

MINGEUN CHOI

Ph.D. Student

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

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EDUCATION

Georgia Institute of Technology

Ph.D. in Mechanical Engineering (Advisor: Dr. Satish Kumar)

Atlanta, GA
Jan. 2023 – Dec. 2027 (expected)

Seoul National University

M.S. in Mechanical Engineering (Advisor: Dr. Seung Jin Song)

Seoul, Republic of Korea

Korea University

B.S. in Mechanical Engineering

Mar. 2017 – Feb. 2019

Seoul, Republic of Korea

Mar. 2013 – Feb. 2017

APPOINTMENTS

Republic of Korea Air Force Academy

Assistant Professor (Rank: First Lieutenant)

Instructor (Rank: Second Lieutenant)

Cheongju, Republic of Korea

Jun. 2020 – May 2022

Jun. 2019 – May 2020

RESEARCH INTERESTS

My research focuses on electrothermal modeling and thin-film thermal-property characterization in heterogeneously integrated electronics. I develop (1) an automated electrothermal modeling framework to co-optimize vertical power delivery architecture and substrate-embedded microfluidic cooling for thermally sustainable, high-power-density operation; (2) a machine-learning-accelerated electrothermal modeling framework to predict spatiotemporal temperature fields from individual FinFET devices to arrays for fast, accurate, self-heating-aware evaluation; and (3) a machine-learning-enabled frequency-domain thermorefectance inversion model to estimate the thermal properties of thin films for high-throughput, low-uncertainty characterization. Together, I aim to build a self-consistent multiscale workflow linking the device and package levels with high-fidelity thermal-property inputs.

PUBLICATIONS

Refereed Journal Articles

- [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 Transfer*, early access, Sep. 16, 2025, doi: [10.1615/AnnualRevHeatTransfer.2025059842](https://doi.org/10.1615/AnnualRevHeatTransfer.2025059842).
- [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, doi: [10.1109/TCPMT.2025.3544105](https://doi.org/10.1109/TCPMT.2025.3544105).
- [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, doi: [10.1021/acsami.4c00993](https://doi.org/10.1021/acsami.4c00993).
- [1] **M. Choi**, B. Goo, G. Cho, and S. J. Song, "Swirl Enhancement Effect on Turbine Rim Seal Performance," *ASME J. Turbomach.*, vol. 146, no. 5, p. 051002, May 2024, doi: [10.1115/1.4064230](https://doi.org/10.1115/1.4064230).

Manuscripts Under Review

- [5] D. Go, V. Ashita, A. Wang, **M. Choi**, H. S. Song, S. Yun, D. Pal, P.-C. Lee, J. Dutta, J. Ryu, C. V. Thompson, M. S. Bakir, S. Kumar, A. C. Kummel, "Chiplet Encapsulation and Planarization with 100 μm Deep Gaps using AlN Powder Spray + Sputter Hybrid Deposition," submitted for publication.
- [4] S. Yun, D. Go, **M. Choi**, R. Kondakindi, P.-C. Lee, W. Aigner, T. Metzger, S. Kumar, P. R. Bandaru, and A. C. Kummel, "High Thermal-Conductivity of Aluminum Nitride on Si (111) Deposited by DC Reactive Sputter at Room Temperature," submitted for publication.
- [3] 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," submitted for publication.
- [2] 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 HiPIMS Plus Kick for Enhanced Thermal Conductivity," submitted for publication.
- [1] **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," submitted for publication.

Refereed Conference Proceedings

- [9] **Best Paper** **News Release** **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. Thermal Thermomech. Phenomena Electron. Syst. (ITherm)*, Dallas, TX, USA, May 2025, to be published.
- [8] **News Release** **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 Meeting (IEDM)*, San Francisco, CA, USA, Dec. 2024, doi: [10.1109/IEDM50854.2024.10873584](https://doi.org/10.1109/IEDM50854.2024.10873584).
- [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. Packaging Integr. Electron. Photon. Microsystems (InterPACK)*, San Jose, CA, USA, Oct. 2024, doi: [10.1115/IPACK2024-141216](https://doi.org/10.1115/IPACK2024-141216).
- [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, doi: [10.1109/IITC61274.2024.10732369](https://doi.org/10.1109/IITC61274.2024.10732369).
- [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, doi: [10.1109/ECTC51529.2024.00364](https://doi.org/10.1109/ECTC51529.2024.00364).
- [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. Thermal Thermomech. Phenomena Electron. Syst. (ITherm)*, Aurora, CO, USA, May 2024, doi: [10.1109/ITherm55375.2024.10709419](https://doi.org/10.1109/ITherm55375.2024.10709419).
- [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, doi: [10.1109/IS-CAS58744.2024.10558456](https://doi.org/10.1109/IS-CAS58744.2024.10558456).
- [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. IEEE Int. Symp. VLSI Technol. Syst. Appl. (VLSI-TSA)*, Hsinchu, Taiwan, Apr. 2024, doi: [10.1109/VLSITSA60681.2024.10546374](https://doi.org/10.1109/VLSITSA60681.2024.10546374).

