PRANAV MILIND KHANOLKAR

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Ph.D. graduate in Mechanical and Industrial Engineering with over 5 years of research experience applying artificial intelligence (AI), machine learning, and automation strategies to solve complex engineering problems. Proficient in Python, deep learning, data analysis, and product lifecycle management, with a strong background in developing scalable, data-driven solutions in practical applications.

EDUCATION

Doctor of Philosophy: Mechanical and Industrial Engineering | University of Toronto, Canada *December 2024*
Relevant courses**:** *CSC2515 – Introduction to Machine Learning, MIE1402 – Experimental Methods in Human Factors Research, APS1023- New Product Innovation, MIE1720 Creativity in Conceptual Design*

Master of Science: Industrial Engineering | The Pennsylvania State University, US *May 2020*
Relevant courses: *IE546 – Design Product Families, IE549 – Design Decision Making, IE402 – Advanced Engineering Economics, IE522 – Discrete Event Simulation, IE570 – Supply Chain Engineering, IE505 – Linear Programming*

Bachelor of Engineering: Mechanical Engineering | University of Mumbai, India *May 2017*
Relevant courses: *Applied Mathematics, Production Processes, Finite Element Analysis, CAD/CAM/CAE, Production Planning and Control, Industrial Engineering and Management, Machine Design, Design of Mechanical Systems*

RESEARCH EXPERIENCE

Graduate Researcher – Ready Lab, University of Toronto *September 2020 – December 2024*
Toronto, Ontario, Canada

- Collaborated with Canadian and UK industry partners to develop strategic roadmaps and best-practice guidelines enabling SMEs to implement digital threads and AI in composite product design processes—leveraging cloud data management and virtual machines—projected to save over £187,500 (or CAD 337,500) annually. (*PhD Dissertation, successfully defended*).
- Qualitatively and quantitatively analyzed 108 published AI-based methods—including generative AI (GenAI) models, large-language models (LLMs), Agentic AI models, and Machine Learning— that are specifically deployed in different stages of the engineering design process and demonstrated how these methods assist engineers. [*Link to publication*]
- Leveraged Natural Language Processing and web-scraping to extract and evaluate the limited prevalence of AI education in 2195 courses offered by 28 accredited 2023-2024 Canadian Mechanical Engineering programs. [*Link to publication*] [*Link to dataset*]
- Drafted and managed three project proposals totaling 375,250 CAD, submitted to NSERC, SSHRC, and MITACS, supporting industry-partnered research initiatives in product design, engineering education, and aerospace design systems.

Mitacs Accelerate Research Intern – University of Toronto & RPS Composites *September 2021 – August 2022*
Toronto, Ontario, Canada

- Drafted the grant for the project, 'A New Automated Approach for Engineering Design and Manufacturing Specification Generation' in collaboration with industry partner – RPS Composites (*awarded $45,000*).
- Conducted a comprehensive review of traditional composite design workflows and software limitations using sensitivity analysis (50+ variations) and engineer interviews to identify inefficiencies and recommend actionable improvements.
- Developed Python-based automation frameworks that generated manufacturing specifications, Bill of Materials, and CNC-compatible DXF files—replacing manual design tasks and improving design cycle speed by 10x. [*Link to publication*]
- Integrated automation solutions into the company's production workflow, contributing to an estimated CAD 10,500 annual savings per product, demonstrating strong ROI and scalable potential across product lines.

Graduate Researcher – THRED Lab, The Pennsylvania State University *June 2019 – May 2020*
State College, Pennsylvania, US

- Researched and implemented AI-based solutions to accelerate finite element analysis of material microstructures, focusing on image-based deep learning methods to enhance computational efficiency without sacrificing accuracy.
- Automated the generation of 6,000 diverse microstructure designs and structural simulations using Abaqus API scripting—creating a robust labeled dataset for training deep learning-based image colorization models.
- Developed and trained a CNN-based image colorization model in Python that predicted strain fields in aluminum microstructures with 96% accuracy, achieving results 20x faster than conventional FEA methods. [*Link to publication*] [*Link to dataset*]

SKILLS

Programming Languages: Python, R, MATLAB, HTML, SQL
AI: Machine Learning & Deep Learning (Sckit Learn, Keras, PyTorch, TensorFlow), Natural Language Processing (NLTK)
Application: AWS, SolidWorks, Onshape, AutoCAD, Autodesk Inventor, ANSYS Workbench, Abaqus, Power BI, Tableau, Minitab
Research Skills: Statistical Analysis, Literature Review, Qualitative Coding and Analysis, Case Study Analysis, Grant Writing

CERTIFICATIONS

- **AWS Fundamentals Specialization** (*Amazon Web Services–AWS, Cloud Computing, AWS Management Console)*

