

# Zhuoyi Zhao

Research interests: Stochastic Network Optimization · Wireless Communications · Network4AI

## EDUCATION

### Northwestern University

M.S. in Electrical Engineering

Advisor: Igor Kadota

Thesis: Optimizing Age-of-Information in Real-World Network

Evanston, USA

Sept. 2023 – Present

### Beijing Jiaotong University

B.E. in Information Engineering

Advisor: Jiayi Zhang

Thesis: Forward Scheduling and Downlink Precoding in Cell-Free Massive MIMO

Beijing, China

Sept. 2019 – Jun. 2023

## SELECTED COURSES

**Communication:** Comm. System, Wireless Comm., Intro. Comm. Net., Adv. Comm. Net., Info. Theory, Seminar: Topics in Wireless Comm., 3GPP 5G NR standard.

**Learning:** Machine Learning, Machine Learning for Medical, Machine Learning and Pattern Recognition.

**Mathematics:** Calculus, Linear Algebra, Probability Theory, Random Processes.

## Publications

- [J2] **Zhuoyi Zhao**, Vishrant Tripathi, Igor Kadota, “Minimizing Age of Information in Networks with Heterogeneous Updates,” submitted, **IEEE/ACM Trans. on Networking**.
- [J1] **Zhuoyi Zhao**, Igor Kadota, “Minimizing Age of Information Without Knowing the Age of Information,” in preparation, **IEEE/ACM Trans. on Networking**.
- [C3] **Zhuoyi Zhao**, Vishrant Tripathi, Igor Kadota, “Optimizing Age of Information in Networks with Large and Small Updates,” to appear in **Proc. IEEE/IFIP WiOpt**, May 2025.
- [C2] **Zhuoyi Zhao**, Igor Kadota, “Optimizing Age of Information Without Knowing the Age of Information,” to appear in **Proc. IEEE INFOCOM**, May 2025. [Acceptance rate 18.7%]
- [C1] Jiakang Zheng, **Zhuoyi Zhao**, Jiayi Zhang, Julian Cheng, Victor C. M. Leung, “Performance Analysis of Cell-Free Massive MIMO Systems with Asynchronous Reception,” **Proc. IEEE Globecom Workshops**, 2022.

## ACADEMIC EXPERIENCE

### Minimizing Age-of-Information in Networks with Heterogeneous Updates

Sept. 2024 – Present

- Derived lower bounds on AoI and two stationary randomized policies for multi-packet update delivery under switching and no-switching scenarios.
- Formulated AoI minimization as virtual-queue stabilization; proposed a dynamic Age-Debt policy and a Lyapunov-based Max-Weight policy with performance guarantees.
- Compared randomized, Age-Debt, Max-Weight, and literature policies; numerical results demonstrate near-optimal performance of Age-Debt and Drift-Plus-Penalty policies.

### Age-of-Information-Aware Scheduling in Real System: It is Achievable

Jan. 2024 – Present

- Derived a lower bound on achievable AoI for any scheduling policy under general packet-generation processes, multiple unreliable channels, and two-way delay.
- Developed MMSE estimators for AoI and system times, and designed a Max-Weight policy with provable performance guarantees using these estimators.
- Evaluated both the optimal randomized policy and the Max-Weight policy analytically and via simulation; results show that Max-Weight with estimation outperforms the randomized policy even without AoI knowledge at the base station.

### Forward Scheduling & Downlink Precoding in Cell-Free Massive MIMO

Mar. 2021 – Jun. 2023

- Analyzed downlink performance with MMSE channel estimation and MR precoding under asynchronous reception; derived closed-form spectral efficiency and validated via MATLAB simulation.
- Developed a scalable Team-MMSE precoding under asymmetric CSI sharing; proposed a low-complexity AP selection algorithm outperforming traditional methods.
- Evaluated Team-MMSE precoding with QuaDRiGa's 3D channel model; benchmarked against SGD, Local-MMSE, and Centralized-MMSE.

## SELECTED PROJECTS

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### Implementation of 5G System with OAI

- Deployed OAI gNB on PC & USRP X310; modified configuration files to test effects of channel conditions, Tx/Rx power, bandwidth, frequency, and user count on data rate.

### Medical Image Segmentation for Brain Tumors via U-Net-Like Network

- Built a U-Net-style TensorFlow model for multi-channel T1/T2 MRI segmentation; applied data and test-time augmentation to improve IOU on held-out test set.

### Predicting Two-Year Survival of Brain-Tumor Patients

- Extracted 1 280-D features from 224×224 non-overlapping tiles using EfficientNetV2S; trained a binary survival classifier and analyzed uncertainty with Monte Carlo Dropout.

## SERVICE

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- **Grader**, EE 307: Communication Systems, *Northwestern University*, Fall 2024.

## HONORS

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- Edward S. Rogers Sr. Graduate Scholarship, *University of Toronto*, 2025–2029.

## SKILLS

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- **Programming:** C, MATLAB, Python, LabVIEW, NetSim
- **Languages:** TOEFL 109

[zhuoyijoeeyzhao@gmail.com](mailto:zhuoyijoeeyzhao@gmail.com) | <https://zhuoyi-zhao.github.io>