# Junkai **Zeng**

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Ph.D. in physics. Researcher in quantum information science with over 10 years of experience in scientific research and software development.

## Experience

**February 2025 – Present** | **Associate Researcher, International Quantum Academy, Shenzhen, China**
- Title changed in Jan 2025 due to workplace restructuring with a slight promotion.

**September 2021 – January 2025** | **Research Assistant Professor, SUSTech, Shenzhen, China**
- Writing grant proposals for research funding;
- Investigate in new methods and develop software tools for quantum optimal control, provide solutions for superconducting and semiconductor qubit experimental groups;
- Mentoring students in quantum computing research.

**March 2021 – October 2019** | **Senior Quantum Control Engineer, Q-Ctrl, Los Angeles, CA, USA**
- Conduct research in new techniques in various aspects in quantum technologies, implement and demonstrate with Jupyter notebooks, and experiment with IBM quantum hardware;
- Contribute to the product code base;
- Develop tools for simulation, performance benchmarking, and integrating with 3rd party libraries;
- Follow agile software development practice (Scrum).

**October 2019 – May 2015** | **Research Assistant, Virginia Tech, Blacksburg, VA, USA**
- Research new theoretical protocols on noise-resistant and quantum control and control optimization for quantum computing devices.
  **Achievement:** I discovered a geometrical structure hidden within the Schrodinger equation that connects quantum mechanics and differential geometry. This structure provides the entire solution space for quantum control pulse sequences that are noise-resistant.
- Develop numerical simulation program to compute the control fidelity.

**May 2018 – April 2018** | **Visiting Student, University of New South Wales, Sydney, Australia**
- Collaborate with experimentalists to integrate theoretical quantum control framework into semiconductor quantum devices;

**May 2016 – August 2014** | **Teaching Assistant, Virginia Tech, Blacksburg, VA, USA**
- Lab TA: General Physics Lab, Foundations of Physics;
- Recitation Instructor: Foundations of Physics;
- Grader: Quantum Mechanics (graduate level).

**May 2014 – February 2013** | **Undergraduate Researcher, University of Science and Technology of China, Hefei, China**
- Modeling on material properties using MATLAB, Python, and C;
- Run first-principle simulation on computing clusters to obtain electronic band structures;
- Research quantum optics techniques and developed simulator in Python.

**August 2013 – May 2013** | **Research Intern, IQC, University of Waterloo, Waterloo, ON, Canada**
- Develop, document, and maintain MATLAB programs to simulate the physical process of electron and nuclear double resonance.
- Analyze data from nuclear magnetic resonance experiments to verify theoretical models

## Education

2014 – 2019 **Ph.D.** in Physics, **Virginia Tech**
Thesis: *Dynamically Corrected Quantum Control: A Geometrical Framework*

2010 – 2014 **B.S.** in Physics, **University of Science and Technology of China**
Thesis: *Rashba Spin-Orbit Coupling In Graphene System*

## Publications

Google Scholar page: https://scholar.google.com/citations?user=jL7pw-0AAAAJ

1. **J. Zeng**, X.-H. Deng, *"Fundamental Costs of Noise-Robust Quantum Control: Speed Limits and Complexity"*, arXiv:2510.07183 (2025)

2. **J. Zeng**, L. Chen, X.-H. Deng, *"Analytically Solvable Robust Single-Qubit Gates for Multi-Qubit Systems with Unwanted Couplings"*, arXiv:2503.12424 (2025)
3. Y.-J. Hai, Y. Song, J. Li, **J. Zeng**, X.-H. Deng, *"Geometric correspondence of noisy quantum dynamics and universal robust quantum gates"*, Physical Review Applied (2025)
4. **J. Zeng**, Y.-J. Hai, H. Liang, X.-H. Deng, *"Enhancing Quantum Circuit Noise Robustness from a Geometric Perspective"*, arXiv:2305.06795 (2023)
5. B. Cheng, X.-H. Deng, et al, *"Noisy intermediate-scale quantum computers"*, Frontiers of Physics 18, 21308 (2023)
6. E. Barnes, F. Calderon-Vargas, W. Dong, B. Li, **J. Zeng**, and F. Zhuang, *"Dynamically corrected gates from geometric space curves"*, Quantum Sci. Technol. 7 023001 (2022)
7. F. Zhuang, **J. Zeng**, S. E. Economou, and E. Barnes, *"Noise-resistant Landau-Zener sweeps from geometrical curves"*, Quantum 6, 639 (2022)
8. B. Li, F. A. Calderon-Vargas, **J. Zeng**, and E. Barnes, *"Designing arbitrary single-axis rotations robust against perpendicular time-dependent noise"*, New J. Phys 23, 093032 (2021)
9. **J. Zeng**, C.-H. Yang, A.-S. Dzurak, and E. Barnes, *"Geometric formalism for constructing arbitrary single-qubit dynamically corrected gates"*, Phys. Rev. A 99, 052321 (2019)
10. **J. Zeng**, E. Barnes, *"Fastest pulses that implement dynamically corrected single-qubit phase gates"*, Phys. Rev. A 98, 012301 (2018)
11. **J. Zeng**, X.-H. Deng, A. Russo, and E. Barnes, *"General solution to inhomogeneous dephasing and smooth pulse dynamical decoupling"*, New J. Phys 20, 033011 (2018)

