

Saptarshi Joshi

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Ph.D. candidate in thermal management of high-power electronics and AI data centers: liquid cold plate design, additive manufacturing, data center system modeling and battery cooling. Open to internships for summer and fall 2027 and to industry roles from 2028.

Education

Ph.D., Mechanical Engineering, University of Illinois Urbana-Champaign Aug 2023 – May 2028 (expected)
Advisor: Prof. Nenad Miljkovic, Energy Transport Research Laboratory.

M.S., Mechanical Engineering, University of Illinois Urbana-Champaign 2025
GPA 4.0/4.0. Thesis: Measurement limits and performance analysis of multilayer insulation under vacuum and cryogenic temperatures using a modified calorimeter-bar setup.

B.Tech. (Honors), Mechanical Engineering, Indian Institute of Technology Bombay Aug 2019 – May 2023
Minor in Artificial Intelligence and Data Science. GPA 9.53/10.

Research Experience

Graduate Research Assistant, Energy Transport Research Laboratory, UIUC Aug 2023 – present

Manifold microchannel cold plates for high-power electronics and AI accelerators

- Co-led the Pareto-based thermal-hydraulic optimization, fabrication and experimental validation of a copper U-type manifold microchannel cooler for a six-device GaN power board: 70–98% lower pressure drop and 19–26% lower thermal resistance than the baseline, heat flux up to 208 W/cm^2 , cooling COP up to 1.6×10^6 , and CFD within 3% of experiment for all but the lowest flow rate (co-first author, *IJHMT*, 2026).
- Ongoing: design framework for large-area manifold microchannel cold plates for next-generation GPU packages dissipating 10 kW and above, combining computational design, reduced-order modeling and machine-learning-assisted optimization; designing, fabricating (additive and conventional manufacturing) and testing GPU-scale cold plates.

Dynamic system-level modeling of liquid-cooled AI data centers

- Ongoing: built a chip-to-ambient transient thermal-hydraulic model of a direct-to-chip liquid-cooled AI rack and a framework to analyze transient performance, energy efficiency and operation under realistic workloads and weather; extending to megawatt-class racks, facility scale and pumped two-phase cooling. First-author manuscript in preparation. Supported by the ARPA-E COOLERCHIPS program and ACRC.

Additively manufactured cold plates for GPUs

- Developed a monolithic GRCop-42 copper cold plate with bi-periodic sinusoidal microchannels made by laser powder bed fusion; internal geometry verified by X-ray CT to within 5% of design. Measured thermal resistance of 0.113–0.137 K/W and pressure drop of 1.1–24.1 kPa over 100–600 W and 1–5 L/min on a calorimeter bar, with COP up to 3.2×10^4 ; 0.150 K/W junction-to-coolant on an NVIDIA RTX A4000 at full power; conjugate CFD within 2% mean absolute error (first author, *Advances in Heat Transfer*, in press).
- Ongoing: manifold microchannel, pin-fin and lattice cold plate designs with industry partners including 3D Systems, IQ Evolution, Tritone Technologies and Fabric8Labs.

Li-ion battery thermal management (co-author, *Applied Thermal Engineering*, 2025)

- Built, as part of a team, an experimental setup for two-phase immersion cooling of Li-ion cells and small packs. Ongoing: electro-thermal modeling of internal cooling channels for large prismatic cells.

Multilayer insulation for cryogenic superconducting motors (M.S. thesis)

- Designed and built a modified ASTM D5470 calorimeter-bar apparatus to measure through-thickness conductance of multilayer insulation under vacuum at ambient and cryogenic temperatures (liquid nitrogen and cryocooler cooling). Used analytical modeling, FEA and uncertainty analysis to establish the measurement floor of the method, about $1 \text{ W/m}^2\text{K}$ (co-author, *Cryogenics*, 2025).

Industry Experience

Thermal R&D Intern, Lennox International, Advanced Technology Division, Dallas, TX May – Aug 2024

- Developed a “green hybrid” control logic for dual-fuel (heat pump plus furnace) systems in a Python–EnergyPlus co-simulation that optimizes real-time cost and emissions from regional energy data; 25% emissions reduction versus conventional dual-fuel control across six Midwest and Northeast locations.
- Compressor testing, and heat exchanger design and simulation, for new heat pump products.

Earlier Research

Bachelor's Thesis, IIT Bombay (Prof. Rajendra Vedula) Aug 2022 – May 2023
Heat transfer enhancement in pin-fin channels for turbine blade cooling using in-stream rib turbulators; 70% higher average Nusselt number at constant pumping power (ANSYS Fluent, OpenFOAM, IR thermal imaging).

