PINGCHUAN MA

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EDUCATION BACKGROUND

Arizona State University
Ph.D student in Electrical Engineering (Computer Engineering)
Advisor: Prof. Jiaqi Gu
Cumulative GPA: 3.93/4.0
University of Southern California
Master of Science in Electrical Engineering
Cumulative GPA: 3.87/4.0
ShanghaiTech University
Bachelor of Engineering in Electrical Engineering
Cumulative GPA: 3.4/4.0

Jan. 2024-present Tempe, AZ, U.S.

Jan. 2021-Dec. 2022 Los Angeles, CA, U.S.

Sept. 2016-Jun. 2020 Shanghai, China

PUBLICATIONS

[1] **Pingchuan Ma**, Ziang Yin, Qi Jing, Zhengqi Gao, Nicholas Gangi, Boyang Zhang, Tsung-Wei Huang, Zhaoran Huang, Duane S. Boning, Yu Yao, Jiaqi Gu "SP²RINT: <u>Spatially-Decoupled Physics-Inspired</u> <u>ProgRessive INverse OpTimization for Scalable, PDE-Constrained Meta-Optical Neural Network Training", Under Review, 2025</u>

[2] Pingchuan Ma, Haoyu Yang, Zhengqi Gao, Duane S. Boning, Jiaqi Gu "*PIC*²O-Sim: A Physics-Inspired Causality-Aware Dynamic Convolutional Neural Operator for Ultra-Fast Photonic Device FDTD Simulation", APL Photonics, 2025

[3] **Pingchuan Ma**, Zhengqi Gao, Amir Begovic, Meng Zhang, Haoyu Yang, Haoxing Ren, Zhaoran Rena Huang, Duane Boning, Jiaqi Gu "BOSON⁻¹: Understanding and Enabling Physically-Robust Photonic Inverse Design with Adaptive Variation-Aware Subspace Optimization", *IEEE/ACM Proceedings Design*, Automation and Test in Europe (DATE), 2025

[4] **Pingchuan Ma**, Zhengqi Gao, Amir Begovic, Meng Zhang, Haoyu Yang, Haoxing Ren, Zhaoran Rena Huang, Duane Boning, Jiaqi Gu "MAPS: Multi-Fidelity AI-Augmented Photonic Simulation and Inverse Design Infrastructure", *IEEE/ACM Proceedings Design, Automation and Test in Europe (DATE)*, 2025

[5] Ziyang Jiang, **Pingchuan Ma**, Meng Zhang, Rena Huang, Jiaqi Gu "**ADEPT-Z: Zero-Shot Automated Circuit Topology Search for Pareto-Optimal Photonic Tensor Cores**", *IEEE/ACM Asia and South Pacific Design Automation Conference (ASP-DAC)*, 2025

[6] Yaojiang Chen, Zhiqi Zhou, **Pingchuan Ma** and Baile Chen "**Nonlinear Characteristics of Uni-Traveling Carrier Photodiode With InGaAs/GaAsSb Type-II Multiple Quantum Wells Absorber**", *IEEE Journal of Lightwave Technology (JLT)*, 2020

AWARDS AND HONORS

DAC Young Fellow	IEEE Design Automation Conference	2024
Fulton Fellowship	Arizona State University	2024

SELECTED RESEARCH EXPERIENCE

Spatially-Decoupled Physics-Inspired Progressive Inverse Optimization for Scalable, PDE-ConstrainedMeta-Optical Neural Network TrainingJan. 2025 - May. 2025Objective: To train a diffractive neural network honoring the Maxwell equations constraints in a scalable manner

- Identified limitations in prior DONN training methods, where oversimplified metasurface modulation led to inaccurate field predictions and degraded performance.
- Proposed a progressive training approach alternating between unconstrained transfer matrix learning and adjoint-based inverse design to enforce physical constraints and match full-wave simulation ground truth.
- Introduced a patch-wise, spatially decoupled inverse design strategy, reducing full-wave simulation complexity from polynomial to linear.

• Achieved a 63.88% average performance improvement across tasks such as image classification and scientific computing, and a 1825× speed-up over conventional adjoint-based training.

A Physics-Inspired Causality-Aware Dynamic Convolutional Neural Operator for Ultra-Fast Photonic Device FDTD Simulation Jan. 2024 - May. 2024 Objective: To develop a neural operator surrogate model to accelerate time-intensive Finite-Difference Time-Domain (FDTD) simulations.

- Key observations: The required receptive field is causally determined by the light propagation range, and the FDTD algorithm inherently aligns with convolution operations.
- Developed a dynamic CNN-based neural operator that accelerates FDTD simulations by $300 \times$ to $600 \times$ while achieving 51.2% higher accuracy compared to previous machine learning arts.

BOSON⁻¹ : Physically-Robust Photonic Inverse Design with Adaptive Variation-Aware Topology Optimization in Subspace June 2024 - Sept. 2024

Accepted by DATE 2025

Objective: To develop a topology optimization framework that ensures manufacturability while producing robust photonic device patterns that account for variations during fabrication and real-world operation.

- Direct project design pattern into a manufacturable subspace to guarantee fabricability.
- Reshape objective landscapes, high dimensional tunnel and light concentrated initialization to tackle nonconvex subspace optimization
- Integrated axial sampling with gradient-ascent worst-case sampling for efficient robust optimization.

CONTEST EXPERIENCES

ICCAD TinyML

Organizer: 2023 ICCAD TinyML

An ensembled machine learning classifier with multiple data augmentations and knowledge distillation for VAs detection on low-end microprocessors

Supervisor: Prof. Jiaqi Gu, Prof. Song Han

- Enhanced performance with data augmentations, focal loss, and resampling; distilled a CNN teacher into a compact student, ensembled with a decision tree, achieving $F_{\beta} > 0.98$, G > 0.92, 16ms latency, and 27KB flash usage.
- Rank top 20 among all the team participating in the contest

WORK EXPERIENCES

Graduate Analog Engineer(Full time) Company: Renesas Electronics America Flyback AC/DC converter controller design Process: MegnaChip .18 BCD Tape-out: Aug 25. 2023

• Take charge of the start-up circuit used in the flyback AC/DC converter controller, including LDO, Oscillator, and Bandgap. etc

TEACHING EXPERIENCE

TA in the Course of Microwave Technology	Oct. 2020 - Nov. 2020
Instructor: Prof. Stepan Lucyszyn, Imperial College London	
TA in the Course of Mathematical Analysis	Sept. 2018 - Jan. 2019
Instructor: Prof. Keying Chen, kychen@sjtu.edu.cn, Shanghai Jiao Tong University	
TA in the Course of Fundamentals of Semiconductor Devices	Mar. 2020 - July 2020
Instructor: Prof. Baile Chen, ShanghaiTech University	

PROFESSIONAL SKILLS

Programming Languages: Python, MATLAB Machine Learning Framework: PyTorch EDA & Tool: Cadence Virtuoso, HSPICE, LATEX Sept. 2023 - Oct. 2023

Framewaork: PyTorch

Feb. 2023 - Dec. 2023