

Zhizhen Zhong

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VISION

I am building **next-generation networked computer systems** by engineering the unique properties of light with emerging optical technologies to **optimize data-intensive workloads** like machine learning and big data analytics. Towards this vision, my research takes an **application-centric approach** to co-design different stacks of the system: from silicon photonics and fiber optics devices, to computer architecture and programmable hardware, all the way to scheduling algorithms and system software.

- **Computer Networks + Fiber Optics:** Reconfigurable optical circuit-switched networks, In-network optical computing
- **Computer Systems + Silicon Photonics:** System architecture for photonic computing, Optical I/O, Programmable photonics

PROFESSIONAL APPOINTMENTS

10/2020 - now	Massachusetts Institute of Technology Postdoctoral Associate, Computer Science and Artificial Intelligence Laboratory	Cambridge, MA, USA
11/2019 – 10/2020	Meta (Facebook) Postdoctoral Research Consultant, Network Platforms	Singapore
1/2018 – 6/2018	University of California, Davis Visiting Ph.D. student, Department of Computer Science	Davis, CA, USA
9/2014 – 7/2019	Tsinghua University Graduate Research Assistant, Department of Electronic Engineering	Beijing, China

EDUCATION

2019	Tsinghua University Doctor of Philosophy, Department of Electronic Engineering <i>Ph.D. Thesis: Traffic-Driven Self-Adaptive Networking in Large-Scale Optical Networks</i>	Beijing, China
2016	Tsinghua University Bachelor of Economics, School of Economics and Management	Beijing, China
2014	Tsinghua University Bachelor of Engineering, Department of Electronic Engineering	Beijing, China



AWARDS AND HONORS

2022	Best Paper Award at OECC 2022	OECC 2022 Conference
2019	Zijing Scholar Fellowship	Tsinghua University
2018	Student Travel Grant at NSDI 2018	USENIX Association
2018	Best Oral Talk at the AUA Postgraduate Academic Forum	Asian University Alliance (AUA)
2017	1st Place Best Poster Award at OECC 2017	IEEE Photonics Society
2016	Tang Lixin Graduate Fellowship 2 annual recipients in the EE department, continuous financial support until Ph.D. graduation	Tsinghua University
2014	Undergraduate Commencement Speaker in Electronic Engineering	Tsinghua University
2014	Outstanding Undergraduate thesis in Electronic Engineering for my thesis “Unified Control Plane for Software-Defined IP-Over-Optical Networks”	Tsinghua University

PUBLICATIONS

My recent research highlights include: the first *on-smartNIC* reconfigurable photonic-electronic computing system (LIGHTNING) running at record-breaking 4.055 GHz compute frequency [SIGCOMM'23a]; the first *in-fiber* photonic edge computing system NETCAST with the IOI smart transceiver [HotNets'23, Science'22, OECC'22 Best Paper, OptSys'21]; multiple ARROW, BOW, and FLEXWAN reconfigurable wide-area optical networks and traffic engineering systems [SIGCOMM'23b, SIGCOMM'21, OFC'21 Postdeadline, ToN'19]; the RSS global backbone risk management system *in production* at Meta [NSDI'21]; and the TOPOPT reconfigurable optical interconnect for distributed DNN training clusters in data centers [NSDI'23].

