

# RITWIK KULKARNI

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## SUMMARY

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PhD student in Mechanical Engineering with a strong foundation in thermal management, heat transfer, and experimental research on thermal interface materials for semiconductor packages. Actively involved in research, problem-solving, and collaboration, with experience in mentoring undergraduate students and presenting at conferences. Passionate about developing innovative thermal solutions and contributing to the field through research and academic engagement.

## EDUCATION

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<b>Purdue University - West Lafayette</b> Doctor of Philosophy in Mechanical Engineering, GPA : 3.86/4.0	August 2021 - December 2025 (Expected)
<b>Texas A&amp;M University - College Station</b> Master of Science in Mechanical Engineering, GPA : 4.0/4.0	August 2019 - August 2021
<b>Indian Institute of Technology - Jodhpur</b> Bachelor of Technology in Mechanical Engineering, GPA: 8.94/10.00, Departmental Rank 2	July 2015 - May 2019

## TEACHING EXPERIENCE

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<b>Graduate Teaching Assistant</b> <i>School of Mechanical Engineering</i>	January 2023 - May 2023 <i>Dr. Devahdhanush Swathibanu, Purdue University</i>
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- Mentored students in course projects as a Teaching Assistant, providing guidance on problem-solving, project development, and conceptual understanding
- Assisted the faculty member in planning laboratory syllabus, making exams and quizzes for 180 students

<b>Graduate Teaching Assistant</b> <i>Engineering Technology Industrial Distribution</i>	January 2020 - April 2021 <i>Dr. Michael Golla, Texas A&amp;M University</i>
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- Performed lab tutoring for MMET 301 - Mechanical Power Transmission and MMET 401 - Fluid Power Transmission.
- Assisted head faculty member in planning laboratory syllabus, making exams and quizzes for 180 students.

## MENTORING EXPERIENCE

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Mentoring a final year undergraduate student on the **Long Term Reliability Testing of Thermal Interface Material in Electronic Packages** to perform experiments and develop analytical models

Mentoring a junior year undergraduate student on the **Development of Thermal Testing Rig for Thermal Interface Material in Immersion Cooling Environment** to conceptualize, design and model the setup and perform preliminary calculations

## RESEARCH EXPERIENCE

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<b>Developing Standardized Accelerated Testing Setup for TIM Degradation</b> <i>Research Thesis</i>	August 2021 - Present <i>Dr. Amy Marconnet, Purdue University</i>
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- Developed a testing rig for inducing mechanical oscillation in thermal grease, enabling *in situ* thermal cycling and performance monitoring using optical and IR imaging
- Automated image processing in Python to analyze *in situ* IR images and Labview data for thermal resistance calculations
- Assessed the effect of squeezing rates (nearly 30  $\mu\text{m/s}$ ) on grease degradation, identifying significant displacement at higher rates. Currently expanding the test setup to test gap pads and gels.

<b>Impact of Warpages in Heater and Heat Sinks on Thermal Grease Degradation</b> <i>Research Thesis</i>	August 2021 - Present <i>Dr. Amy Marconnet, Purdue University</i>
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- Designed and fabricated a test setup to evaluate thermal grease performance on non-flat surfaces simulating warpages in a thermal cycling environment, with *in situ* optical imaging to track voids and degradation patterns
- Automated image capture and processing in Python to identify and estimate voids and crack in greases
- Assessed the impact of non-flat heat sinks on thermal grease degradation, proposing a design modification to minimize degradation; currently testing with non-flat heaters

<b><i>In situ</i> degradation of Thermal Interface Material and its Mitigation Strategies</b> <i>Research Thesis</i>	August 2021 - Present <i>Dr. Amy Marconnet, Purdue University</i>
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- Aimed towards building apparatus to observe degradation of thermal greases in power cycled environment and develop degradation mitigation strategies to mitigate pump-out
- Developed experimental apparatus to perform *in situ* IR and optical observations to observe pump-out behavior on a combination of factors like bondline thickness, cycle time and TIM type
- Identified significant contribution of bondline thickness and TIM type on the degradation

### **Heat Transfer Correlation Development for Impinging Jets**

*Masters' Thesis*

August 2019 - July 2021

*Dr. Lesley Wright, Texas A&M University*

- Developed industrial-friendly heat transfer correlations for novel leading edge in gas turbine blades, essential for estimation in design phase of product development.
- Carried out experiments over 6 parameters and 576 conditions to cover possible industrial operations.
- Deployed data-acquisition modules using Labview and using statistical methods to develop an extensive correlation.

### **Energy-Exergy Analysis of Texas A&M Central Utility Plant**

*Semester Project*

August 2019 - December 2020

*Dr. Dion Antao, Texas A&M University*

- Analyzed thermodynamic performance on CUP components with the aim to improve efficiency and effectiveness as per the Energy Action Plan 2020. Collaborated with the CUP Staff for quinquennial operating conditions and performance data for thermodynamic assessment of individual component.
- Summarized the calculation process with the conclusion of CUP being technically sound and possible optimization of gas turbine to be in the 50-80 % exergy efficiency range.

