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Quantum Network × Online Learning: Foundations, Fusion, & Frontier

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Quantum networks (QNs) are rapidly emerging as the backbone of future quantum communication and distributed quantum computing. Yet their practical deployment remains challenging: quantum states are fragile, network resources are scarce, and performance must be inferred and optimized under severe uncertainty. In this talk, I will introduce recent advances in evaluating and operating QNs, focusing on two core tasks—characterizing network performance and selecting the best communication paths. After presenting these quantum-native challenges and solutions, I will briefly show how ideas from online learning (OL) naturally complement QN operation. In particular, I will highlight how lightweight OL principles can guide adaptive decision-making in dynamic quantum environments, and how the realities of QNs reveal new directions where classical OL models must be expanded. I will conclude with a forward-looking perspective on building deployable quantum networks, outlining key technical bottlenecks, emerging opportunities, and the role of adaptive algorithms in shaping the next generation of large-scale quantum communication systems.

Xuchuang Wang is a postdoctoral researcher in the Manning College of Information & Computer Sciences at the University of Massachusetts Amherst, working with Don Towsley and Mohammad Hajiesmaili. He received his Ph.D. in Computer Science & Engineering from The Chinese University of Hong Kong, advised by John C.S. Lui. His research spans online learning theory, quantum networking systems, and the emerging intersection between the two. His interdisciplinary work has appeared in top-tier venues across machine learning, networking, and performance evaluation. His recent paper was selected as a Best Paper Finalist (top 5) at ACM SIGMETRICS 2025.

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