

### Research interests

Quantum information theory, Quantum computing, Quantum sensing, Reinforcement learning, Integrated sensing and communications, Ultraviolet communications.

### Education

- 2024–Present **PhD, Artificial Intelligence**, *Hong Kong University of Science and Technology (Guangzhou)*, Guangzhou, China.  
Advised by Xin Wang and Yinan Li.  
Focus areas: quantum information and quantum computation.
- 2022–2024 **PhD, Electrical & Computer Engineering**, *University of Toronto*, Toronto, Canada.  
Advised by Amr S. Helmy.  
Focus areas: quantum sensing and quantum optics.  
Note: drop out due to prolonged delays in obtaining the student visa.
- 2018–2021: **Master of Engineering, Instrument & Meter**, *Tsinghua University*, Beijing, China..  
Focus areas: ultraviolet communications.  
GPA: 3.87/4.00.  
Advised by Jianshe Ma and Ping Su.
- 2014–2018: **Bachelor of Engineering, Measurement & Control Technology**, *Harbin University of Science and Technology*, Harbin, China..  
Specialized area: photoelectric information.  
GPA: 3.95/4.0.  
Advised by Zimei Su and Lihua Wu.

### Fellowships & Awards

- 2022 –2024 **ECE Graduate Fellowship**, as a PhD student in University of Toronto.
- 2020 **National Scholarship of China (Top 0.2%)**.
- 2020 **Excellent Oral Presentation Certificate** in *IEEE 20th International Conference on Communication Technology*, Nanning, China
- 2020 **Outstanding Communist Youth League Member** at Tsinghua University.
- 2019 **Comprehensive Excellence Scholarship** at Tsinghua University.
- 2018 **Excellent Graduation Thesis** award at Hrbust.
- 2017 **Third Prize in Global Management Challenge**.
- 2017 **Provincial First Prize of Optoelectronic Design Competition**, Heilongjiang Province, China.
- 2017 **Provincial Third Prize of the National Software and Information Technology Competition**, Heilongjiang Province, China.
- 2016 **Ruyuan Talent Scholarship** sponsored by Beijing Alumni Association, the highest scholarship at Hrbust. Only 8/7500 awarded each year.

- 2016 **National Scholarship of China** (Top 0.2%).  
2016 **Scholarship of Chinese Instrument and Control Society**, China.  
2016 **National First Prize of Mathematical Modeling Contest** (Top 1%), China.

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## Research Experience

- 01/2024 – **Research on Magic State Distillation.**  
present
  - Study deep reinforcement learning for discovering magic state distillation protocols.
  - Investigate quantum combs for magic state distillation in the context of quantum resource theory.
  - Design quantum error correction codes for magic state distillation.
  - Participate in developing Python-based quantum research and error correction platforms.Advisor : Prof. Xin Wang, Associate Professor, Thrust of Artificial Intelligence, Information Hub, Hong Kong University of Science and Technology (Guangzhou)
- 10/2022 – **Research and Development on Performance Evaluation of Quantum Devices.**  
12/2023
  - Conduct various research in **direct fidelity estimation** for quantum state, process, and measurement, leading to 1 paper and 5+ patents.
  - Participate in the development of a Python-based quantum error processing platform. My primary responsibility involves developing the quantum device performance evaluation tools, which form part of the Quantum Error Processing (QEP) platform. Website: <https://github.com/baidu/QCompute/tree/master/Extensions/QuantumErrorProcessing>.Mentor : Dr. Kun Wang, Senior Researcher, QEP Team, Institute for Quantum Computing, Baidu Research
- 09/2022 – **Research on Quantum Illumination.**  
2024
  - Conduct research in the estimation methods of reflected coefficient in quantum illumination.Advisor : Prof. Amr Helmy, Professor, Department of Electrical & Computer Engineering, University of Toronto
- 09/2018 – **Study on Theory of Deep Ultraviolet Scattering Communications.**  
06/2022
  - Proposed a nonlinear minimum mean square error receiver designed for photon counting receiver, photon multiplier tube, and avalanche photon diode, leading to 1 paper.
  - Designed and evaluated subcarrier-intensity modulation schemes for ultraviolet communications over turbulence channel, leading to 1 paper.
  - Established a new channel model for ultraviolet scattering communication, leading to 1 paper and 1 patent.
  - Proposed the first transceiver jitter model in ultraviolet communication, leading to 1 paper and 1 patent.
  - Designed a Monte Carlo integration model that featured significant improvements, leading to 1 paper with the best oral award.Advisor : Prof. Jianshe Ma and Prof. Ping Su, Associate Professor, Department of Instrument & Meter Engineering, Tsinghua Shenzhen International Graduate School

### Other Research Experience.

- 07/2022 – 09/2022: A literature review on the real-time Linux system performance, hosted by Mr. Xuyang Zhang at Hirain company. (This is my first internship in the industry.)
- 08/2020 – 10/2020: Study on Policy Evaluation and Control of Reinforcement Learning for Blackjack, advised by Prof. Pietro Lio at the University of Cambridge.
- 04/2017 – 04/2018: Research on State Recognition for Cardiovascular System Based on Pulse Wave, advised Prof. Zimei Su at Hrbust. (This is my first research project, and I have won the best thesis award for this work.)