- **Generative AI Engineering and Fine-Tuning Transformers** (*Prompt Engineering, LLMs, Performance Tuning*)
- **IBM AI Engineering Professional Certificate** (*Tensorflow, PyTorch, Keras, Apache Spark, Deep Learning, Big Data*)
- **NLP - Natural Language Processing with Python** (*Spacy, LDA, Word2Vec, NLTK, NER, Topic Modelling, Sentiment Analysis*)
- **Python for Data Science and Machine Learning Bootcamp** (*Pandas, Seaborn, SciKit-Learn, NumPy, Matplotlib, Plotly*)
- **Lean Six Sigma Yellow Belt: Quantitative Tools for Quality and Productivity Professional Certificate** (*DMAIC, Critical-to-Quality, Failure Modes & Effects, Root Cause Analysis, Heijunka, Kanban, Jidoka, Poka Yoke, Quality Control*)
- **Sustainability Consulting** (*Product Lifecycle Management, Corporate Sustainability, Environmental Management Systems*)
- **Product Design and Analysis** – by CADD Centre Training Services Pvt. Ltd. (*SolidWorks and ANSYS*)

PUBLICATIONS

JOURNAL ARTICLES

- **Khanolkar, P. M.**, Gopsill, J., & Olechowski A. (2025). Decoding the Digital Thread Digitalization Approach for Product Design and Development: Benefits, Challenges and Extensions. Under review at the Artificial Intelligence for Engineering Design, Analysis and Manufacturing Journal
- **Khanolkar, P. M.**, Vrolijk, A., & Olechowski A. (2023). Mapping artificial intelligence-based methods to engineering design stages: a focused literature review. Artificial Intelligence for Engineering Design, Analysis and Manufacturing 37, e25, 1–18. **Link to paper**.
- **Khanolkar, P. M.**, McComb, C. C., & Basu, S. (2021). Predicting elastic strain fields in defective microstructures using image colorization algorithms. Computational Materials Science, 186, 110068. **Link to paper**
- Yelve, N. P., Rode, S., Das, P., & **Khanolkar, P. M.** (2019). Some new algorithms for locating a damage in thin plates using Lamb waves. Engineering Research Express, 1(1), 015027. **Link to paper**

PEER-REVIEWED CONFERENCE PROCEEDINGS

- **Khanolkar, P. M.**, Lu, J., Hurst, A., & Olechowski A. (2024). Assessing The Prevalence of Artificial Intelligence in Mechanical Engineering And Design Curricula. In International Design Engineering Technical Conferences and Computers and Information in Engineering Conference, American Society of Mechanical Engineers, 2024. **Link to paper.**
- **Khanolkar, P. M.**, Vrolijk, A., & Olechowski A. (2023). A Case Study of the Decision-Making Behind the Automation of a Composites-Based Design Process. Proceedings of the Design Society, 3, 49-58. **Link to paper**.
- **Khanolkar, P. M.**, Gad, M., Liao, J., Hurst, A., & Olechowski, A. (2021). A Pilot Study on The Prevalence of Artificial Intelligence in Canadian Engineering Design Curricula. Proceedings of the Canadian Engineering Education Association (CEEA). **Link to paper**.
- **Khanolkar, P. M.**, Abraham, A., McComb, C., & Basu, S. (2020). Using deep image colorization to predict microstructure-dependent strain fields. Procedia Manufacturing, 48, 992-999. **Link to paper**.
- Rode, S., Yelve, N., **Khanolkar, P. M.**, Thube, M., Thampy, A., & Thomas, C., (2017). Development of a Lamb Wave-Based Algorithm for Detecting a Damage in Thin Plate Structures. ISSS International Conference on Smart Materials, Structures, and Systems. **Link to paper**.

GRANT REPORT

- Olechowski, A., **Khanolkar, P. M.**, Lu, J., & Hurst, A. (2022). Towards a Modern Canadian Engineering Design Curriculum: Balancing Artificial Intelligence and Human Cognition. **Link to paper**

DATASETS

- Jia Sheng (Jerry) Lu, **Pranav Milind Khanolkar**, Ada Hurst, & Alison Olechowski. (2021). Keyword-Matching-for-Canadian-Mechanical-Engineering-Programs: Second Release (v1.0.1). Zenodo. **Link to paper.**
- **Khanolkar, P. M.**, Basu, S., & McComb, C. (2021). Image-based data on strain fields of microstructures with porosity defects. Data in Brief, 34, 106627. **Link to paper.**

PRESENTATIONS & INVITED TALKS

- **Panelist at DAIR to Innovate 2024** *October 2024*
  Bombardier Centre for Aerospace & Aviation, Centennial College – Downsview Campus, Toronto, Ontario, Canada
  Topic: Unlocking new potential with digital technologies and Product Lifecycle Management (PLM)
- **Conference Presenter at IDETC-CIE 2024** *August 2024*
  International Design Engineering Technical Conferences & Computers and Information in Engineering Conference, Washington, DC, US
  Topic: Assessing the Prevalence of Artificial Intelligence in Mechanical Engineering and Design Curricula
- **Poster Presenter at MIE Graduate Symposium** *June 2024*
  University of Toronto, Toronto, Ontario, Canada
  Topic: Digital Thread-Enabled Data Management Framework for Modelling and Simulation of Electric Vehicle Battery Thermal

