MINGEUN CHOI

George W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology
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EDUCATION

Georgia Institute of Technology — Atlanta, GA
Ph.D. in Mechanical Engineering (Advisor: Dr. Satish Kumar) — Jan. 2023–Dec. 2027 (expected)

Seoul National University — Seoul, Republic of Korea
M.S. in Mechanical Engineering (Advisor: Dr. Seung Jin Song) — Mar. 2017–Feb. 2019

Korea University — Seoul, Republic of Korea
B.S. in Mechanical Engineering — Mar. 2013–Feb. 2017

APPOINTMENTS

Republic of Korea Air Force Academy — Cheongju, Republic of Korea
Assistant Professor (Rank: First Lieutenant) — Jun. 2020–May 2022
Instructor (Rank: Second Lieutenant) — Jun. 2019–May 2020

RESEARCH INTERESTS

My research focuses on thermal science and engineering for advanced microelectronics. My interests include (1) machine-learning-enabled frequency-domain thermoreflectance inversion for depth-dependent thermal-property characterization of thin films, (2) numerical analysis and machine-learning-accelerated prediction of spatiotemporal temperature fields and thermal crosstalk in transistor arrays, and (3) electrothermal co-design of vertical power delivery and substrate-embedded microfluidic cooling, alongside the development of numerical solvers and machine-learning models for transient and advection-dominated heat transfer.

PUBLICATIONS († First Author(s); * Corresponding Author(s))

Refereed Journal Articles

[11] P.-C. Lee†, **M. Choi**, D. Contreras Mora, A. Ross, S. Yun, D. Pal, D. Go, J. Dutta, X. Wang, M. Clark, L. Chen, R. Kanjolia, M. Moinpour, H. Chandra, S. Kumar, and A. C. Kummel*, "Quasi-Ballistic Thermal Transport in Vertically Aligned h-BN," *ACS Omega*, vol. 11, no. 42, pp. 64801–64811, Oct. 2026. [Link]

[10] S. Krishnakumar†, Y. Popryho, **M. Choi**, R. R. Khorasani, M. Swaminathan, S. Kumar, and I. Partin-Vaisband*, "A Comprehensive Design Framework for Vertical Power Delivery in High-Performance Computing," *IEEE Trans. Compon. Packag. Manuf. Technol.*, vol. 16, no. 9, pp. 2089–2102, Sep. 2026. [Link]

[9] **M. Choi**†, R. Dutta, P. Saha, M. Singh, S. Mukhopadhyay, S. Datta, and S. Kumar*, "Deep Operator Network-Accelerated Spatiotemporal Temperature Field Assessment of Fin Field-Effect Transistor Arrays," *Appl. Therm. Eng.*, vol. 304, pt. 1, Art. no. 132498, Sep. 2026. [Link]

[8] **M. Choi**†, S. Krishnakumar, Y. Popryho, R. R. Khorasani, M. Swaminathan, I. Partin-Vaisband, and S. Kumar*, "Self-Consistent Electrothermal Modeling of Distributed Vertical Power Delivery Architecture with Substrate-Embedded Microfluidic Cooling," *IEEE Trans. Compon. Packag. Manuf. Technol.*, vol. 16, no. 7, pp. 1534–1542, Jul. 2026. [Link]

[7] D. Go†, V. Ashita, A. Wang, **M. Choi**, H. S. Song, S. Yun, D. Pal, P.-C. Lee, J. Dutta, J. Ryu, S. Kumar, C. V. Thompson, M. S. Bakir, and A. C. Kummel*, "Chiplet Encapsulation and Planarization with 100 μm Deep Gaps using AlN Powder Spray + Sputter Hybrid Deposition," *Adv. Eng. Mater.*, vol. 28, no. 6, Art. no. e202502821, Mar. 2026. [Link]

[6] S. Yun†, D. Go, **M. Choi**, R. Kondakindi, P.-C. Lee, P. R. Bandaru, S. Kumar, and A. C. Kummel*, "High Speed, High Thermal-Conductivity of Aluminum Nitride Deposited by DC Reactive Sputtering at Low Temperature in the Transition Regime," *Ceram. Int.*, vol. 52, no. 4, pp. 4777–4786, Feb. 2026. [Link]

