Zhuoyi ZHAO
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Research interest: Stochastic Network Optimization, Wireless Communications, Network4AI

Education

Northwestern University, Evanston, USA Sep. 2023-Present
M.S. in Electrical Engineering GPA: 3.81/4 *Advisor: Igor Kadota*
Beijing Jiaotong University, Beijing, China Sep. 2019-Jun. 2023
B.E. in Information Engineering GPA: 3.44/4 *Advisor: Jaiyi Zhang*

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

Optimizing Age of Information Without Knowing the Age of Information (Accepted)
***Authors**: **Zhuoyi Zhao**, Igor Kadota*
Publication Title: **Proc. of IEEE INFOCOM, 2025**
Performance Analysis of Cell-Free Massive MIMO Systems with Asynchronous Reception
***Authors:** Jiakang Zheng, **Zhuoyi Zhao**, Jiayi Zhang, Julian Cheng, and Victor C. M. Leung*
Publication Title: **Proc. of IEEE Globecom Workshops, 2022**
Minimizing Age of Information for Large Updates (Ongoing)
Authors: **Zhuoyi Zhao**, Vishrant Tripathi, Igor Kadota

Academic Experience

Age of Information-aware Scheduling in Real System: It is Achievable Jan. 2024-Present

- Derived a lower bound on the achievable AoI by any scheduling policies, an optimal randomized policy for any packet generation processes in a very general network model with general packet generation processes, multiple unreliable channels and two-way delay.
- Developed MMSE estimators of the AoI and system times for any AoI-aware scheduling policy, and a Max-Weight policy that leverages these estimators.
- Evaluated the AoI of the optimal randomized policy and the Max-Weight policy both analytically and through simulations. The numerical results suggest that the Max-Weight policy with estimation outperforms the optimal randomized policy even when the BS has no AoI knowledge.

Minimizing Age of Information for Large Updates Sep. 2024-Present

- Derived a lower bound on the achievable AoI for any scheduling policies and derived two stationary randomized policies to minimize AoI for multiple packet transmissions per update, for switching and no-switching cases within a delivery of update, respectively.
- Transformed AoI minimization into virtual queue stabilization problems and developed a dynamic scheduling (Age-Debt) policy for functions of AoI. Developed a dynamic Lyapunov function based Drift-Plus-Panelty policy by establishing multiple virtual queues and derived the corresponding performance guarantee.
- Evaluated the AoI for the randomized policies, Age-Debt policy, Drift-Plus-Panelty Policy, and policies from literature. Numerical results indicate that both the Age-Debt policy and the Drift-Plus-Panelty policy achieve near-optimal performance, with the former optimizing the AoI function and the latter offering low complexity.

Forward Scheduling and Downlink Precoding of Cell-Free Massive MIMO Mar. 2021-Jun. 2023

- Analyzed the downlink performance of Cell-Free massive MIMO employing MMSE channel estimation and MR precoder with asynchronous reception, derived the closed-form expression of corresponding SE, and verified it with MATLAB simulation.
- Developed a scalable Team-MMSE precoding under asymmetric CSI sharing between APs in Cell-Free massive MIMO, presented a heuristic low-complexity AP selection algorithm for the scalable Team-MMSE precoding, which outperforms traditional AP selection algorithms.
- Evaluated the performance of Team-MMSE precoding with 3D channel model QuaDRiGa, and compared it with the traditional SGD algorithm, Local-MMSE, and Centralized-MMSE.

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Selected Projects

Implementation of 5G System with OAI

- Implemented a 5G system on a PC and USRP X310 with OAI gNB, constructing experimental scenarios by modifying the OAI configuration files to test the impact of channel conditions, Tx/Rx power, bandwidth, frequency, and the number of users on the achievable data rate.

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

- Implemented a U-Net-like network in TensorFlow with contracting and expanding paths for brain tumor segmentation. Designed a model processing multi-channel T1 and T2 images, outputting segmentation maps for background, T1, and T2 signals.
- Applied data augmentation and test-time augmentation techniques to enhance model performance. Selected the optimal model based on validation loss and reported the best intersection-over-union (IOU) on the test dataset.

Predicting Two-Year Survival of Patients Diagnosed with Brain Tumors

- Developed a binary classifier for patient survival prediction by extracting 1280-dimensional features from 224×224 pixel non-overlapping tiles using an EfficientNetV2S Model, and analyzed the relationship between model uncertainty and accuracy with Monte Carlo Dropout, reporting certainty distributions for predictions.

Skills

- **Programming Skills:** C Language, Matlab, Python, LebView, NetSim
- **Language Proficiency:** TOEFL: 109