- SIGCOMM 2023 [1] [Lightning: A Reconfigurable Photonic-Electronic SmartNIC for Fast and Energy-Efficient Inference](#)
Z. Zhong, M. Yang, J. Lang, C. Williams, L. Kronman, A. Sludds, H. Esfahanizadeh, D. Englund, M. Ghobadi
ACM SIGCOMM 2023 Conference, pp. 452-472, 2023
- SIGCOMM 2023 [2] [FlexWAN: Software Hardware Co-design for Flexible and Cost-Effective Optical Backbones](#)
C. Miao, Z. Zhong, Y. Zhang, K. He, F. Li, M. Chen, Y. Zhao, X. Li, Z. He, X. Zou, J. Wang
ACM SIGCOMM 2023 Conference, pp. 319-332, 2023
- SIGCOMM 2023 Demo [3] [First Demonstration of Real-Time Photonic-Electronic DNN Acceleration on SmartNICs](#)
Z. Zhong, M. Yang, J. Lang, D. Englund, M. Ghobadi
ACM SIGCOMM 2023 Conference, pp. 1173-1175, 2023
- HotNets 2023 [4] [On-Fiber Photonic Computing](#)
M. Yang*, Z. Zhong*, M. Ghobadi (* Equal contribution)
ACM HotNets 2023 Conference, pp. 263-271, 2023
- NSDI 2023 [5] [TopoOpt: Co-optimizing Network Topology and Parallelization Strategy for Distributed Training Jobs](#)
W. Wang, M. Khazraee, Z. Zhong, M. Ghobadi, Z. Jia, D. Mudigere, Y. Zhang, A. Kewitsch
USENIX Symposium on Networked Systems Design and Implementation (NSDI), pp. 739-767, 2023
- CLEO 2023 [6] [Wavelength Multiplexed Photonic Edge Computing in the Output Stationary Frame](#)
R. Hamerly, A. Sludds, S. Bandyopadhyay, Z. Chen, Z. Zhong, L. Bernstein, M. Ghobadi, D. Englund
CLEO: Applications and Technology, pp. ATu3I-1, 2023
- Science 2022 [7] [Delocalized Photonic Deep Learning on the Internet's Edge](#)
A. Sludds, S. Bandyopadhyay, Z. Chen, Z. Zhong, J. Cochrane, L. Bernstein, D. Bunandar, P. B. Dixon, S. A. Hamilton, M. Streshinsky, A. Novack, T. Baehr-Jones, M. Hochberg, M. Ghobadi, R. Hamerly, D. Englund
Science, no. 378, vol. 6617, pp. 270-276, 2023
- OECC 2022 [8] [WDM-Enabled Photonic Edge Computing](#)
A. Sludds, R. Hamerly, S. Bandyopadhyay, Z. Chen, Z. Zhong, L. Bernstein, M. Ghobadi, D. Englund
OptoElectronics and Communications Conference (OECC), pp. WC3-2, 2022
Best Paper Award
- OFC 2022 [9] [Demonstration of WDM-Enabled Ultralow-Energy Photonic Edge Computing](#)
A. Sludds, R. Hamerly, S. Bandyopadhyay, Z. Zhong, Z. Chen, L. Bernstein, M. Ghobadi, D. Englund
Optical Fiber Communication Conference (OFC), pp. Th3A-3, 2022
- SIGCOMM 2021 [10] [ARROW: Restoration-Aware Traffic Engineering](#)
Z. Zhong, M. Ghobadi, A. Khaddaj, J. Leach, Y. Xia, Y. Zhang
ACM SIGCOMM 2021 Conference, pp. 560-579, 2021
- OFC 2021 [11] [BOW: first real-world demonstration of a Bayesian optimization system for wavelength reconfiguration](#)
Z. Zhong, M. Ghobadi, M. Balandat, S. Katti, A. Kazerouni, J. Leach, M. McKillop, Y. Zhang
Optical Fiber Communication Conference (OFC), pp. F3B-1, 2021
Postdeadline Paper
- OptSys 2021 [12] [IOI: In-Network Optical Inference](#)
Z. Zhong, W. Wang, M. Ghobadi, A. Sludds, R. Hamerly, L. Bernstein, D. Englund
ACM SIGCOMM 2021 Workshop on Optical Systems, pp. 18-22, 2021
- NSDI 2021 [13] [A social network under social distancing: risk-driven backbone management during COVID-19 and beyond](#)
Y. Xia, Y. Zhang, Z. Zhong, G. Yan, C. Lim, S. Ahuja, S. Bali, A. Nikolaidis, K. Ghobadi, M. Ghobadi
USENIX Symposium on Networked Systems Design and Implementation (NSDI), pp. 217-231, 2021

