Zhongyuan Zhao, Ph.D.

Curriculum Vitae

Dept. of Electrical and Computer Engineering
Rice University
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EDUCATION

Ph.D. Department of Computer Science and Engineering, University of Nebraska-Lincoln, 2019

Dissertation: *Improving Spectrum Efficiency by Exploiting User and Channel Behaviors for Next Generation Wireless Networks*

Advisor: *Mehmet Can Vuran*

M.Sc. Department of Electronic Engineering, University of Electronic Science and Technology of China, 2009

Thesis: *Design and Implementation of Channelized Digital Receiver based on PCI-Express*

Advisor: *Zishu He*

B.Sc. Department of Electronic Engineering, University of Electronic Science and Technology of China, 2006

PROFESSIONAL APPOINTMENT (Full-Time)

2019-Present Postdoctoral Research Associate, Rice University, Houston, Texas

2013-2019 Graduate Research & Teaching Assistant, University of Nebraska-Lincoln, Lincoln, Nebraska

2011-2013 (Radio Frequency) Integration and Verification Engineer, Ericsson, Chengdu, China

2009-2011 Digital Signal Processing Software Engineer, ArrayComm, Chengdu, China

PROFESSIONAL DESIGNATION

Member of Institute of Electrical and Electronics Engineers (IEEE), 2013-present

IEEE Communications Society
IEEE Signal Processing Society

RESEARCH EXPERIENCE

2019-Present *Autonomous Networking for Multi-domain Operations*, Houston, Texas,
Advisor: Santiago Segarra

Develop machine learning techniques to enhance the autonomous decision-making for routing and scheduling in wireless multihop networks. Develop fast and

distributed solutions for combinatorial optimization problems in wireless systems, by combining domain knowledge, graph neural networks, and reinforcement learning. Write academic papers and reports related to the project and present research findings in academic conferences. Supervise summer research internships.

2019-2019 *Computational Biology for Drug Repurposing*, Lincoln, Nebraska, Advisor: Tomas Helikar

Developed a Python software to analyze human genome microarray data and molecular interaction network for drug repurposing for gene-related diseases.

2017-2019 *Cognitive Secure Cloud Radio Access Network for Efficient Spectrum Sharing*, Lincoln, Nebraska, Advisor: Mehmet Can Vuran

Design and build Nebraska Experimental Testbed of Things (NEXTT), a large-scale testbed of cloud radio access network, in collaboration with the university IT department, Holland Computing Center, City of Lincoln, and industrial partners. The testbed offers researchers and students easy access to experimental sub-6GHz cellular, vehicle-to-infrastructure, and underground-to-aboveground communications on two university campuses and a public street. Conduct research on radio frequency machine learning, dynamic spectrum sharing, and radio propagation on 5.8GHz vehicle-to-barrier channels. Write academic papers, reports, and grand proposal related to the projects and present research findings in academic conferences.

2013-2017 *Cog-TV: Business and Technical Analysis of Cognitive Radio TV Sets for Enhanced Spectrum Access*, Lincoln, Nebraska, Advisor: Mehmet Can Vuran

Studied the feasibilities of sharing the television (TV) spectrum dynamically to secondary wireless broadband through cooperative TV sets. The findings include a thorough analysis of the amount and characteristics of spectrum holes in TV band across 274 U.S. cities that outlines its technical feasibility and economic potential; a dynamic pricing scheme for the network operators to profit and manage congestion under frequent interruptions from TV viewers; and an analytical model of aggregate interference for regulator to manage the radio interference in shared spectrum.

2011-2013 *Remote Radio Head in 4th Generation LTE Base-station* (Ericsson), Chengdu, China

Conducted radio performance, environmental, and certification tests on the radio frontend of the 4th generation Long-Term Evolution (LTE) cellular base stations. Led a team of 5 engineers to develop an in-house radio-frequency test automation software, resulting in a 90% reduction in testing time. Spearheaded the transformation of the Integration and Verification Department from manual to Python programming-based radio frequency test.

