Yuyang Wang, Ph.D.
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Faculty Search Committee
Department of Electrical and Computer Engineering
Duke University
Duke University Pratt School of Engineering
Box 90291
Durham, NC 27708 USA

Dear Members of the Faculty Search Committee,

Re: Application for the Tenure-Track Assistant Professor Position

I am writing in response to the advertised faculty position (**Tenure-Track Assistant Professor—Job # 25738**) in the Department of Electrical and Computer Engineering at the Duke University. I am currently a Postdoctoral Research Scientist at the Columbia Nano Initiative of the Columbia University under the mentorship of Prof. Keren Bergman. My Ph.D. in Electrical and Computer Engineering was awarded by the University of California, Santa Barbara in 2021, where I was co-advised by Prof. Kwang-Ting Cheng and Prof. John E. Bowers. My research portfolio, which is both diverse and synergistic, focuses on silicon photonics (SiPh) optical interconnects, with significant implications for the broad area of computer engineering. I believe that my interdisciplinary research background positions me well to contribute to your department's ongoing excellence.

The prevalence of communication bottleneck in the era of data ubiquity—emerged in modern distributed computing infrastructures and exacerbated by the pervasiveness of data-intensive AI/machine learning applications—drives my research that seeks **transformative connectivity solutions** for future system scalability. I aim to cultivate the potential of CMOS-compatible silicon photonics to develop ultra high-bandwidth and energy-efficient optical interconnects. Building upon a unique link architecture that facilitates unprecedented channel parallelism, I envision system-level breakthroughs that boost the density, adaptability, and functionalities of optical interconnects amidst the ever-evolving data landscape.

My Ph.D. research laid the groundwork for this vision, **vertically integrating design enablement technologies** for integrated silicon photonics across device, circuit, and system levels, including modeling, simulation, and variation mitigation techniques to democratize the design of yield- and performance-optimized SiPh devices and circuits. The research resulted in publications at leading design automation conferences like DAC and ICCAD, esteemed photonics venues like OFC and JLT, and a book chapter in press with Springer, bridging electronics and photonics research communities.

Orthogonally expanding on my Ph.D. work, my postdoctoral work at the Columbia University focuses on the design and implementation of massively scalable SiPh chip I/Os, **horizontally integrating optimization techniques** across the entire design cycle, from initial design to post-fabrication tuning and runtime reconfiguration. I spearheaded two generations of SiPh transceiver chips—co-designed with 3D-integrated electronic drivers and advanced packaging in collaboration with both academia and industry partners—integrating over 2,000 microresonators into an 8 mm × 8 mm footprint to achieve 16 Tbps chip I/O bandwidth with sub-pJ/b energy consumption. The highlighted link architecture played a pivotal role in securing a $35M SRC JUMP 2.0 grant involving 23 principal investigators, to which I contributed through proposal writing. An invited paper detailing the chip's design and characterization is currently under review for

CICC 2024, and a manuscript focusing on the end-to-end demonstration of the link is slated for an invited submission to *Nature Communications Physics*.

Moving forward, I anticipate an even more diverse and dynamic data landscape, shaped by the growing heterogeneity of computing applications. Emerging privacy-focused frameworks such as federated learning emphasize the exchange of models over data, which—coinciding with the expansion of large models like GPTs—further pushes the system bottleneck from computation to communication capabilities. This shift necessitates the next generation of **reconfigurable system connectivity** that can adapt on-demand to varying traffic needs while maintaining high bandwidth and energy efficiency. My foundation work in reconfigurable system architectures and runtime adaptation techniques, built upon the scalable link architecture, will be the cornerstone of my ongoing research endeavor to equip future computing infrastructures for the ever-evolving data context.

I also envision opportunities arising from deeper integration of silicon photonics within computing sockets, dependent on the synergy between **innovative system architectures** and groundbreaking optical I/O technologies. For instance, by leveraging 3D optical I/Os densely routed

I foresee opportunities arising from the close integration of silicon photonics with computing electronics, dependent on the synergy between innovative architectures and improved design capabilities. For instance, we can revolutionize future chip-to-chip connectivity by leveraging 3D optical I/Os densely routed with multiple layers of waveguides on-chip—a concept that I helped formulate for presentation at the 2023 DARPA ERI Summit—opening up new horizons for computing architectures and interconnect functionalities with manifolded reach of on-board optical connectivity, while signaling new challenges in design and optimization. I also recognize the rapidly evolving data landscape in distributed computing—influenced by privacy concerns and the rise of frameworks like federated learning, which prioritize model over data exchange, as well as the surge in large models like GPTs—shifting the computation-communication balance further toward the latter, creating greater potential for traffic-adaptable optical interconnects in future computing systems. My interdisciplinary research, sitting at the nexus of electronics/photonics, devices/systems, and design/applications, positions me to collaborate with the diverse faculty members at the Duke University in the field of *emerging architectures and hardware for machine learning acceleration* (Hai "Helen" Li, Yiran Cheng, Christ D Richmond), *integrated circuit design and automation* (Xin Li), *data center efficiency* (Tyler K Bletsch), *high performance computing and computer architectures* (John A. Board, Andrew Douglas Hilton, Daniel J. Sorin, Lisa Wills), *optic and photonic devices* (William T. Joines, Natalia Litchinitser), *wireless and optical networking* (Tingjun Chen), as well as *AI/machine learning* (Lawrence Carin, Neil Gong, Henry Pfister, Galen Reeves, Cynthia D. Rudin), to innovate transformative connectivity solutions across the full system stack.

My training in California and New York has enriched me with diverse and inclusive academic experiences, fueling my passion to contribute to the Duke University's community through not only research, but also teaching, mentoring, and outreach. As a teaching assistant and guest lecturer, I have taught at both undergraduate and graduate levels, focusing my teaching philosophy on the balance of engagement, conveyance, and inspiration through visualization. I also value the role of mentoring in fostering students' intellectual growth beyond technical skills and have actively mentored students tailored to their research interests and career aspirations. My advocacy for diversity and inclusion is reflected in my experiences of working with—as well as my efforts to promote the accessibility of STEM education to—underrepresented groups in my endeavors.

I am enthusiastic about joining the Department of Electrical and Computer Engineering at the Duke University to further its excellence in research and education. Enclosed are my application materials, and I am glad to provide additional information if required. I look forward to the possibility of discussing my qualifications and research vision with you. Thank you for considering my application, and I anticipate your response.

Yours sincerely,

Yuyang Wang

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encl: Curriculum Vitae
Research Statement
Teaching Statement