- ToN 2019 [14] [Provisioning short-term traffic fluctuations in elastic optical networks](#)
Z. Zhong, N. Hua, M. Tornatore, J. Li, Y. Li, X. Zheng, B. Mukherjee
IEEE/ACM Transactions on Networking, vol. 27, no. 4, pp. 1460-1473, 2019
- OFC 2019 [15] [Routing without routing algorithm: an AI-based routing paradigm for multi-domain optical networks](#)
Z. Zhong, N. Hua, Z. Yuan, Y. Li, X. Zheng
Optical Fiber Communication Conference (OFC), pp. Th2A-24, 2019
- OFC 2019  [16] [Achieving ultralow-latency optical interconnection for high performance computing \(HPC\) systems by joint allocation of computation and communication resources](#)
R. Luo, Y. Yu, N. Hua, Z. Zhong, J. Li, X. Zheng, B. Zhou
Optical Fiber Communication Conference (OFC), pp. W1J-4, 2019
High-Scored Paper
- CLEO 2019 [17] [Crosstalk tracing in weakly-coupled short-reach mode-division multiplexing optical networks with deep learning](#)
R. Luo, N. Hua, Y. Li, Z. Zheng, Z. Zhong, X. Zheng, B. Zhou
CLEO: Science and Innovations, pp. JTh2A-78, 2019
- Opt. Exp. 2019 [18] [Optical spectrum feature analysis and recognition for optical network security with machine learning](#)
Y. Li, N. Hua, J. Li, Z. Zhong, S. Li, C. Zhao, X. Xue, X. Zheng
Optics Express, vol. 27, no. 17, pp. 24808-24827, 2019
- JOCN 2019 [19] [Flexible low-latency metro-access converged network approach based on optical time slice switching](#)
J. Li, N. Hua, Z. Zhong, Y. Yu, X. Zheng, B. Zhou
Journal of Optical Communications and Networking, vol. 11, no. 12, pp. 624-635, 2019
- IEEE Access [20] [Time-sliced flexible resource allocation for optical low earth orbit satellite networks](#)
Z. Zheng, N. Hua, Z. Zhong, J. Li, Y. Li, X. Zheng
IEEE Access, vol. 7, pp. 56753-56759, 2019
- OFC 2018 [21] [Throughput scaling for MMF-enabled optical datacenter networks by time-slicing-based crosstalk mitigation](#)
Z. Zhong, N. Hua, Y. Yu, Z. Wu, J. Li, H. Yan, S. Li, R. Luo, J. Li, Y. Li, X. Zheng
Optical Fiber Communication Conference (OFC), pp. M2E-5, 2018
- OFC 2018 [22] [A flexible low-latency metro-access converged network approach based on time-synchronized TWDM-PON](#)
J. Li, N. Hua, Y. Yu, Z. Zhong, X. Zheng, B. Zhou
Optical Fiber Communication Conference (OFC), pp. Th2A-50, 2018
- OFC 2018 [23] [In-service crosstalk monitoring and tracing for short-reach space-division multiplexing \(SDM\) optical networks](#)
R. Luo, N. Hua, Y. Yu, Z. Zhong, Z. Wu, J. Li, X. Zheng, B. Zhou
Optical Fiber Communication Conference (OFC), pp. W2A-17, 2018
- ICC 2018 [24] [An online strategy for service degradation with proportional QoS in elastic optical networks](#)
S. Santos, A. K. Horota, Z. Zhong, J. De Santi, G. B. Figueiredo, M. Tornatore, B. Mukherjee
IEEE International Conference on Communications (ICC), 2018
- OECC 2017  [25] [Evolving optical networks for latency-sensitive smart-grid communications via optical time slice switching \(OTSS\) technologies](#)
Z. Zhong, N. Hua, Z. Liu, W. Li, Y. Li, X. Zheng
OptoElectronics and Communications Conference (OECC), 2017
1st Place Best Poster Award
- IEEE Comm. Lett. [26] [Balancing energy efficiency and device lifetime in TWDM-PON under traffic fluctuations](#)
J. Li, Z. Zhong, N. Hua, X. Zheng, B. Zhou
IEEE Communications Letters, vol. 21, no. 9, 2017
- ONDM 2017 [27] [Enabling low latency at large-scale data center and high-performance computing interconnect networks using fine-grained all-optical switching technology](#)
N. Hua, Z. Zhong, X. Zheng
Optical Network Design and Modeling (ONDM), 2017

ACP 2017 [28] [Fast-reconfigurable optical interconnect architecture based on time-synchronized node coordination for high performance computing](#)
Y. Yu, N. Hua, **Z. Zhong**, J. Li, R. Luo, Z. Zheng, X. Zheng
Asia Communications and Photonics Conference (ACP), 2017