[5] P.-C. Lee†, **M. Choi**, D. Contreras Mora, K. Wang, S. Yun, D. Go, J. Dutta, D. Pal, S. Kumar, and A. C. Kummel*, "High-Speed AlN Film Deposition via Low-Pressure Bipolar High Power Impulsed Magnetron Sputter for Enhanced Thermal Conductivity," *Thin Solid Films*, vol. 832, Art. no. 140821, Dec. 2025. [Link]

[4] **M. Choi**†, D. Vaca, and S. Kumar*, "Machine Learning-Enabled Fast and Accurate Inversion of Thermal

Properties at the Micro- and Nanoscale via Optical Metrology," *Annu. Rev. Heat Transf.*, vol. 28, pp. 277–337, Oct. 2025. [Link]

[3] **M. Choi**†, S. Krishnakumar, R. R. Khorasani, M. Swaminathan, I. Partin-Vaisband, and S. Kumar*, "Substrate-Embedded Microfluidic Cooling of Distributed Vertical Power Delivery Architectures for High-Performance Computing Processors," *IEEE Trans. Compon. Packag. Manuf. Technol.*, vol. 15, no. 9, pp. 1912–1920, Sep. 2025. [Link]

[2] P.-C. Lee†, A. J. McLeod, **M. Choi**, D. Vaca, D. Contreras Mora, K. Wang, S. Yun, J. Dutta, D. Pal, S. Kumar, and A. C. Kummel*, "Achieving a High Thermally Conductive One Micron AlN Deposition by High Power Impulse Magnetron Sputtering Plus Kick," *ACS Appl. Mater. Interfaces*, vol. 16, no. 20, pp. 26664–26673, May 2024. [Link]

[1] **M. Choi**†, B. Goo, G. Cho, and S. J. Song*, "Swirl Enhancement Effect on Turbine Rim Seal Performance," *J. Turbomach.*, vol. 146, no. 5, Art. no. 051002, May 2024. [Link]

Manuscripts Under Review

[3] **M. Choi**† and S. Kumar*, "STREAM 1.0: An Efficient Spatiotemporal Thermal Response Emulator Using Prescribed Velocity Fields for Advanced Microelectronics," submitted for publication.

[2] **M. Choi**†* and S. Kumar*, "Rationally Enriched Chebyshev Trunk Bases for DeepONet Surrogates of High Péclet Entrance Transport," submitted for publication.

[1] **M. Choi**†, M. Herndon, K. Uechi, N. Akel, and S. Kumar*, "Deep Operator Network Framework for Bidirectional Power-State and Temperature Analysis in Vertical Power Delivery Modules," submitted for publication.

Refereed Conference Proceedings

[12] **Best Paper** **M. Choi**†, M. Herndon, K. Uechi, N. Akel, and S. Kumar*, "DeepONet-Enabled Fast and Scenario-Aware Spatial Temperature Prediction of a Vertical Power Delivery Module for Hyperscale Data Centers," in *Proc. 25th IEEE Intersoc. Conf. Therm. Thermomech. Phenom. Electron. Syst. (ITherm)*, Orlando, FL, USA, May 2026, accepted for publication.

[11] P.-C. Lee†, D. Contreras Mora, **M. Choi**, S. Yun, D. Pal, A. Ross, M. Clark, L. Chen, H. Chandra, R. Kanjolia, M. Moinpour, S. Kumar, and A. Kummel*, "Vertical aligned Hexagonal Boron Nitride with Ballistic Thermal Conductivity," in *Proc. Int. VLSI Symp. Technol. Syst. Appl. (VLSI TSA)*, Hsinchu, Taiwan, Apr. 2026. [Link]

[10] R. Dutta†, M. Shon, S. Lim, P. Saha, **M. Choi**, M. P. Singh, S. Kumar, S. Mukhopadhyay, S. K. Lim, S. Yu, and S. Datta*, "Self-Heating in GAA Nanosheet FETs with integrated Back Side Power Delivery Network: Device to Circuit Electro-Thermal Analysis and Implications," in *Proc. IEEE Int. Reliab. Phys. Symp. (IRPS)*, Tucson, AZ, USA, Mar. 2026. [Link]