## Presentations

1. **J. Zeng**, L. Chen, X.-H. Deng, *"Analytically Solvable Robust Single-Qubit Gates for Multi-Qubit Systems with Unwanted Couplings"*, 全国量子物理青年学者研讨会, Guilin, China, 2025
2. **J. Zeng**, L. Chen, X.-H. Deng, *"Analytically Solvable Robust Single-Qubit Gates for Multi-Qubit Systems with Unwanted Couplings"*, 全国量子控制研讨会, Changchun, China, 2025
3. **J. Zeng**, L. Chen, X.-H. Deng, *"Analytically Solvable Robust Single-Qubit Gates for Multi-Qubit Systems with Unwanted Couplings"*, APS March Meeting in Hong Kong, Hong Kong, China, 2025
4. **J. Zeng**, Y.-J Hai, L. Hao, X.-H. Deng, *"Enhancing Quantum Circuit Noise Robustness from a Geometric Perspective"*, 全国量子控制研讨会, Shenzhen, China, 2024
5. **J. Zeng**, Y.-J Hai, L. Hao, X.-H. Deng, *"Quantum Circuit Noise Tailoring from a Geometric Perspective"*, DPG Spring Meeting, Berlin, Germany, 2024
6. **J. Zeng**, Y.-J Hai, L. Hao, X.-H. Deng, *"Noise Tailoring from a Geometric Perspective"*(Poster), International Conference on Emerging Quantum Technology, Hefei, China, 2023
7. **J. Zeng**, *"Tutorial: Quantum Control*, Summer Workshop for Quantum errors, Control & Correction, Shenzhen, China, 2023
8. **J. Zeng**, Y.-J Hai, L. Hao, X.-H. Deng, *"Noise Tailoring from a Geometric Perspective"*(Poster), International Conference on Emerging Quantum Technology, 全国量子控制研讨会, Chengdu, China, 2023
9. Y.-J. Hai, J. Li, **J. Zeng**, D. Yu, X.-H. Deng, *"Universal Robust Quantum Gates by Geometric Correspondence"*, APS March Meeting, Virtual, 2023
10. B. Li, F. Calderon-Vargas, **J. Zeng**, and E. Barnes, *"Geometric filter function approach to dynamically corrected gates that suppress time-dependent noise"*, APS March Meeting, Virtual, 2021
11. F. Zhuang, **J. Zeng**, E. Barnes, and S. Economou, *"Noise-resistant Landau-Zener sweeps from geometrical curves"*, APS March Meeting, Virtual, 2021
12. A. Warren, **J. Zeng**, E. Barnes, and S. Economou, *"Gate designs for spin qubits"* (Poster), Quantum Computing Program Review (QCPR), Annapolis, MD, 2019
13. **J. Zeng**, *"Geometrical Formalism On Quantum Control"*, Peng Cheng Laboratory (PCL), Shenzhen, China, 2019
14. **J. Zeng**, E. Barnes, *"Geometric Formalism For Constructing Arbitrary Single-qubit Dynamically Corrected Gates"*, APS March Meeting, Boston, MA, 2019
15. **J. Zeng**, X.-H. Deng, A. Russo, and E. Barnes, "Fastest Pulses That Implement Dynamically Corrected Single-qubit Phase Gates" (Poster), Quantum Computing Program Review (QCPR), Denver, CO, 2018
16. **J. Zeng**, *"Geometrical Approach to Pulse Shaping for Robust Single Qubit Control"*, University of New South Wales, Sydney, Australia, 2018

17. **J. Zeng**, and E. Barnes, *"A Geometrical Approach To Robust Quantum Control That Respects Pulse Constraints And Minimizes Gate Times"*, APS March Meeting, Los Angeles, CA, 2018
18. **J. Zeng**, X.-H. Deng, and E. Barnes, *"A Geometrical Approach To Dynamical Decoupling With Smooth Pulses"*, APS March Meeting, New Orleans, LA, 2017