JOCN 2016 [29] [Energy efficiency and blocking reduction for tidal traffic via stateful grooming in IP-over-optical networks](#)
Z. Zhong, N. Hua, M. Tornatore, Y. Li, H. Liu, C. Ma, Y. Li, X. Zheng, B. Mukherjee
IEEE/OSA Journal of Optical Communications and Networking (JOCN), vol. 8, no. 3, pp. 175-189, 2016

GLOBECOM 2016 [30] [On QoS-assured degraded provisioning in service-differentiated multi-layer elastic optical networks](#)
Z. Zhong, J. Li, N. Hua, G. B. Figueiredo, Y. Li, X. Zheng, B. Mukherjee
IEEE Global Communications Conference (GLOBECOM), 2016

OECC 2015 [31] [Considerations of effective tidal traffic dispatching in software-defined metro IP over optical networks](#)
Z. Zhong, N. Hua, H. Liu, Y. Li, X. Zheng
OptoElectronics and Communications Conference (OECC), 2015

ICOON 2015 [32] [Achieving heterogeneous packet-optical networks inter-connection with a software-defined unified control architecture](#)
X. Zheng, N. Hua, **Z. Zhong**
IEEE International Conference on Optical Communications and Networks (ICOON), 2015

ACP 2014 [33] [Unified control for IP over optical transport networks based on software-defined architecture](#)
Z. Zhong, X. Chen, N. Hua, Y. Li, X. Zheng
Asia Communications and Photonics Conference (ACP), 2014

TEACHING

Instructor	MIT 6.S918: Optical Computing in the Era of AI I developed this new course at MIT EECS with my colleague Dr. Saumil Bandyopadhyay and mentor Prof. Dirk Englund to bring cutting-edge knowledge on photonic computing systems for undergraduate and graduate students. Course website: https://light-computing.github.io	2024 Winter
Trainee	MIT Kaufman Teaching Certificate Program I was selected for this semester-long program on developing teaching skills for future faculty candidates. Here is a letter from MIT Vice-Chancellor Ian A. Waitz on completing this certificate program.	2022 Spring
Guest Lecturer	MIT 6.5820: Computer Networks Guest lectures on 1) optical networks in wide-area networks and 2) optical data center networks.	2021 Fall
Guest Lecturer	Saint Louis University CSCI 5090: Computer Networks Guest lecture on wide-area traffic engineering.	2021 Fall

SELECTED INVITED PRESENTATIONS



Seminar	Google TechTalk Lightning and Beyond: Integrating Photonic Computing into the Networked Computer Systems	01/2024
Poster	Boston University Photonics Center Symposium The Lightning SmartNIC: Integrating Photonic Computing into the Networked Computer Systems	11/2023
Seminar	University of Maryland Systems Seminar Lightning: A Reconfigurable Photonic-Electronic SmartNIC for Fast and Energy-Efficient Inference	11/2023
Seminar	Stanford Systems Seminar Lightning: A Reconfigurable Photonic-Electronic SmartNIC for Fast and Energy-Efficient Inference	10/2023
Seminar	UC Berkeley NetSys Group Seminar Lightning: A Reconfigurable Photonic-Electronic SmartNIC for Fast and Energy-Efficient Inference	10/2023
Poster	Google Networking Research Summit Lightning: A Reconfigurable Photonic-Electronic SmartNIC for Fast and Energy-Efficient Inference	10/2023