[9] **Best Paper** **M. Choi**†, S. Krishnakumar, Y. Popryho, R. R. Khorasani, M. Swaminathan, I. Partin-Vaisband, and S. Kumar*, "Automated Electro-Thermal Modeling Framework of Distributed Vertical Power Delivery Architectures with Substrate-Embedded Microfluidic Cooling," in *Proc. 24th IEEE Intersoc. Conf. Therm. Thermomech. Phenom. Electron. Syst. (ITherm)*, Dallas, TX, USA, May 2025. [Link]

[8] **M. Choi**†, R. Dutta, P. Saha, M. P. Singh, S. Mukhopadhyay, S. Datta, and S. Kumar*, "Fast Prediction of Spatio-Temporal Temperature Profiles in FinFET Arrays via Numerical and Machine-Learning Approaches," in *Proc. IEEE Int. Electron Devices Meet. (IEDM)*, San Francisco, CA, USA, Dec. 2024. [Link]

[7] Y. Im†, J. Kim, **M. Choi**, M. Bouzidi, X. Li, J. W. Kim, A. M. Muslu, S. Kumar, M. Swaminathan, S. K. Sitaraman, and Y. Joshi*, "Parametric Thermal Design for Heterogeneously Integrated High-Power Packages," in *Proc. ASME 2024 Int. Tech. Conf. Exhib. Packag. Integr. Electron. Photonic Microsyst. (InterPACK)*, San Jose, CA, USA, Oct. 2024. [Link]

[6] P.-C. Lee†, A. J. McLeod, **M. Choi**, D. Vaca, S. Kumar, and A. C. Kummel*, "Thermal Conductivity Study of One Micron AlN Deposition by Bipolar High Power Impulse Magnetron Sputtering," in *Proc. IEEE Int. Interconnect Technol. Conf. (IITC)*, San Jose, CA, USA, Jun. 2024. [Link]

[5] S. Krishnakumar†, **M. Choi**, R. R. Khorasani, R. Sharma, M. Swaminathan, S. Kumar, and I. Partin-Vaisband*, "Vertical Power Delivery for High Performance Computing Systems with Buck-Derived Regulators," in *Proc. IEEE 74th Electron. Compon. Technol. Conf. (ECTC)*, Denver, CO, USA, May 2024. [Link]

[4] **M. Choi**†, S. Krishnakumar, R. R. Khorasani, I. Partin-Vaisband, R. Sharma, M. Swaminathan, and S. Kumar*, "Thermal Analysis of High Current Vertical Power Delivery Network with Embedded Microchannel Cooling,"

in *Proc. 23rd IEEE Intersoc. Conf. Therm. Thermomech. Phenom. Electron. Syst. (ITherm)*, Aurora, CO, USA, May 2024. [Link]

[3] S. Krishnakumar†, **M. Choi**, R. R. Khorasani, R. Sharma, M. Swaminathan, S. Kumar, and I. Partin-Vaisband*, "Design Considerations for DC-DC Voltage Regulators in Distributed Vertical Power Delivery Systems," in *Proc. IEEE Int. Symp. Circuits Syst. (ISCAS)*, Singapore, May 2024. [Link]

[2] P.-C. Lee†, A. J. McLeod, **M. Choi**, D. Vaca, D. Contreras Mora, S. Kumar, and A. C. Kummel*, "High Thermally Conductive, High-Speed Deposition of AlN by Bipolar High Power Impulse Magnetron Sputtering," in *Proc. Int. VLSI Symp. Technol. Syst. Appl. (VLSI TSA)*, Hsinchu, Taiwan, Apr. 2024. [Link]

[1] **M. Choi**†, B. Goo, G. Cho, and S. J. Song*, "Swirl Enhancement Effect on Turbine Rim Seal Performance," in *Proc. ASME Turbo Expo 2023: Turbomach. Tech. Conf. Expo.*, Boston, MA, USA, Jun. 2023. [Link]

Conference Presentations

[11] M. Singh†, **M. Choi**, L. Patra, R. Dutta, P. Saha, S. Mukhopadhyay, S. Datta, and S. Kumar*, "Machine Learning Enabled Fast and Accurate Thermal Model of Nanoscale Transistors and Circuits," presented at the *Gov. Microcircuit Appl. Crit. Technol. Conf. (GOMACTech) 2026*, New Orleans, LA, USA, Mar. 9–12, 2026.