2009-2011 *Digital Signal Processing Software in 4th Generation Cellular Base-station* (ArrayComm), Chengdu, China

Develop and optimize digital signal processing (DSP) software for WiMAX and LTE cellular base-stations, focusing on efficient implementations of the physical layer protocols, beamforming, MIMO, MU-MIMO, channel estimation, and source & channel coding, in a real-time operating system (RTOS) running on multi-core DSP

processors. Improve the runtime of baseline implementation by 20x via mixed C and Assembly programming.

2006-2009 *Channelized Software-Defined Radio Receiver*, Chengdu, China

Designed and developed the intermediate frequency sub-system for a channelized multi-antenna software-defined radio receiver for electronic reconnaissance. Responsibilities included hardware design, system integration, and design of digital signal processing modules on field-programmable gate array (FPGA), including high-speed filter-banks (with patent awarded), data interfaces, and a control unit.

RELEVANT SKILLS

Quantitative	Probability and stochastic processes, statistics, machine (deep) learning, optimization.
Programming	Python (Tensorflow, PyTorch), Matlab, R, SAS, C/C++, Javascript, Assembly, Verilog, SQL, Scripting languages in Excel, Linux, and OSX.
Computing	Familiar with Linux & OSX; experienced in programming on GPU, DSP, FPGA, SoC, and high-performance computing cluster (HPCC).
Languages	Native in Chinese; Proficient in English.
Others	Technical writing and presentation, software development process.

PUBLICATIONS

In Preparation

Zhongyuan Zhao, Ananthram Swami, and Santiago Segarra, "Distributed Link Sparsification for Scalable Scheduling using Graph Neural Networks," *IEEE Transactions on Wireless Communications,* manuscript in preparation.

Zhongyuan Zhao, Gunjan Verma, Ananthram Swami, and Santiago Segarra, "Distributed Routing in Dynamic Wireless Networks based on Packet Pheromone and Graph Neural Networks," *IEEE International Workshop on Computational Advances in Multi-Sensor Adaptive Processing (CAMSAP 2023),* manuscript in preparation.

Peer Reviewed Journal Articles

2022 **Zhongyuan Zhao,** Gunjan Verma, Chirag Rao, Ananthram Swami, and Santiago Segarra, "Link Scheduling using Graph Neural Networks," *IEEE Transactions on Wireless Communications,* accepted for publication. DOI: 10.1109/TWC.2022.3222781

2021 **Zhongyuan Zhao**, Mehmet C. Vuran, Fujuan Guo, and Stephen Scott, "Deep-Waveform: A Learned OFDM Receiver Based on Deep Complex-Valued Convolutional Networks," in IEEE Journal on Selected Areas in Communications, vol. 39, no. 8, pp. 2407-2420, Aug.

2021 **Zhongyuan Zhao**, Mehmet C. Vuran, Baofeng Zhou, Mohammad M.R. Lunar, Zahra Aref, David P. Young, Warren Humphrey, Steve Goddard, Garhan Attebury, and Blake France, "A City-Wide Experimental Testbed for The Next Generation Wireless Networks," *Ad Hoc Networks*, Vol. 111, pp102305, Feb.

2019 Demet Batur, Jennifer Ryan, **Zhongyuan Zhao**, and Mehmet C. Vuran, "Dynamic Pricing of Wireless Internet Based on Usage and Stochastically Changing Capacity," *Manufacturing and Service Operations Management*, Published Online, Feb.

2019 **Zhongyuan Zhao**, Mehmet C. Vuran, Demet Batur, and Eylem Ekici, "Shades of White: Impacts of Population Dynamics and TV Viewership on Available TV Spectrum," *IEEE Transactions on Vehicular Technology*, Vol. 68, No. 3, pp2427-2442, Jan.

2018 Samil Tamel, Mehmet C. Vuran, Mohammad M. R. Lunar, **Zhongyuan Zhao**, Abdul Salam, Ronald K. Faller, and Cody Stolle, "Vehicle-to-Barrier Communication During Real-World Vehicle Crash Tests," *Computer Communications*, Vol 127, pp. 172-186, Sep.

2007 Haihong Tang, **Zhongyuan Zhao**, "DSP and CPLD-based Digital AC Soft Starter," *Automation Information*, (5), pp.53-55.

