

# Haoqin Deng

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## Education

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**University of Southern California (USC)**, Viterbi School of Engineering Aug 2017 - May 2022

- Bachelor of Science: Electrical and Computer Engineering
- GPA: 3.688/4.0 (Undergraduate courses); 4.0/4.0 (Graduate courses)

## Publications

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- **Deng, Haoqin**, and Mercedeh Khajavikhan. "Parity-time symmetric optical neural networks." *Optica* 8.10 (2021): 1328-1333.
- Cheng, Jinglei, **Haoqing Deng**, and Xuehai Qian. "Accqoc: Accelerating quantum optimal control based pulse generation." *2020 ACM/IEEE 47th Annual International Symposium on Computer Architecture (ISCA)*. IEEE, 2020.

## Research Experiences

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### Optical Computing

*Research Assistant, supervised by Prof. Mercedeh Khajavikhan, USC* *May 2021 – present*

- Researched various architectures of Optical Neural Network(ONN), Quantum Optical Neural Network(QONN), Continuous/Discrete Variable Quantum Computation
- Developed PT-ONN architecture with cascading PT-symmetric couplers, based on modulations of gain/loss contrasts; implemented simulations of on-chip training of PT-ONN using finite difference method with Python; achieved 68% training accuracy on MNIST dataset; simulated directional couplers in COMSOL; verified system transfer matrix of PT couplers with Mathematica
- Reproduced on-chip training of MZI-based ONN with Python; achieved 71% on-chip training accuracy on MNIST dataset
- Investigated the detrimental effect of V-shaped, intensity-dependent optical nonlinearity on VGG network architecture

### CMOS Neuromorphic Circuits

*Research Assistant, supervised by Prof. Alice Parker, USC* *Feb 2021 - Aug 2021*

- Developed VLSI circuits of excitatory/inhibitory synapse, Axon Hillock, STDP-dopamine-noise synapse, dendritic spiking, edge detector, voltage adder, using Cadence; designed transistors to operate at subthreshold regime; obtained ideal biological waveforms for each circuit component
- Designed a multi-layer neural network with edge-detection, STDP-synapse, and dopamine-modulation layers; used PyTorch to simulate the network topology, spike propagation, and synaptic weight update, with hardware-realistic parameters; achieved unity accuracy on self-designed four-class, nine-pixel dataset

### Quantum Computing

*Research Assistant, supervised by Prof. Xuehai Qian, USC* *May 2019 – Mar 2021*

- Developed Accelerating Quantum Optimal Control (accQOC), a comprehensive compilation methodology that accelerates pulse generation by 9x:
  - partitioned the DAG of quantum circuit into sub-components under size constraints, using Qiskit
  - concatenated QOC pulses of each components using dynamic programming
  - balance partitioned the MST of computing nodes for efficient parallel computation, using METIS
- Worked on the optimization of VQE(Variational Quantum Eigen-solver) algorithm:
  - worked on circuit-level implementation of VQE with pyQpanda

- optimized VQE measurement overhead through joint measurement of commuting Hamiltonians; projecting linearly-independent basis terms onto qubit computational basis using stabilizer formalism
- worked on pulse-level optimization of VQE circuits using Qiskit open-pulse and QOC

### Computing with InP Memristors

Research Assistant, supervised by **Prof. Rehan Kapadia, USC**

Jun 2020 – Jan 2021

- Researched various architectures of mapping ANN/SNN onto hardware using semiconductor devices that mimic synapses, neurons
- Simulated a temporal-encoded convolutional Spiking Neural Network(SNN) and a rate-encoded SNN with PyTorch, incorporating InP-synapse STDP parameters; achieved 89% & 91% training accuracies respectively, on MNIST dataset
- Collaborated on designing Arduino/breadboard implementation of neural networks, utilizing a crossbar array of InP memristors
- Grew InP using the Low-Temperature Templated Liquid-Phase(LT-TLP) technique

### Internships:

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**Shanghai AIKE Measurement Co.**

Jul 2018 – Aug 2018

- Learned to use Labview to sample data and control hardware
- Used Labview to automate a printer to print labels on a streamline
- Assisted in designing the structure of a dispenser

### Activities:

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**Mobile App: “Go Eat”**

2020 LA Hacks

- Developed a cross-platform app that recommends restaurants according to users’ preferences
- Developed KNN and genetic models to recommend restaurants based on users’ and restaurants’ features
- Implemented data fetching and storage using Firebase

**Desktop Game: “Mind Palace”**

2019 LA Hacks

- Developed a game that trains players to master “Mind Palace” mnemonic technique
- Designed game stages and implemented them with SDL library
- Extracted key information from sentences with Google Cloud API

**Neural Signal Sampling**

2019 CASS Student Design Competition

- Collaborated on designing a neural-signal sampling device
- Realized data transfer between FPGA and PC using Opal-Kelly’s API; implemented SPI protocol to transfer data between FPGAs; visualized data on PC end with matplotlib library

### Skills:

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**Programming:** Python, C/C++, Java, Javascript, CSS, Verilog

**Tools/Frameworks:** PyTorch, Qiskit, Cadence, Matlab, Modelsim, LTspice, Mathematica

### Awards:

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- Advanced to Phase II of CASS Student Design Competition 2019
- Dean’s list 2018-2020