[10] P.-C. Lee†, D. Contreras Mora, **M. Choi**, S. Yun, D. Pal, A. Ross, M. Clark, L. Chen, R. Kanjolia, M. Moinpour, S. Kumar, and A. C. Kummel*, "Vertical Aligned Hexagonal Boron Nitride with High Interfacial Thermal Conductivity," presented at the *56th IEEE Semicond. Interface Specialists Conf. (SISC)*, San Diego, CA, USA, Dec. 10–13, 2025.

[9] D. Contreras Mora†, P.-C. Lee, **M. Choi**, D. Go, S. Yun, M. Moinpour, L. Chen, M. Clark, R. Kanjolia, S. Kumar, and A. C. Kummel*, "Thermal Boundary Conductance of Ultrathin Aluminum Nitride Interfaces for Advanced Packaging," presented at the *56th IEEE Semicond. Interface Specialists Conf. (SISC)*, San Diego, CA, USA, Dec. 10–13, 2025.

[8] D. Contreras Mora†, P.-C. Lee, **M. Choi**, S. Kumar, and A. C. Kummel*, "Low Pressure HiPIMS + Kick AlN Deposition with Ultra High Growth Rate," presented at the *Gov. Microcircuit Appl. Crit. Technol. Conf. (GOMACTech) 2025*, Pasadena, CA, USA, Mar. 17–20, 2025.

[7] P.-C. Lee†, D. Contreras Mora, A. J. McLeod, **M. Choi**, D. Vaca, S. Kumar, and A. C. Kummel*, "Enhancing AlN Crystallographic Properties and Thermal Conductivity Using HiPIMS + Kick Deposition," presented at the *Gov. Microcircuit Appl. Crit. Technol. Conf. (GOMACTech) 2024*, Charleston, SC, USA, Mar. 18–21, 2024.

[6] P.-C. Lee†, D. Contreras Mora, A. J. McLeod, **M. Choi**, D. Vaca, S. Kumar, and A. C. Kummel*, "Achieving a High Thermal Conductive One Micron AlN Deposition by High Power Impulse Magnetron Sputtering Plus Kick," presented at the *54th IEEE Semicond. Interface Specialists Conf. (SISC)*, San Diego, CA, USA, Dec. 13–16, 2023.

[5] J. Pak†, S. Oh, and **M. Choi***, "Computational Modeling for Investigating Flow Instabilities in Gas Turbine Rim Seals," presented at the *KSPE Spring Conf. 2020*, Online via Zoom, Jul. 16–17, 2020.

[4] **M. Choi**†, B. Goo, and S. J. Song*, "Design of a Low-Speed Single-Stage Turbine Facility for Ingress Measurement," presented at the *IGTC 2019 Tokyo*, Tokyo, Japan, Nov. 17–22, 2019.

[3] **M. Choi**†, B. Goo, and S. J. Song*, "Sealing Performance Measurement of Single Radial-Clearance Rim Seal," presented at the *KSFM Winter Conf. 2018*, Yeosu, Republic of Korea, Nov. 28–30, 2018.

[2] **M. Choi**†, H. R. Kim, S. Kim, G. Cho, and S. J. Song*, "Measurement of Double-Clearance Rim Seal Performance to Prevent Hot Gas Ingestion in Large-Scale Gas Turbines," presented at the *KSFM Summer Conf. 2018*, Jeju, Republic of Korea, Jul. 4–6, 2018.

[1] **Best Presentation** **M. Choi**†, G. Cho, and S. J. Song*, "Rebuilding of 1-Stage Axial Turbine Rim Seal Test Facility in Seoul National University," presented at the *KSFM Summer Conf. 2018*, Jeju, Republic of Korea, Jul. 4–6, 2018.