Conference Proceedings & Demo

2023 **Zhongyuan Zhao**, B. Radojicic, G. Verma, A. Swami, and S. Segarra, "Delay-aware Backpressure Routing using graph neural networks," accepted to IEEE *International Conference on Acoustics, Speech and Signal Processing (ICASSP),* Rhodes Island, Greece, June 4-10.

2023 **Zhongyuan Zhao**, Ananthram Swami, and Santiago Segarra, "Graph-based Deterministic Policy Gradient for Repetitive Combinatorial Optimization Problems," accepted to *International Conference on Learning Representations (ICLR),* pp. 1-21, Kigali, Rwanda, *May 1-5*.

2022 **Zhongyuan Zhao**, Gunjan Verma, Ananthram Swami, and Santiago Segarra, "Delay-oriented Distributed Scheduling using Graph Neural Networks," IEEE *International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2022)*, pp. 8902-8906, Singapore, May 23-27.

2022 **Zhongyuan Zhao**, Gunjan Verma, Ananthram Swami, and Santiago Segarra, "Distributed Link Sparsification for Scalable Scheduling using Graph Neural Networks," IEEE *International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2022)*, pp. 5308-5312, Singapore, May 23-27.

2021 **Zhongyuan Zhao,** Gunjan Verma, Chirag Rao, Ananthram Swami, and Santiago Segarra, "Distributed Scheduling using Graph Neural Networks," IEEE *International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2021)*, pp. 4720-4724, Toronto, Ontario, Canada (virtual conference), Jun. 6-11.

2019 **Zhongyuan Zhao**, Mehmet C. Vuran, Zahra Aref, David P. Young, Warren Humphrey, Steve Goddard, Garhan Attebury, Blake France, Baofeng Zhou, and Mohammad M. R. Lunar, "A City-Wide Experimental Testbed for Next Generation Wireless Networks," IEEE Int. *Balkan Conference on Communications and Networking (BalkanCom'19)*, Skopje, North Macedonia, Jun. 10-12.

2018 **Zhongyuan Zhao**, and Mehmet C. Vuran, "Modeling Aggregate Interference with Heterogeneous Secondary Users and Passive Primary Users for Dynamic Admission

and Power Control in TV Spectrum," *IEEE Int. Balkan Conference on Communications and Networking (BalkanCom'18)*, Podgorica, Montenegro, Jun. 6-8.

2017 D. Rempe, M. Snyder, A. Pracht, A. Schwarz, T. Nguyen, M. Vostrez, **Z. Zhao**, and M. C. Vuran, "A Cognitive Radio TV Prototype For Effective TV Spectrum Sharing," *IEEE International Symposium on Dynamic Spectrum Access Networks (DySPAN)*, pp. 117-118, Baltimore, MD, March 6-9.

2014 **Zhongyuan Zhao**, Mehmet C. Vuran, Demet Batur, Eylem Ekici, "Ratings for Spectrum: Impacts of TV Viewership on TV Whitespace," *IEEE Global Communications Conference (GlobeCom'14)*, pp.941-947, Austin, TX, Dec. 8-12.

2009 Hongping Hu, **Zhongyuan Zhao**, "A Real-Time High Resolution Image Compression System Based on ADV212," *2nd International Congress on Image and Signal Processing (CISP'09)*, pp.1-4, Tianjin, China, Oct.

PATENTS

2016 **Zhongyuan Zhao**, Weixu Wang, Luping Pan, "PLL and Adaptive Compensation Method in PLL," International Patent, US9496881 B2, EP3047573 A4, CN105580278A, Issued Date: May.

2012 Zishu He, **Zhongyuan Zhao**, Jianzhong Zhang, Ting Chen, Kexin Jia, "Method and Apparatus for An Implementation of Polyphase Filter Structure," China, CN101958697B, Issued Date: Jul.