Conference Talk	SIGCOMM 2023 Lightning: A Reconfigurable Photonic-Electronic SmartNIC for Fast and Energy-Efficient Inference	09/2023
Live Demo	SIGCOMM 2023 Demos and Posters Session Lightning: A Reconfigurable Photonic-Electronic SmartNIC for Fast and Energy-Efficient Inference	09/2023
Seminar	MIT Research Laboratory of Electronics Lunch and Learn Seminar Series RFSoc and its Applications in Quantum Photonics Research	08/2023
Talk	Google Networking Research Summit ARROW and BOW: Building Resilient Wide-Area Networks with Reconfigurable Optics	02/2022
Conference Talk	SIGCOMM 2021 ARROW: Restoration-Aware Traffic Engineering	08/2021
Workshop Talk	IAP MIT & Univ. of Washington Workshop on Future of Cloud Computing ARROW and BOW: Building Resilient Wide-Area Networks with Reconfigurable Optics	06/2021
Workshop Talk	SIGCOMM 2020 Workshop on Optical Systems Design (OptSys) The Impact of COVID-19 Social Distancing on Facebook's Optical Backbone	08/2020
Workshop Talk	SIGCOMM 2020 Workshop on Optical Systems Design (OptSys) Leveraging Optical Noise for Fast Fiber Cut Recovery	08/2020
Seminar	University College London Optical Networks Group Seminar Exploiting Optical-Layer Reconfigurability for Demand-Responsive Networks	07/2019
Seminar	Nokia Bell Labs (Murray Hill) Special Seminar Exploiting Optical-Layer Reconfigurability for Demand-Responsive Networks	03/2019
Seminar	Georgia Tech ECE Special Seminar Exploiting Optical-Layer Reconfigurability for Demand-Responsive Networks	04/2018
Workshop Talk	UC Davis Post-OFC Workshop Exploiting Optical-Layer Reconfigurability for Demand-Responsive Networks	03/2018

PRESS COVERAGE

Project Lightning [1, 3]	The First SmartNIC (Data Movement Controller) for Photonic Computing Covered by: MIT News , Photonics.com , TechXplore	09/2023
Project TopoOpt [5]	Meta, MIT, Telescent Test Robotic Arm in Optical AI Infrastructure Covered by: HPC Wire , Business Wire	04/2023
Projects NetCast [6, 7, 8, 9] & IOI [12]	Delocalized Photonic Deep Learning on the Internet's Edge Covered by: MIT News , The Economist , Optica OPN	10/2022
Projects Arrow [10] & Bow [11]	Fiber Cut Recovery via Reconfigurable Optics in Wide-Area Networks Covered by: MIT News , ACM TechNews , A Decade of Innovation at MIT CSAIL	08/2021
Project RSS [13]	Meta's risk-driven backbone management during COVID-19 and beyond Covered by: Engineering at Meta	08/2021

CONTRIBUTED OPEN-SOURCE ARTIFACTS

Project Lightning [1, 3]	 lightning Verilog RTL implementation for the reconfigurable count-action datapath on ZCU111 RFSoc FPGA, together with PetaLinux configuration on the embedded ARM core, Python implementation for photonic devices calibration, and micro benchmarking, laser cutting and 3D print design files
Project TopoOpt [5]	 TopoOpt PyTorch implementation for distributed DNN training on ImageNet dataset as a baseline for TopoOpt, using a cluster of twelve A100 GPU servers

Project Arrow [10]	 arrow Julia implementation for the IP-optical cross-layer traffic engineering algorithms using the Gurobi linear program solver
Project Bow [11]	 bow Python implementation for the Bayesian Optimization framework using the Ax.dev adaptive experimentation backend and GNPpy optical network emulator
Project RSS [13]	 covid-mobility Python implementation for the analyzing the aggregated daily views of USA foot-traffic movement between census block groups from SafeGraph

ACADEMIC SERVICES

Conference Program Committee	IEEE ICNP 2024 ACM SIGCOMM 2023 USENIX NSDI 2023 ACM SIGCOMM Workshop on Optical Systems (OptSys) 2021 WCSP 2019
Conference External Reviewer	USENIX NSDI 2024 ACM IMC 2022 ACM UbiComp 2021
Artifact Evaluation Committee	ACM SIGCOMM 2023 (Co-Chair) ACM SIGCOMM 2022 ACM SIGCOMM 2021
Journal Reviewer	IEEE/ACM Transactions on Networking ACM SIGCOMM Computer Communication Review Optics Express
Journal Reviewer	Optics Letters Photonics Research IEEE/Optica Journal of Lightwave Technology IEEE/Optica Journal of Optical Communications and Networking IEEE/ACM Transactions on Networking ACM SIGCOMM Computer Communication Review IEEE Communications Magazine IEEE Transactions on Network and Service Management IEEE Photonics Journal IEEE Access
Committee	Optica Technical Groups on Optical Communications

DEPARTMENT AND UNIVERSITY SERVICES

Selection Committee	MIT CSAIL METERO Postdoctoral Fellowship Program	2021, 2022
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