YIHUAI GAO

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EDUCATION

Tsinghua University — Sep 2018 – present

- *Electronic Engineering* senior undergraduate, Overall GPA 3.93, Major GPA 3.95 (rank 4/243).
- **GPA 3.99 (rank 2/243)** in the 2nd year and **GPA 4.00 (rank 1/243)** in the 3rd year.
- *Mathematics Second Major*, GPA 3.90 (top 10% in Tsinghua Math Department).
- One year of study in *Chemical Engineering* before changing major to EE, GPA 3.93 (rank 3/87).

Massachusetts Institute of Technology — May 2022 – Sept 2022

- Visiting student in Quantum Photonics Group, MIT EECS. ***Advisor: Prof. Dirk Englund***

PUBLICATIONS & MANUSCRIPTS

- **Yihuai Gao***, Linsen Li*, Kevin Chen, Ian Christen, Matthew Trusheim, Prajit Dhara, Hamza Raniwala, Dirk Englund. **A statistical comparison of diamond tin-vacancy centers in diamond nanostructures by robotic spectroscopy on over 10,000 quantum emitters**. In preparation.
- Fang Zhang, Xing Zhu, Rui Chao, Cupjin Huang, Linghang Kong, Guoyang Chen, Dawei Ding, Haishan Feng, **Yihuai Gao**, Xiaotong Ni, Liwei Qiu, Zhe Wei, Yueming Yang, Yang Zhao, Yaoyun Shi, Weifeng Zhang, Peng Zhou, Jianxin Chen. **A Classical Architecture Towards Digital Quantum Computers**. *In submission to the 50th International Symposium on Computer Architecture (ISCA 2023)*.
- Jieao Zhu, **Yihuai Gao**, Hansen Wang, Hao Wu. **A Realizable GAS-based Quantum Algorithm for Traveling Salesman Problem**. *arXiv: 2212.02735 (2022)*
- Wanrong He, **Yihuai Gao**, Shi Han, Haoyu Dong. **HERMES: Interactive Spreadsheet Formula Prediction via Hierarchical Formulet Expansion**. *Planning to submit to the 61st Annual Meeting of the Association for Computational Linguistics (ACL 2023)*.

RESEARCH EXPERIENCE

Robotic Optical Experiment System for Scalable Quantum Emitter Metrology

Advisor: Prof. Dirk Englund — Quantum Photonics Laboratory, MIT, May 2022 – Sept 2022

- Conduct large-scale robotic characterization on SnV centers in diamond quantum microchiplets (QMCs) for the study on emitter systems and integrated applications in quantum information processing.
- Develop a fully automated optical experiment system with closed-loop control. Contribute **10k+ lines of Python and MATLAB code** to the software repository.
- Utilizing convolution-based template matching, I enable large-scale widefield metrology with **real-time high-accuracy pattern recognition** for the frame of QMCs to realize automatic alignment.
- Provide **6x speed up (from 1hr to 10min)** based on senior Ph.D. student's imaging program through pipelining and multithreading, collecting PLE curves from more than 10000 quantum emitters overnight automatically.
- Conduct diamond color center spin-photon interface simulation using *Lumerical* and *COMSOL* to estimate the position of emitters from the electron multiplying charge-coupled device (EMCCD) output.
- Statistically analyze the enormous data to investigate the relationships between emitter region/location and their optical properties (intensity, linewidth, etc.).

High-Throughput Architecture for Quantum Computer System

Advisor: Prof. Yaoyun Shi — Quantum Lab, Alibaba Damo Academy, Oct 2021 – Apr 2022

- Propose a classical control architecture for large-scale quantum processors through a general-purpose RISC-V CPU with an application-specific quantum instruction set.

- Conduct memory-mapped I/O (MMIO) simulation as the interface between CPU and quantum processor. Optimize the reading and writing throughput by RISC-V vector instructions.
- Evaluate neural network decoders for efficiently decoding the large-scale surface code. Use RISC-V vector instruction for performance optimization.

Quantum Speedup for Combinatorial Optimization Algorithms

Advisor: Prof. Hao Wu   Mathematics Dept., Tsinghua University, Jul 2021 – Oct 2021

- Investigate the quantum speedup for the traveling salesman problem (TSP) by implementing Grover Adaptive Search (GAS) framework with the encoding designed for sparse graphs.
- Use the Python library *Qiskit* to simulate our quantum algorithm for TSP, verifying its correctness.
- Reach a higher success rate in simulation than the previous approaches with quadratic quantum speed up.

Interactive Spreadsheet Formula Prediction

Advisor: Dr. Haoyu Dong and Dr. Shi Han   Microsoft Research, Jul 2021 – Apr 2021

- Develop a transformer-based spreadsheet formula prediction model for Microsoft Excel.
- Propose a novel sample strategy that allows efficient parallel training of the three-stage decoder.
- Provide rigorous mathematical proof that the sampling strategy will efficiently optimize the loss function in expectation.

SCHOLARSHIPS & AWARDS

- **Tsinghua Presidential Scholarship (2022)**, 10/3000+, **highest honor** for Tsinghua undergraduates.
- National Scholarship (2022, 2021), 5/243 in Tsinghua EE Department.
- Person of the Year in Science and Technology Innovation (1/243) in Tsinghua EE Department (2021).
- Championship among 50+ teams in Tsinghua Electronics Design Competition (2020).
- Gold Medal in Chinese Chemistry Olympiad (2017).

TEACHING EXPERIENCE

- **Teaching Assistant** in Electronic System Designing. Prepare lectures for Arduino and STM32 development.
- **One-on-One Tutoring Volunteer**. Take part in STEM courses tutoring for over 500 hours.
- **Recitation Class Lecturer**. Give over 15 midterm/final recitation lectures to over 200 Tsinghua students.

LEADERSHIPS & ACTIVITIES

- **Vice President of Student Association of Science and Technology** of Tsinghua EE Department, hosted Hardware Design Competition with over 350 participants, and Electronic Design Competition with over 100 participants.
- President of Tsinghua Student Rope-jumping Association. Won championship 3 times in men's speed jump (272/min).
- Member of Tsinghua University Symphonic Band (Clarinet section).

SKILLS

- Programming Languages: Python (10k+ lines), MATLAB (10k+ lines), C/C++ (5k+ lines), Verilog (FPGA), Microcontroller programming (STM32, Arduino), Git, Linux Shell Script, Docker; Deep Learning Platform: PyTorch
- Optical & RF Experiment Devices: Hamamatsu EMCCD, AWG, SLM, Montana Cryostation, Msquared Laser
- Optical & MEMS Simulation: Lumerical, COMSOL
- TOEFL: 108 (25 in speaking section)