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## Publications

- 2021 **Zanqiu Shen**, Jianshe Ma, and Ping Su. Lmmse-based simo receiver for ultraviolet scattering communication with nonlinear conversion. *IEEE Wireless Communications Letters*, volume 10, pages 2140–2144. IEEE, 2021.
- 2020 **Zanqiu Shen**, Jianshe Ma, Serge B Provost, and Ping Su. Effects of transceiver jitter on the performance of optical scattering communication systems. *Optics Letters*, volume 45, pages 5680–5683. Optica Publishing Group, 2020.

- 2019 **Zanqiu Shen**, Jianshe Ma, Tao Shan, and Tianfeng Wu. Modeling of ultraviolet scattering propagation and its applicability analysis. *Optics letters*, volume 44, pages 4953–4956. Optica Publishing Group, 2019.
- 2023 **Zanqiu Shen** and Kun Wang, Fidelity Estimation of Entangled Measurements with Local States, *Submitted to Quantum*, appeared at arXiv: 2312.13730.
- 2022 **Zanqiu Shen**, Jianshe Ma, Tianfeng Wu, Tao Shan, Yupeng Chen, and Ping Su, Ultraviolet scattering communication using subcarrier intensity modulation over atmospheric turbulence channels, *Submitted to Journal of Lightwave Technology*, appeared at arXiv:2212.00611.
- 2020 **Zanqiu Shen**, Jianshe Ma, Tao Shan, and Ping Su. Improved monte carlo integration models for ultraviolet communications. In *2020 IEEE 20th International Conference on Communication Technology (ICCT)*, pages 168–172. IEEE, 2020.
- 2020 Tao Shan, Jianshe Ma, Tianfeng Wu, **Zanqiu Shen**, and Ping Su. Single scattering turbulence model based on the division of effective scattering volume for ultraviolet communication. *Chinese Optics Letters*, volume 18, page 120602. Chinese Optical Society, 2020.
- 2020 Tao Shan, Jianshe Ma, Tianfeng Wu, **Zanqiu Shen**, and Ping Su. Modeling of ultraviolet omni-directional multiple scattering channel based on monte carlo method. *Optics Letters*, volume 45, pages 5724–5727. Optica Publishing Group, 2020.

## Talks

- 06/2023 **Baidu Research Technology Sharing Session**, *Direct Fidelity Estimation for Quantum Devices*.
- 10/2020 **ICCT2020**, *Improved Monte Carlo Integration Models for Ultraviolet Communication*.

## Patents

### Granted patents

- 2019 Jianshe Ma, **Zanqiu Shen**, Ping Su, Tao Shan, Tianfeng Wu, *A non-line-of-sight communication channel modeling method*, CN112543074A.
- 2019 Jianshe Ma, **Zanqiu Shen**, Ping Su, Tao Shan, Tianfeng Wu, *A method for calculating the bit error rate of non-line-of-sight communication links*, CN112543051A.
- 2018 Zimei Su, Zicong Miao, Bing Deng, Zhilin Gan, **Zanqiu Shen**, *Real-time monitoring system of cardiovascular diseases based on pulse wave*, CN108618765B.
- 2017 Chunyu Yu, Peng Lei, Shouqiang Kang, **Zanqiu Shen**, *Design of a six-dimensional fractional-order hyperchaotic system and chaotic signal generator*, CN107359980B.

### Filed patents

- 2023 Kun Wang, **Zanqiu Shen**, *Method and apparatus for determining the fidelity of quantum states, electronic devices, and media*, CN116739099A.
- 2023 Kun Wang, **Zanqiu Shen**, *Efficient method and apparatus for estimating the performance of quantum measurement device, electronic devices, and media*, CN116739098A.
- 2023 Kun Wang, **Zanqiu Shen**, *Method and apparatus for estimating the performance of quantum measurement device, electronic devices, and media*, CN116739097A.

## Academic service

Journal reviewer for Ultraviolet communications: IEEE Transactions on Communications, IEEE Wireless Communication Letters, IEEE Communication Letters, Optics Express, Applied Optics.

## Teaching Assistantship

- Spring, 2020 : **Precision Measurement and Metrology**, Tsinghua University.
- Fall, 2019 : **Test and Measurement Technology**, Tsinghua University.

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## Computer skills

Languages Python, Matlab, C/C++.

Frameworks QCompute, Qiskit.

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## Referees

### **Prof. Jianshe Ma**

*Associate Professor, Department of  
Instrument & Meter Engineering*

Tsinghua University

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### **Prof. Ping Su**

*Associate Professor, Department of  
Instrument & Meter Engineering*

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### **Prof. Kun Wang**

*Associate Professor*

National University of Defense Technology

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### **Prof. Amr S. Helmy**

*Professor, Department of*

*Electrical & Computer Engineering*

University of Toronto

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