James Wang

8770 Washington Blvd • Culver City, CA 90232 • jwang369@usc.edu • 213-442-6686

Education

University of Southern California **Aug 2021 – Present**

B.S in Electrical and Computer Engineering, B.S in Mathematics, Minor in Physics *Los Angeles, CA*

GPA: 4.0/4

Relevant Coursework

Graduate courses:

- EE 578: Computational Electromagnetics for Engineers, Prof. Constantine Sideris
- EE 530: Optical Materials, Instruments and Devices, Prof. Mercedeh Khajavikhan
- EE 506: Semiconductor Physics, Prof. Tony Levi

Undergraduate courses:

- Quantum Mechanics
- Electronic Circuits
- Real Analysis
- Electrodynamics
- Embedded System
- Modern Algebra
- Engineering E&M
- Linear System
- Geometry
- Physical Electronics
- Probability Theory
- Statistics

Working Manuscripts

- **James Wang**, Constantine Sideris. "*Ultrafast Simulation and Optimization of Nanophotonic Devices using Precomputed Numerical Green's Functions*", In Preparation 2024
- Yuanhao Liang, **James Wang**, Ran Yin, ..., Zaijun Chen "*Time-of-flight VCSEL Optical Neural Network*", In Preparation 2024

Publications

- Yuanhao Liang, **James Wang**, Xinyi Ren, ..., Zaijun Chen. "*VCSEL Optical Neural Networks for High-throughput AI Training*", Submitted to CLEO 2025
- Kaiwen Xue, Lian Zhou, Chunho Lee, ..., **James Wang**, ..., Zaijun Chen. "*Scalable, Low-energy Homodyne Computing Crossbar based on TFLN and SiN/Si Photonics*", Submitted to CLEO 2025

Research Experience

Analog/RF Integrated Circuits, Microsystems and Electromagnetics Lab **April 2024 – Present**

Advisor: Prof. Constantine Sideris *Los Angeles, CA*

Ultrafast Nanophotonic Simulation and Optimization

- Developed an ultrafast nanophotonic simulation method using Precomputed Numerical Green's Functions (PNGFs) and matrix rank update with further acceleration by basis functions approximation
- Implemented Direct Binary Search (DBS) optimization using PNGFs with orders of time faster than conventional DBS
- Optimized a 2D 1550nm 50:50 power splitter with more than 99% transmission in less than 13 seconds and fabrication-friendly arbitrary ratio power splitters (90:10, 80:20, 70:30) with high efficiency in similar time span
- Inverse designed high-performance 2D broadband directional coupler (1500nm - 1600nm) in less than 6 minutes and verified using Lumerical, converging several orders of times faster than the FDTD method using Lumerical
- Expected to generalize to the 3D case of PNGFs method with further acceleration by matrix compression techniques

Low-Dimensional Transformer for Nanophotonic Design

- Derived and implemented fast gradient calculation in nanophotonic optimization using the PNGFs method
- Collaborating with Prof. Raphaël Pestourie at GaTech to explore the potential low-dimensionality in nanophotonics design using a novel transformer model with data generated efficiently from the PNGFs method

Intelligent and Quantum Photonics Group **Aug 2022 – Present**

Advisor: Prof. Zaijun Chen *Los Angeles, CA*

VCSEL Optical Neural Network

- Developed a high-speed, parallelized, power-efficient, and high-throughput hardware system for optical neural network which can compute general matrix multiplication and 2D convolution
- Built the system in lab through aligning, tuning, and calibrating the vertical cavity surface emitting laser (VCSEL) array, diffractive optical element (DOE), spatial light modulator, and other optical elements
- Assisted in improving random multiplication accuracy to less than 3% in standard deviation and implementing Convolution Neural Networks (CNNs) with high accuracy (e.g. $> 98\%$ of model's accuracy for MNIST dataset)
- Further assisted in CNNs training using the hardware system, approaching model accuracy trained by the computer

Spectral Optical Neural Network

- Trained neural network that is experimentally verifiable with dual-comb interference for gas species classification, pressure, and temperature sensing based C_2H_2 and HCN absorption spectrum from HITRAN database
- Programmed high-speed arbitrary waveform generator (AWG) and IQ Modulator to encode single-sideband neural network weights in the spectral domain
- Assisted in directly using two waveshapers for neural network inference of MNIST dataset in the spectral domain
- Designed high-speed Printed Circuit Boards (PCBs) to test and wirebond Lithium Niobate chips, integrated VCSEL arrays, and transimpedance amplifier circuits for photodetector array

Work Experience

ZTE Photonics Technology Co.,Ltd **May 2023 – Aug 2023**

Research and Development Department Intern *Nanjing, China*

- Analyzed parameters including linewidth, power, and spectral response for integrable tunable laser assemblies (ITLAs)
- Collaborated with coworker to design testing method and experiment for gain chips and semiconductor optical amplifiers and tested their parameters including amplified spontaneous emission gain, resistance, dispersion, and divergence angle
- Built experiments and tested on-chip photodetector responsivity and spot-size converter (SSC) loss with fiber array

University of Southern California **Aug 2022 – Present**

Course Producer *Los Angeles, CA*

- EE 141: Applied Linear Algebra for Engineering, *Fall 2022*
- EE 202: Linear Circuits, *Spring 2023*
- EE 370: Engineering Electromagnetism, *Fall 2024*

Projects

Nanophotonic Inverse Design of an 2D TM Mode 1 to 4 Low Loss Power Splitter **Feb 2024 – May 2024**

- Coded 2D Finite-Difference Frequency Domain (FDFD) simulation with perfectly matched layer (PML)
- Derived gradient of the objective function with respect to design parameters using the adjoint method and implemented adaptive gradient descent in topology optimization of the structure
- Optimized a non-intuitive ϵ_r distribution that could perform low-loss ($T > 99\%$) and uniform 1 to 4 power splitting

Environment Detection Glass for Visually Impaired Persons **Jan 2024 – May 2024**

- Proposed a glass for visually impaired people that detects approaching objects and their velocity with user notification
- Designed wearable vibration motor driving circuits with Bipolar Junction Transistors(BJTs) and diodes and programmed microcontroller to process sensor data, drive vibration motor, and wirelessly communicate with mobile devices
- Integrated the components into a wearable device and tested its functionality and reliability in a dark environment

Chaos Theory from Nonlinear Pendulums to Broader Applications **Oct 2023 – Dec 2023**

- Simulated nonlinear pendulum to analyze the period-doubling and sensitivity to initial conditions of a chaotic system
- Explored and discovered quasi-linear relationship between damping ratio and chaotic threshold of a system
- Did literature review in the applications of chaos theory in broader fields including medicine, neuroscience, and sociology

Skills

Programming Languages: MATLAB, C++, Python, C, Java
Technical Software: Lumerical, Ansys HFSS, Intel MKL, Pytorch, KiCAD, LTspice, SolidWorks, Autodesk Fusion, VisIt
Laboratories: Optics, Vector Network Analyzer (VNA), Arbitrary Waveform Generator (AWG), Oscilloscope, Electronics

Awards

W.V.T. Rusch Engineering Honors Degree **2023 - Present**
Center for Undergraduate Research in Viterbi Engineering (CURVE) Fellowship **2022 - Present**
Academic Achievement Award **2021 - Present**