu Shao), Fall 2020
- SI151 Convex Optimization and its Applications in Information Science (Taught by Prof. Yuanming Shi), Fall 2023

Data Specialist Intern, *Shanghai ZhonghuiYida Company* 2019.06 - 2019.08

- Crawling bond information & maintaining the system
- Analyzing bond information

SKILLS

Programming Languages	Python, C++, Matlab, Julia, etc.
Technical Skills	PyTorch, CVX, STK, LaTeX, Markdown, etc.