

## SMC eNewsletter's Student Corner Column (Dec 2024 Issue)

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In this issue of the Student Corner Column, we interview Hailan Ma, co-author of the paper “Deep Reinforcement Learning With Quantum-Inspired Experience Replay” published in the IEEE Transactions on Cybernetics (Vol. 52, No. 9, 9326-9338, 2022).

1. Please tell us a bit about your background and your research area.

*I am Hailan Ma, and I recently completed my Ph.D. in Electrical Engineering at the University of New South Wales, Canberra. My research primarily focuses on machine learning for quantum control and quantum compression, with a particular focus on developing reinforcement learning methods for manipulating complex quantum systems. I am also deeply fascinated by quantum machine learning, especially exploring quantum-enhanced agents for sequential decision-making tasks. As a researcher with a strong background in quantum control, I aim to make contributions to the integration of machine learning and quantum technologies.*

2. How did you become interested in your field?

*My interest in this field began with my fascination for the intersection between quantum physics and artificial intelligence—two foundational yet deeply interconnected areas. The potential of combining these fields presents a promising direction for advancing science. When I first started, quantum machine learning was still in its infancy, offering a wealth of opportunities for exploration. I became attracted by the idea of introducing quantum mechanics into the design of experience replay to achieve a balance between sample complexity and diversity. This interdisciplinary project highlights the significance of quantum physics in advancing intelligent control problems.*

3. What motivated you to join the IEEE SMC Society?

*I joined the IEEE SMC Society because it provides a versatile platform for interdisciplinary collaboration and knowledge exchange. As a researcher working at the intersection of quantum technologies and artificial intelligence, I value the opportunity to engage with experts and peers from diverse backgrounds who share a same passion for advancing intelligent systems and control. The society offers a unique space to discuss cutting-edge ideas, gain fresh perspectives, and contribute to a community dedicated to pushing the boundaries of science and technology.*

4. What motivated you to publish in the IEEE Transactions on Cybernetics?

*This journal holds significant prestige in fields such as intelligent control, reinforcement learning and quantum applications. I chose to publish my paper in this journal due to its leading role in shaping research in these areas.*

5. What is the main innovation in your paper titled “Deep Reinforcement Learning With Quantum-Inspired Experience Replay ” and its importance to IEEE Transactions on Cybernetics?

*The main innovation of our paper lies in proposing a quantum-inspired experience replay mechanism for deep reinforcement learning. By leveraging quantum mechanics to represent samples into quantum states, our approach proposes to first prepare quantum states based on its significance and then to depreciate quantum states according to replay times. Our approach aims to achieve a balance between*

*sample efficiency and sample complexity. The approach in our paper acts as a simple yet effective method for a class of offline reinforcement learning problems that might have great popularity in sequential-decision tasks. This advancement is crucial for improving the efficiency of deep reinforcement learning, particularly in addressing complex environments. Our paper is also a successful innovation of introducing quantum physics into artificial intelligence, which is a key focus of IEEE Transactions on Cybernetics.*

6. Where would you see yourself in 5-years' time career wise?

*In five years, I aim to focus on quantum-enhanced intelligent systems. My goal is to contribute to bridging the gap between quantum physics and artificial intelligence by developing innovative methods that leverage quantum principles to solve real-world problems in autonomous systems and control. I aspire to collaborate with academic and industry partners to advance the practical applications of these technologies. Additionally, I hope to contribute to the IEEE SMC Society by fostering interdisciplinary research and nurturing the next generation of researchers in this exciting field.*

### **Biography:**



Hailan Ma received the B.E. degree in automation and the MA. Sc degree in control science and engineering from Nanjing University, Nanjing, China, in 2014 and 2017, respectively. She received the Ph. D. degree in electrical engineering at University of New South Wales, Canberra, Australia in 2024. She was a Research Engineer at 2012 lab of Huawei Technology Nanjing from 2017 to 2019. She was a Research Assistant with Nanjing University, Nanjing, China from 2019 to 2020. She is a member of Technical Committee on Quantum Cybernetics, IEEE Systems, Man and Cybernetics Society. She is now a postdoc researcher with School of Engineering, Australian National University. Her research interests include learning-based control for quantum systems, quantum machine learning, and quantum compression.