

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

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| February 2025
Present | Associate Researcher, INTERNATIONAL QUANTUM ACADEMY, Shenzhen, China <ul style="list-style-type: none">› Title changed in Jan 2025 due to workplace restructuring with a slight promotion. |
| September 2021
January 2025 | Research Assistant Professor, SUSTECH, Shenzhen, China <ul style="list-style-type: none">› 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 <ul style="list-style-type: none">› 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 <ul style="list-style-type: none">› 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 <ul style="list-style-type: none">› Collaborate with experimentalists to integrate theoretical quantum control framework into semiconductor quantum devices; |
| May 2016
August 2014 | Teaching Assistant, VIRGINIA TECH, Blacksburg, VA, USA <ul style="list-style-type: none">› 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 <ul style="list-style-type: none">› 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 <ul style="list-style-type: none">› 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

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| 2014 – 2019 | Ph.D. in Physics, VIRGINIA TECH
THESIS: <i>Dynamically Corrected Quantum Control: A Geometrical Framework</i> |
| 2010 – 2014 | B.S. in Physics, UNIVERSITY OF SCIENCE AND TECHNOLOGY OF CHINA
THESIS: <i>Rashba Spin-Orbit Coupling In Graphene System</i> |

PUBLICATIONS

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

1. H. Xu, T. Chen, **J. Zeng**, X.-H. Deng, F. Gao, X. Wang, Z.-Y. Xue, C. Zhang, "Universal Robust Quantum Gates via Doubly Geometric Control", arXiv:2604.02962 (2026)

2. T. Feng, Y. Cao, W. Yu, **J. Zeng**, X. Li, X.-H. Deng, Q. Zhao, "Entanglement-Induced Resilience of Quantum Dynamics", arXiv:2602.20987 (2026)
3. **J. Zeng**, X.-H. Deng, "Fundamental Costs of Noise-Robust Quantum Control: Speed Limits and Complexity", arXiv:2510.07183 (2025)
4. **J. Zeng**, L. Chen, X.-H. Deng, "Non-Perturbative Geometric Framework for Single-Qubit Gates under Always-On Couplings", arXiv:2503.12424 (2025)
5. 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)
6. **J. Zeng**, Y.-J. Hai, H. Liang, X.-H. Deng, "Enhancing Quantum Circuit Noise Robustness from a Geometric Perspective", arXiv:2305.06795 (2023)
7. **J. Zeng**, E. Barnes, "Generating error-resistant quantum control pulses from geometrical curves" (Patent), US Patent 11966816 (2024)
8. B. Cheng, X.-H. Deng, et al, "Noisy intermediate-scale quantum computers", Frontiers of Physics 18, 21308 (2023)
9. 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)
10. F. Zhuang, **J. Zeng**, S. E. Economou, and E. Barnes, "Noise-resistant Landau-Zener sweeps from geometrical curves", Quantum 6, 639 (2022)
11. 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)
12. **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)
13. **J. Zeng**, E. Barnes, "Fastest pulses that implement dynamically corrected single-qubit phase gates", Phys. Rev. A 98, 012301 (2018)
14. **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**, X.-H. Deng, "Fundamental Costs of Noise-Robust Quantum Control: Speed Limits and Complexity", IEEE qCCL 2026, Aalborg, Denmark, 2026
2. **J. Zeng**, X.-H. Deng, "Fundamental Costs of Noise-Robust Quantum Control: Speed Limits and Complexity", APS March Meeting in Hong Kong, Hong Kong, China, 2026
3. **J. Zeng**, X.-H. Deng, "Fundamental Costs of Noise-Robust Quantum Control: Speed Limits and Complexity", QIP 2026, Riga, Latvia, 2026
4. **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
5. **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
6. **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
7. **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
8. **J. Zeng**, Y.-J. Hai, L. Hao, X.-H. Deng, "Quantum Circuit Noise Tailoring from a Geometric Perspective", DPG Spring Meeting, Berlin, Germany, 2024
9. **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
10. **J. Zeng**, "Tutorial: Quantum Control, Summer Workshop for Quantum errors, Control & Correction, Shenzhen, China, 2023
11. **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
12. Y.-J. Hai, J. Li, **J. Zeng**, D. Yu, X.-H. Deng, "Universal Robust Quantum Gates by Geometric Correspondence", APS March Meeting, Virtual, 2023

13. 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
14. F. Zhuang, **J. Zeng**, E. Barnes, and S. Economou, "Noise-resistant Landau-Zener sweeps from geometrical curves", APS March Meeting, Virtual, 2021
15. A. Warren, **J. Zeng**, E. Barnes, and S. Economou, "Gate designs for spin qubits" (Poster), Quantum Computing Program Review (QCPR), Annapolis, MD, 2019
16. **J. Zeng**, "Geometrical Formalism On Quantum Control", Peng Cheng Laboratory (PCL), Shenzhen, China, 2019
17. **J. Zeng**, E. Barnes, "Geometric Formalism For Constructing Arbitrary Single-qubit Dynamically Corrected Gates", APS March Meeting, Boston, MA, 2019
18. **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
19. **J. Zeng**, "Geometrical Approach to Pulse Shaping for Robust Single Qubit Control", University of New South Wales, Sydney, Australia, 2018
20. **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
21. **J. Zeng**, X.-H. Deng, and E. Barnes, "A Geometrical Approach To Dynamical Decoupling With Smooth Pulses", APS March Meeting, New Orleans, LA, 2017