PATENTS

[3] A. C. Kummel, P.-C. Lee, D. Contreras Mora, D. Go, S. Kumar, and **M. Choi**, "Aluminum Nitride Thin Film Deposition Using Sputtering," U.S. Patent Appl. 20260110074A1, Apr. 23, 2026. [Link]

[2] **M. Choi** and S. J. Song, "Gas Turbine Engine with Improved Flow Stability and Cooling Efficiency," Republic of Korea Patent 10-2206447, Jan. 18, 2021. [Link]

[1] **M. Choi**, S. J. Song, and B. Goo, "Gas Turbine Engine with Improved Sealing and Operability," Republic of Korea Patent 10-2202368, Jan. 7, 2021. [Link]

RESEARCH EXPERIENCE

Georgia Institute of Technology — Micro Nano Devices and Systems Laboratory
Graduate Research Assistant — Jan. 2023–Present

- Supported by the Center for Heterogeneous Integration of Micro Electronic Systems (CHIMES), led by the Semiconductor Research Corporation (SRC) and sponsored by the Defense Advanced Research Projects Agency (DARPA) to develop advanced thermal management solutions for heterogeneously integrated electronics.
- Enabled distributed vertical power delivery (VPD) architectures with substrate-embedded microfluidic cooling in 3D-stacked processors that sustain current densities exceeding 2 A/mm² at up to 80% efficiency.
- Developed high-thermal-conductivity aluminum nitride (AlN) thin films as heat spreaders using low-pressure high-power impulse magnetron sputtering (HiPIMS) with "plus kick voltage" to achieve deposition rates above 25 nm/min at temperatures below 200°C.

Graduate Research Assistant — Aug. 2023–Present

- Sponsored by the Thermal Modeling of Nanoscale Transistors (Thermonat) program operated by Defense Advanced Research Projects Agency (DARPA) to develop innovative multi-scale thermal management approaches for nanoscale transistors as part of their Microsystems Exploration (μE) initiative.
- Developed a machine learning–accelerated multi-scale modeling framework that predicts spatio-temporal temperature profiles in 14 nm fin field-effect transistor (FinFET) arrays nearly 2300 times faster than conventional finite-volume method (FVM).
- Developed a device-to-circuit electrothermal framework for gate-all-around nanosheet field-effect transistors (GAA NSFETs) with backside power delivery networks (BSPDN) by calibrating self-heating effect (SHE)-aware BSIM-CMG models to predict over 10% frequency degradation.

Seoul National University — Turbomachinery Laboratory
Graduate Student Researcher — Mar. 2017–Feb. 2019

- Sponsored by Doosan Enerbility to construct and validate an engine-representative gas turbine test rig aimed at reducing hot gas ingestion and to investigate the impact of swirling sealing flows on rim sealing performance.
- Constructed a scaled test rig of the first high-pressure turbine (HPT) stage in H^+ gas turbines, and demonstrated that reducing rim seal clearance decreases hot gas ingestion by significant margins.
- Developed a patented rotor disk attachment "swirler" that enhances rim sealing performance up to 23 % by increasing swirl in the wheel-space, potentially increasing overall gas turbine efficiency and power by up to 0.02 percentage points and 0.18 %, respectively.

TEACHING EXPERIENCE

Georgia Institute of Technology — George W. Woodruff School of Mechanical Engineering
Teaching Practicum — Jan. 2024–May 2024

- Heat Transfer (ME3345) — Spring 2024

Republic of Korea Air Force Academy — Department of Mechanical Engineering
Instructor – Assistant Professor — Jun. 2019–May 2022

- Fluid Mechanics (A0532) — Spring 2020, Spring 2022
- Applied Fluid Mechanics (A1154) — Spring 2021
- Thermodynamics (A0438) — Fall 2022
- Heat Transfer (A0439) — Fall 2019, Fall 2020, Fall 2021
- Energy Systems Engineering (A1692) — Fall 2022
- Engineering Mechanics: Statics and Dynamics (A0066) — Fall 2019, Fall 2020, Spring 2022
- Mechanical Component Design and Drawing (A0151) — Fall 2019, Fall 2020
- Manufacturing Processes and Practice (A0138) — Spring 2021
- Mechanical Engineering Laboratory (A0145) — Spring 2021, Spring 2022
- Practical Research on Military Task (A1610) — Fall 2020, Fall 2021

Seoul National University Department of Mechanical Engineering
Teaching Assistant Mar. 2018–Dec. 2018
- Mechanical System Design Project 2 (M2794.004300) Fall 2018
- Mechanical System Design Project 1 (M2794.004200) Spring 2018
- Fluid Mechanics (M2794.001300) Spring 2018

MENTORING EXPERIENCE

Hsin-Er Kuo, Georgia Institute of Technology Aug. 2025–Present
- Provided mentorship in frequency-domain thermoreflectance (FDTR).