AWARDS

2022 IEEE Signal Processing Society Travel Grant for 2022 IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP 2022)

2006-2009 National Scholarship, UESTC (China)

2006 Outstanding Graduate, UESTC

2005 National 1st-class Prize, National Undergraduate Electronic Design Contests (China)

CONFERENCE PARTICIPATION

2022 **Zhongyuan Zhao**, Gunjan Verma, Ananthram Swami, and Santiago Segarra, "Delay-oriented Distributed Scheduling using Graph Neural Networks," IEEE *International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2022)*, pp. 8902-8906, Singapore, May 23-27.

2022 **Zhongyuan Zhao**, Gunjan Verma, Ananthram Swami, and Santiago Segarra, "Distributed Link Sparsification for Scalable Scheduling using Graph Neural Networks," IEEE *International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2022)*, pp. 5308-5312, Singapore, May 23-27.

2021 **Zhongyuan Zhao,** Gunjan Verma, Chirag Rao, Ananthram Swami, and Santiago Segarra, "Distributed Scheduling using Graph Neural Networks," IEEE *International Conference on Acoustics, Speech, and Signal Processing (ICASSP 2021)*, pp. 4720-4724, Toronto, Ontario, Canada (virtual conference), June 6-11.

2017 D. Rempe, M. Snyder, A. Pracht, A. Schwarz, T. Nguyen, M. Vostrez, **Z. Zhao**, and M. C. Vuran, "A Cognitive Radio TV Prototype For Effective TV Spectrum Sharing," IEEE International Symposium on Dynamic Spectrum Access Networks, pp. 117-118, Baltimore, MD, March 6-9.

2014 **Zhongyuan Zhao**, Mehmet C. Vuran, Demet Batur, Eylem Ekici, "Ratings for Spectrum: Impacts of TV Viewership on TV Whitespace," IEEE Global Communications Conference, pp.941-947, Austin, TX, December 8-12.

TEACHING EXPERIENCE

University of Nebraska-Lincoln, Graduate Teaching Assistant

Data Structure and Algorithms (fall 2017, spring 2019)

Multi-Agent System (fall 2017)

University of Electronic Science and Technology of China, Teaching Assistant

Electronic Design Training Program (fall 2005 - summer 2007, 2-year program)

PROFESSIONAL SERVICE

Conference Activities

Session Co-chair, Machine Learning for Communications, *IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP),* Singapore, May 2022

Technical Program Committee Member*, IEEE Vehicular Technology Conference 2020-Fall*

Peer Reviewer

IEEE Transactions on Wireless Communication

IEEE Journal on Selected Areas in Communications

IEEE Communications Surveys and Tutorials

IEEE Transactions on Signal Processing

IEEE Communications Letters

IEEE Signal Processing Letters

IEEE Transactions on Signal and Information Processing over Networks

IEEE Transactions on Cognitive Communications and Networking

IEEE Transactions on Vehicular Technology

IEEE Transactions on Mobile Computing

IEEE Transactions on Multimedia

EURASIP Journal on Wireless Communications and Networking

Elsevier Journal of Physical Communication

The International Journal of Computer and Telecommunications Networking

Wireless Communications and Mobile Computing

SCIENTIA SINICA Informationis

IEEE Asilomar Conference on Signals, Systems, and Computers
IEEE International Symposium on Dynamic Spectrum Access Networks (DySPAN)
IEEE Global Communications Conference (GLOBECOM)
IEEE International Conference on Acoustics, Speech, & Signal Processing (ICASSP)
IEEE International Conference on Computer Communications (INFOCOM)
IEEE International Conference on Communications (ICC)
IEEE Vehicular Technology Conference (VTC)
International Conference on Distributed Computing Systems

To Profession

Secretary, Graduate Student Association, Department of Computer Science and Engineering, University of Nebraska-Lincoln, 2017-2018

PROFESSIONAL DEVELOPMENT/CERTIFICATIONS

2018 Coursera 5-course specialization: Deep Learning, Specialization Certificate.

2018 Coursera 5-course specialization: Foundations of Management, 4/5 Certificates.

2017 Certificate of Completion, Institute for International Teaching Assistants, UNL.

LANGUAGES

English: Advanced reading, writing, speaking

Mandarin: Advanced reading, writing, speaking (native language)