Research Intern, Université Laval, Québec City (Prof. Seyed M. Taghavi) Summer 2022
Laboratory of Complex Fluids Research. Ran 250+ high-speed imaging and PIV experiments on buoyant jets in viscoplastic fluids; built a MATLAB image-analysis pipeline; identified six flow regimes; trained machine-learning models for jet characteristics ($R^2 = 0.98$).

Research Intern, University of California, Los Angeles (Prof. M. Khalid Jawed) 2021
Data-driven modeling for the discrete elastic rods algorithm.

Publications

1. B. Bazmi*, **S. Joshi***, W. Y. Park, S. Aflatounian, A. A. Lad, J. Liu, E. Shatskiy, V. S. Garimella, C. Tang, Y. Lin, M. Asheghi, H. A. Mantooth, K. E. Goodson, N. Miljkovic, "High-heat-flux liquid cooling of electronics with manifold microchannels: Thermal-hydraulic optimization and experimental validation," *International Journal of Heat and Mass Transfer* 268, 128924 (2026).
2. **S. Joshi**, B. Bazmi, W. Y. Park, D. Farhat, E. Shatskiy, O. M. Zaki, S. Green, D. Black, W. P. King, N. Miljkovic, "Metal additive manufacturing enables monolithic copper cold plate development with sinusoidal microchannels for direct-to-chip cooling," *Advances in Heat Transfer* (in press, 2026).
3. H. Qiu, V. S. Garimella, C. Li, **S. Joshi**, R. Roy, M. Bongarala, D. J. Apigo, S. N. Parbat, S. Faisal, T. Salamon, N. Miljkovic, "Immersion-cooled 1U power supply unit for fanless, warm-liquid-cooled data centers," *Applied Thermal Engineering* 303, 132309 (2026).
4. M. J. Dipto, K. F. Rabbi, Z. Liu, Y. Gurumukhi, J. G. Sederholm, **S. Joshi**, P. V. Braun, P. Wang, N. Miljkovic, "Internal flow cooling of cylindrical lithium-ion batteries," *Applied Thermal Engineering* 281, 128458 (2025).
5. S. Aflatounian, K. Luo, S. Sirimanna, Y. Gurumukhi, **S. Joshi**, D. H. Parker, T. Balachandran, H. Rautela, J. Xiao, K. S. Haran, N. Miljkovic, "Design and development of an apparatus for evaluating multi-layer insulation effectiveness," *Cryogenics* 149, 104080 (2025).
6. H. Hassanzadeh, **S. Joshi**, S. M. Taghavi, "Predicting buoyant jet characteristics: a machine learning approach," *Chemical Product and Process Modeling* (2024).
7. S. B. Sachin, **S. Joshi**, J. S. Murallidharan, A. Singh, G. Kumaraswamy, K. Sinha, "Enhancing ventilation of enclosed spaces using CFD, Part 3: Ventilation of high-occupancy rooms of IIT Bombay," *Resonance* (2024).
8. H. Hassanzadeh, **S. Joshi**, S. Akbari, S. M. Taghavi, "Buoyant miscible jets in a viscoplastic medium with applications in plug and abandonment of oil and gas wells," *ASME OMAE* (2023).

In preparation: **S. Joshi**, H. Tyagi, X. Du, A. Jain, W. Y. Park, I. Pinkus, V. Ganesan, N. Miljkovic, "Data center thermal analysis using dynamic system modeling." (*co-first authors)

Presentations

- ASME InterPACK 2026, San Diego, CA: "High-heat-flux single-phase liquid cooling of gallium nitride power electronics with manifold microchannels: thermal-hydraulic optimization and experimental validation" (oral, presenting author).
- ACRC Fall 2026 meeting: dynamic system modeling of direct-to-chip liquid-cooled AI data centers (oral, poster).
- ACRC meetings, Spring 2025, Fall 2025 and Spring 2026 (posters and talks); Power and Energy Conference at Illinois (PECI), 2026; POETS Annual Meeting, 2024 and 2025.

Leadership

Team Leader, Team Rakshak (unmanned aerial systems team), IIT Bombay Aug 2020 – Jun 2023
Led a three-tier team of 65+ students across four subsystems: CAD of a 250+ part aircraft, aerodynamic design, structural and impact analysis, and manufacturing.

Skills

Simulation: ANSYS Fluent and Icepak, COMSOL, OpenFOAM, MATLAB/Simulink/Simscape, EnergyPlus, Flotherm

Design and fabrication: SolidWorks, design for additive manufacturing, CNC-machined and printed cold plates

Experimental: single-phase and two-phase liquid cooling test loops, calorimeter-bar characterization, vacuum and cryogenic testing, battery cycling, IR thermography, PIV and high-speed imaging, LabVIEW and DAQ

Programming and data: Python, MATLAB, C/C++, machine learning (scikit-learn, PyTorch), L^AT_EX