### **Improvement in film cooling and internal channels in Turbine Blades**

*Summer Research Intern*

May 2018 - July 2018

*Dr. Rajendra P. Vedula, IIT Bombay*

- Examined effect of blowing ratios on film cooling efficiency and attained associated temperature of internal cooling channels. Conducted experiments on plate configuration of 35° surface angle and 45° diffusion angle and incorporated experimental idiosyncrasies into thermal model on ANSYS Fluent, to get near-accurate results.
- Extracted heat transfer coefficients as input for internal cooling model in MATLAB and obtain temperatures of internal jets.

### **Improving filtration and strength in gravity induced filters**

*Undergraduate Thesis*

January 2018 - May 2019

*Dr. Anand K. Plappally, IIT Jodhpur*

- Worked on improving strength and filtration efficiency of the pressurized ceramic filtration system which are to be used among communities in Barnar village in Jodhpur.
- Carried out numerical simulation and experimentation to estimate the effect of flow rates on filtration efficiency with WHO indicators of potable water. Expanded the spectrum of filtration impurity for ceramic filter in regard to microbial impurity by 60% and E. Coliform bacteria by 84%.

### **Flow Analysis of asymmetric twin impinging jets on a flat plate**

*Semester Project*

Jan 2017 - Jan 2018

*Dr. Laltu Chandra, IIT Jodhpur*

- Worked on development of solar convective furnace for heat treatment of metals using heated air jets, configuration selected for achieving optimum heat transfer.
- Simulated preliminary flows in *OpenFOAM* using *SimpleFOAM* solver of impinging heated air jets in solar convective furnace.
- Designed and fabricated a small setup for experimentation of multiple impinging jets for various height and slot widths. This was used to experimentally verify simulations results using *PIV* and *LDV* techniques.

## **PROFESSIONAL EXPERIENCE**

### **Thermal Interface Materials Characterization in a System on Wafer Assembly**

*Dojo/Autopilot Thermal Intern*

September 2023 - May 2024

*Tesla*

- Performed inhouse thermal characterization of different TIMs on SOW at different powers as a screening test for reliability tests
- Carried out reliability testing of thermal grease by power cycling the system unit to check for TIM degradation

### **Thermal Management of Next Generation Chip**

*Dojo/Autopilot Thermal Intern*

September 2023 - May 2024

*Tesla*

- Carried out numerical analysis using thermal model network to obtain first-pass temperatures
- Developed simulation model in Icepak to estimate the thermal margin of the components in a complex arrangement

- Coordinated with the different stakeholders for feedback and presented a workable thermal management solution for the system

### **Leak Tests in Data Center Components**

September 2023 - May 2024

*Dojo/Autopilot Thermal Intern*

*Tesla*

- Developed qualification criterion for passing production-based IT rack components
- Carried out leak tests across IT racks to determine the number of repetitions needed for consistent leak data
- Formulated an instruction document for performing leak tests and the qualifying criterion with improved reliability of test

### **Design and Development of HVAC Hardware in Loop Setup**

June 2020 - August 2020

*Advanced Technology Intern*

*Lennox International*

- Created simulation capability by establishing an electrical design of hardware setup and *NI* data exchange between controller, virtual building and virtual roof-top unit (RTU). Integrating *EnergyPlus* for robust electronics system to take local weather and data center thermal systems details.
- Programmed *Python* interactive scripts for automating co-simulation in HIL systems design. Yielding pragmatic results for zone parameters and loads by testing yearlong runs for 15 cities and comparing with performance of actual RTU.
- Laying out connections between relay boards, level shifters, controller and *NI* components. Programmed *Python* interactive scripts to allow for co-simulation in the HIL. Yielding pragmatic results for zone parameters and loads by testing yearlong runs for 15 cities and comparing with the performance of actual RTU.

## **TECHNICAL SKILLS**

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### **Modelling & Analysis Programming**

COMSOL, ANSYS Fluent, SolidWorks, JMP  
Python, MATLAB, R, Latex, Labview

## **LEADERSHIP**

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**Social and Social Media Officer, Mechanical Engineering Graduate Students Association, Purdue University** - Organizing social events to promote gathering amongst graduate students and creating content to disseminate information amongst the community

**Director of Editorial, Indian Graduate Students Association, Texas A&M University** - Leading a team of 4 graduates for creating, managing and distributing creative content, catering to the students' community.

**Captain, Public Speaking Cell** - Initiated Model UN in IIT Jodhpur, nurturing debate, negotiation and diplomacy skills in student community.

## **PUBLICATIONS**

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**Impact of Impact of Non-Flat Heat Sink Surfaces on the Degradation of Thermal Greases**, Submitted to IEEE-ITherm 2025

***In situ* Optical Observations of Degradation of Thermal Greases with Thermal Cycling**, Proceedings of IEEE-ITherm 2023

**Heat Transfer and Pressure Loss Correlations for Leading Edge, Jet Impingement Using Racetrack-Shaped Jets With Filleted Edges**, Proceedings of ASME IGTI 2022 Conference

**Heat Transfer and Pressure Loss Correlations for Leading Edge, Jet Impingement Using Racetrack-Shaped Jets With Filleted Edges**, ASME. J. Heat Transfer, December 2023

**Parametric Study and Correlation of Racetrack Shaped Jets for Leading Edge Impingement**, ASME. J. Heat Transfer, October 2022