

# Jiajian Luo

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F-1 STEM OPT (3 years); I-140 approved under EB-2 NIW

## SUMMARY

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Ph.D. in Mechanical Engineering from UC Irvine, specializing in electronic and data center thermal analysis and cooling designs. Skilled in FEA/CFD simulation (COMSOL, ANSYS Fluent/Mechanical/ Icepak), experimental validation (IR thermography, thermocouples, RTD method), and AI/ML heat transfer research. Collaborated with NVIDIA, Texas Instruments, and Samsung to bridge research innovation with manufacturable cooling solutions for 2.5D/3D integration, co-packaged optics, and power devices.

## QUALIFICATIONS

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### Thermal Analysis

- Electronic cooling in device/package levels (GPU/ASIC, HBM, co-packaged optics, 2.5D/3D packaging)
- Data center cooling in system levels (liquid-/air-cooled systems, HVAC, CDUs, racks, servers)

### Multi-physics Modeling & CAD Design

- CFD/thermal/structural/electrical simulation (COMSOL, ANSYS Fluent/ Mechanical/ Icepak)
- 3D CAD design & MEMS layout (SolidWorks, AutoCAD, L-edit)

### Hands-on Characterization & Cleanroom Fabrication

- Thermal/electrical testing (IR thermography, thermocouple, four-point-probe testing)
- Cleanroom fabrication (lithography, metallization, wet/dry etching, lift-off, SEM)

### Programming, Data Analysis & Machine Learning

- Automated simulation pipeline design and experimental data acquisition (MATLAB, Python)
- Machine learning optimization and control

## EXPERIENCE

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### Graduate Researcher

*Sep. 2019 – Sep. 2025*

Department of Mechanical and Aerospace Engineering, UC Irvine

#### ❖ Development of In-Chip Thermoelectric Cooling (Collaboration with Texas Instruments)

- Designed and modelled CMOS-compatible thermoelectric coolers (TECs) for transistor-level thermal management, achieving an 8 °C reduction under a 400 W/cm<sup>2</sup>, 100×100 μm<sup>2</sup> LDMOS device.
- Microfabricated in-chip TECs (3mm × 3mm) in cleanroom environment using lithography, metal deposition, lift-off, and etching, delivered experimentally functional devices.
- Conducted hands-on thermal experiments using RTD, thermocouple, and IR camera for cooling characterization and validation, measured ~3 °C cooling for a 0.6 W, 30 × 44 μm<sup>2</sup> local hotspot.

#### ❖ CFD Modeling of Data Center for Machine Learning Thermal Control

- Performed system-level CFD modeling using ANSYS Fluent for the HVAC system in a raised-floor data center, with investigation on CRACs, perforated tiles, plenums, racks, etc.
- Scripted and automated simulations of a coolant distribution unit (CDU) under various operational conditions and dynamic workloads, developed machine learning models to predict cooling outcomes.
- Developed optimization algorithms for cooling controls using supervised/reinforcement learnings.

### ❖ **AI-Driven Thermal Management for Multi-Hotspot SoC**

- Scripted and automated 100,000+ FEM simulations to train deep neural networks for real-time thermal/power predictions in a multi-hotspot SoC.
- Trained and fine-tuned a 120M-parameter CNN to achieve less than 0.40% RMSE for predicting complex thermal-electrical physics using Python with TensorFlow and NumPy libraries.
- Developed backtracking algorithm for temperature control under dynamic SoC workloads within 1.6s, reducing peak hotspot temperature by 50.6%.

### ❖ **Thermal Optimization for PCB Soldering Process (Collaboration with Samsung)**

- Modelled advanced laser-based soldering process using COMSOL Multiphysics; simulated radiative/convective heating events in PCBs, BGA, and chiplets.
- Optimized heating conditions to reduce package temperature non-uniformity by 78.5%, enhancing package mechanical reliability.

### **Research Intern**

*Jun. 2025 – Sep. 2025*

NVIDIA, Circuits Research Group

### ❖ **Thermal Design for Photonics-Enabled GPU Modules**

- Designed and benchmarked advanced cooling methods for next-gen photonics-enabled GPUs, including thermoelectric, microchannel, and TIM-based solutions.
- Performed 2D/3D thermal simulations (ANSYS Icepak/Flotherm) for 2.5D/3D packaging, co-packaged optics, HBMs, and GPU/ASIC systems, identifying design trade-offs.
- Collaborated cross-functionally with photonic and electrical engineers, providing thermal insights that informed design integration and improved system performance.

## **PUBLICATION**

**Luo, J.** and Lee J. "Machine Learning-Assisted Thermoelectric Cooling for Multi-Hotspot Dynamic Thermal Management." *Journal of Applied Physics* (2024) <https://doi.org/10.1063/5.0206287>

**Luo, J.** et al. "Dynamic Thermal Management in SOI Transistors Using Holey Silicon-Based Thermoelectric Cooling." *IEEE Transactions on Electron Devices* (2024) <https://doi.org/10.1109/TED.2024.3358788>

**Luo, J.** et al. "Analysis of Non-Fourier Heat Conduction Problem with Suddenly Applied Surface Heat Flux." *Journal of Thermophysics and Heat Transfer* (2020) <https://doi.org/10.2514/1.T5849>

## **EDUCATION**

**University of California, Irvine, CA, USA**

- *Ph.D. in Mechanical Engineering* (GPA: 3.91/4.0)
- *M.S. in Mechanical Engineering* (GPA: 3.93/4.0)

*Sep. 2021 – Sep. 2025*

*Sep. 2019 – Jun. 2021*