HONORS AND AWARDS

William H. Glenn, Sr. Fellowship, Georgia Institute of Technology 2026
- Awarded a topping fellowship for technology commercialization efforts.

Excellent Honor Scholarship, Embassy of the Republic of Korea in the USA 2026
- Awarded under the Korean Honor Scholarship (KHS) program.

EPS Graduate Student Grant, IEEE Electronics Packaging Society (EPS) 2026

Professor Avram Bar-Cohen Best Paper Award, IEEE 2026
- Received the award in the Emerging Technologies & Fundamentals Track at IEEE ITherm.

Paul R. Yopp Memorial Fellowship, Georgia Institute of Technology 2026
- Awarded a topping fellowship for a roadmap paper.

Beth & Ford Flowers Fellowship, Georgia Institute of Technology 2025
- Awarded a topping fellowship for the most first-author journal papers.

Best Paper Runner-Up Award, IEEE 2025
- Received the award in the System Level Thermal Management Track at IEEE ITherm.

Excellence in Service and Leadership Award, Georgia Institute of Technology 2025
- Recognized for student advocacy, professional development, and community engagement.

Beth & Ford Flowers Fellowship, Georgia Institute of Technology 2025
- Awarded a topping fellowship for community building and leadership.

Strong Gap Funding Topping Fellowship, Georgia Institute of Technology 2024

Best Presentation Award, Korean Society for Fluid Machinery 2018
- Received the award in the Gas Steam Turbine 1 general session at the KSFM Summer Conf.

Merit-Based Scholarship, Seoul National University 2018

Brain Korea 21 Plus Fellowship, National Research Foundation of Korea 2017

National Science and Engineering Scholarship, Korea Student Aid Foundation 2015–2016

Semester High Honors, Korea University 2014–2016

Academic Excellence Scholarship for Freshman, Korea University 2013

TEACHING CERTIFICATIONS

Tech to Teaching, Georgia Institute of Technology Mar. 2025
- Completed a capstone teaching practicum in Heat Transfer (ME 3345), designing and delivering four sessions with over 90 % positive student feedback.

CIRTL Associate, Center for the Integration of Research, Teaching, and Learning (CIRTL) Mar. 2025
- Completed foundational training in evidence-based teaching and inclusive pedagogy.

LEADERSHIP AND SERVICE

Director of Communications, Georgia Tech Nu Chapter of Pi Tau Sigma Jan. 2025–Dec. 2025
- Launched a monthly newsletter and redesigned the chapter website, driving a 100 % increase in new-initiate turnout in Spring 2025 and boosting alumni engagement by 30 %.

External Vice President, Mechanical Engineering Graduate Association (MEGA) May 2024–Apr. 2025
- Coordinated eight professional networking events with Dow Inc., Sandia National Laboratories (SNL), Exponent, and Kratos Defense, increasing event offerings by 50 % and student attendance by 40 % over the academic year.

PROFESSIONAL AFFILIATIONS AND ACADEMIC SERVICE

Peer Review

IEEE Trans. Compon. Packag. Manuf. Technol.	2026–Present
IEEE Trans. Sustain. Comput.	2026–Present
IEEE Intersoc. Conf. Therm. Thermomech. Phenom. Electron. Syst. (ITherm)	2026–Present

Professional Memberships

IEEE Electron Devices Society (EDS)	2026–Present
IEEE Electronics Packaging Society (EPS)	2026–Present
ASME	2026–Present
IEEE	2024–Present

REFERENCES

Satish Kumar
Frank H. Neely Professor
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Andrew C. Kummel
Distinguished Professor
Department of Chemistry and Biochemistry
University of California San Diego
akummel@ucsd.edu

Inna Partin-Vaisband
Associate Professor
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University of Illinois Chicago
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Seung Jin Song
Professor
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