- [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, doi: [10.1115/GT2023-101389](https://doi.org/10.1115/GT2023-101389).

PATENTS

- [3] P.-C. Lee, **M. Choi**, D. Contreras Mora, D. Go, S. Kumar, and A. C. Kummel, "Low-Pressure HiPIMS Method for Rapid Deposition of High-Thermal Conductivity Aluminum Nitride Film," U.S. Provisional Patent Application 63/710,945, filed Oct. 23, 2024.
- [2] **M. Choi** and S. J. Song, "Gas Turbine Engine with Improved Flow Stability and Cooling Efficiency," Republic of Korea Patent 10-2206447, filed Oct. 8, 2020, issued Jan. 18, 2021, doi: [10.8080/1020200130286](https://doi.org/10.8080/1020200130286).
- [1] **M. Choi**, B. Goo, and S. J. Song, "Gas Turbine Engine with Improved Sealing and Operability," Republic of Korea Patent 10-2202368, filed Sep. 16, 2020, issued Jan. 7, 2021, doi: [10.8080/1020200119006](https://doi.org/10.8080/1020200119006).

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 – Aug. 2025

- Sponsored by the Defense Advanced Research Projects Agency (DARPA) to develop innovative multi-scale thermal management approaches for nanoscale transistors as part of their Microsystems Exploration (μ E) 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).

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 improving overall efficiency and power of the gas turbine can be increased by up to 0.02 pp and 0.18 %.

TEACHING EXPERIENCE

Georgia Institute of Technology

Teaching Practicum

- Heat Transfer (Spring 2024)

George W. Woodruff School of Mechanical Engineering

Jan. 2024 – Apr. 2024

ME3345

Republic of Korea Air Force Academy

Instructor – Assistant Professor

Department of Mechanical Engineering

Jun. 2019 – May 2022

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

Seoul National University

Teaching Assistant

Department of Mechanical Engineering

Mar. 2018 – Dec. 2018

- Mechanical System Design Project 2 (Fall 2018) M2794.004300
- Mechanical System Design Project 1 (Spring 2018) M2794.004200
- Fluid Mechanics (Spring 2018) M2794.001300

TECHNICAL SKILLS

- **Engineering and Simulation Software:** ANSYS Icepak (including PyAEDT); ANSYS Fluent (including PyFluent); ANSYS CFX; Dassault Systèmes SolidWorks; Microsoft Visual Studio Code.
- **Programming and Scripting:** Python; MathWorks MATLAB; Julia; National Instruments LabVIEW.
- **Experimental Metrology (including Relevant Instrument):** Frequency-domain thermoreflectance (FDTR); thermoreflectance thermal imaging (TTI); thermofluidic measurement; machining; manufacturing; commissioning; calibration; uncertainty analysis.

HONORS AND AWARDS

Most First Author Journal Papers Topping Fellowship , Georgia Institute of Technology	2025
Best Paper Runner-Up Award , Institute of Electrical and Electronics Engineers	2025
News Release Excellence in Service and Leadership Award , Georgia Institute of Technology	2025
Community Builder/Leader Topping Fellowship , Georgia Institute of Technology	2025
Strong Gap Funding Topping Fellowship , Georgia Institute of Technology	2024
Best Presentation Award , Korean Society for Fluid Machinery	2018
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 the capstone teaching practicum for Heat Transfer (ME 3345) by designing and delivering four instructional sessions, earning 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 practices and inclusive-pedagogy frameworks, applying these methods to improve classroom equity and student engagement.

LEADERSHIP AND SERVICE

Director of Communications, [Georgia Tech Nu Chapter of Pi Tau Sigma](#) Jan. 2025 - Present

- Launched a monthly newsletter and renovated 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 graduate-student attendance by 40 % over the academic year.

REFERENCES

Satish Kumar

Frank H. Neely Professor
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Georgia Institute of Technology
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Inna Partin-Vaisband

Associate Professor
Department of Electrical and Computer Engineering
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Andrew C. Kummel

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Department of Chemistry and Biochemistry
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