Aditya Bhardwaj

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Personal Information

Email: a7b@uchicago.edu

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Current residence: Chicago, IL

Website: https://a7b.github.io/

Education

The University of Chicago

B.A., Physics, 2020–2024 (expected)

GPA: 3.99/4.00

Experience

Undergraduate researcher, Robotic Exploration Lab at Carnegie Mellon University

PI: *Prof. Zachary Manchester*

Working on a senior thesis on visual feedback control with imitation learning and Koopman models. Wrote simulation environment from scratch and implemented model predictive control algorithms to interface with learned models.

September 2023–Present

Undergraduate researcher, University of Chicago Department of Physics

PIs: *Prof. David Schuster* and *Prof. Zachary Manchester*

Developing iterative learning control (ILC) algorithms to compensate for model errors in quantum optimal control (QOC) as well as direct trajectory optimization methods for QOC in collaboration with the Robotic Exploration Lab.

Assisting with optimal control solutions to help realize a quantum random access memory protocol.

Wrote software for testing ILC algorithms on quantum hardware.

Realized gates on a transmon qubit that were robust within 1% error to detunings in the qubit frequency of up to several multiples of the dispersive shift induced by the transmon-cavity interaction.

Collaborated with Q-CTRL on automated calibration of microwave control pulses and robust control of cavity QED systems.

August 2021–Present

QURIP intern, IBM Research and Princeton University — May 2023–October 2023

PI at Princeton: *Prof. Hakan Türeci*
Mentors at IBM: *Dr. Alireza Seif* and *Dr. Derek Wang*

Spent 6 weeks at Princeton followed by 6 weeks at IBM working on developing a protocol for quantum metrology, a type of parameter estimation problem, in the few-resource regime. Tested protocol on IBM hardware and wrote an internal report summarizing findings and next steps.

REU student, University of Chicago Department of Mathematics — June 2021–August 2021

Mentor: *Phillip Lo*

Studied how to make rigorous mathematical sense of the path integral formulation of quantum mechanics. Wrote a paper on the imaginary-time path integral, constructing the n-dimensional Wiener measure and introducing operator semigroup theory in order to prove the Feynman-Kac formula. Attended talks and solved problems in combinatorics, group theory, projective geometry, and analysis.

PAPERS

Aaron Trowbridge, **Aditya Bhardwaj**, Kevin He, David I. Schuster, Zachary Manchester. *Direct Collocation for Quantum Optimal Control.* 2023 IEEE International Conference on Quantum Computing and Engineering. **Best Paper Award in Technologies and Systems Engineering Track (2nd Place).** arXiv: 2305.03261 [quant-ph].

Aditya Bhardwaj. *The Imaginary-Time Feynman Path Integral.* The University of Chicago Mathematics REU 2021.

TALKS & POSTERS

Direct Collocation for Quantum Optimal Control. Joint paper talk with Aaron Trowbridge. 2023 IEEE International Conference on Quantum Computing and Engineering.

Piccolo.jl: An Integrated Quantum Optimal Control Stack. Joint talk with Aaron Trowbridge. JuliaCon 2023.

Collocation Methods and Iterative Learning for Quantum Optimal Control. Poster. University of Chicago Undergraduate Research Symposium 2023.

SELECTED COURSEWORK

PHYS 44900 - Conformal Field Theory and its Applications

PHYS 49100 - Biological Physics

PHYS 38500 - Advanced Mathematical Methods

PHYS 44300, 44400 - Quantum Field Theory I, II
PHYS 35200, 35300 - Statistical Mechanics, Advanced Statistical Mechanics
PHYS 31600 - Advanced Classical Mechanics
CMSC 39100 - The Physics of Computation
MENG 37400 - Advanced Quantum Information and Computation
PHYS 34100, 34200 - Graduate Quantum Mechanics I, II
SOSC 13110, 13210, 13310 - SSI: Formal Theory (Game Theory and Mechanism Design)
** All graduate courses except for SOSC*

Honors and Awards

Unitary Fund Microgrant	2023
Phi Beta Kappa (3rd Year)	2023
Quad Summer Undergraduate Research Grant	2022
James Franck Institute Summer Fellowship (declined)	2022
Robert Maynard Hutchins Scholar	2022

Skills

Julia, Python, Java, C++, Mathematica, LaTeX, Git, R