Management Systems

- **Conference Presenter at ICED23** *August 2023*
  The 24th International Conference on Engineering Design, University of Bordeaux, France
  Topic: A Case Study of The Decision-Making Behind the Automation of a Composites-Based Design Process
- **Poster Presenter at MIE Graduate Symposium** *June 2023*
  University of Toronto, Toronto, Ontario, Canada
  Topic: Deep Co-design: Streamlining the Electro-Thermal Design Process for Future Automation
- **Guest Speaker at Engineering Education Research Roundtable 2022** *April 2022*
  University of Toronto - Institute for Studies in Transdisciplinary Engineering Education and Practice, Toronto, Ontario, Canada
  Topic: Navigating frameworks and methodologies for analyzing engineering curriculum
- **Conference Presenter at CEEA 2021** *June 2021*
  The Annual Conference of the Canadian Engineering Education Association, University of Prince Edward Island, PEI, Canada
  Topic: A Pilot Study on The Prevalence of Artificial Intelligence in Canadian Engineering Design Curricula
- **Presenter at THRED Group** *November 2019*
  The Pennsylvania State University, State College, Pennsylvania, US
  Topic: Using Deep Image Colorization to Predict Microstructure-Dependent Strain Fields
- **Conference Presenter at ISSS 2017** *July 2017*
  International Conference on Smart Materials, Structures and Systems, IISc Bangalore, India
  Topic: Development of a Lamb Wave-Based Algorithm for Detecting a Damage in Thin Plate Structures

PROJECTS

Comparative Analysis of Self-Supervised Learners *December 2021*
- Reviewed and documented five self-supervised learning algorithms (MoCo, SimCLR, BYOL, SwAV, Barlow Twins), performing comparative analysis to evaluate their strengths and limitations in image classification tasks.
- Conducted T-SNE-based qualitative analysis and quantitative transfer learning evaluation using the CIFAR-10 dataset to assess generalization and out-of-distribution performance of SSL models against supervised baselines.
- Developed an ensemble framework combining SSL and supervised learning methods, resulting in improved image classification accuracy over individual models, highlighting synergy across learning paradigms.

Statistical analyses of the BRFSS for Effective Monitoring of Weight-related Concerns *December 2020*
- Analyzed the Behavioral Risk Factor Surveillance System (BRFSS) dataset of 437,000+ respondents across 276 variables—including health, demographic, and behavioral data—to uncover patterns and inform predictive modeling efforts.
- Applied K-means clustering to detect correlations between state populations and Body Mass Index (BMI), revealing geographic trends in obesity and population health distribution.
- Developed logistic regression models in R to predict heart attack, cancer, and diabetes diagnoses using smoking, drinking, and BMI as predictors—demonstrating that the inclusion of BMI significantly improved model performance.

Design Improvement of Debris Subsystem for Tennant Floor Scrubbers – Designing Product Families *December 2019*
- Led a team of seven graduate researchers to assess product platform opportunities for Tennant floor scrubber models (T300, T500, T600), focusing on improving manufacturing efficiency through component commonality.
- Calculated Product Commonality Index (PCI) and Generational Variety Index (GVI) to identify platform-able components and tradeoffs between variety and commonality, enhancing product family efficiency and design coherence.
- Constructed a Design Structure Matrix (DSM) to evaluate component interface dependencies and risk propagation from design changes, culminating in a comprehensive report with platforming recommendations.

Non-Destructive Testing of Thin Plates using Ultrasonic Guided Waves (*Undergraduate Thesis*) *March 2017*
- Designed and implemented two MATLAB-based algorithms for rapid and accurate damage detection and localization in thin plate structures, for potential integration in aerospace systems, emphasizing early damage detection in composite structures to improve safety, inspection efficiency, and maintenance planning.
- Authored and presented the paper "Development of a Lamb Wave Based Algorithm for Detecting a Damage in Thin Plate Structures" at the ISSS International Conference, showcasing novel techniques for non-destructive testing. [*Link to publication*]

TEACHING & MENTORSHIP EXPERIENCE

Teaching Assistant – MIE258 Engineering Economics & Accounting – University of Toronto *Fall 2024, Fall 2023, Fall 2022*
Toronto, Ontario, Canada
- Taught the following topics: Cash Flow Analysis, Financial Comparison Methods, Financial Accounting, Replacement Decisions, Taxes, Inflation, Dealing with Risk and Uncertainty, Emission Policy, and Business Plans.
- Led weekly tutorials and Q&A sessions for approximately. 50 students on concepts of engineering economics and accounting.
- Supervised and graded midterm and final exams—providing detailed feedback on how students can improve their understanding of concepts of engineering economics and accounting.

Teaching Assistant – APS100 Orientation to Engineering – University of Toronto *Term: Fall 2024, Fall 2023*
Toronto, Ontario, Canada

- Facilitated active online learning activities and sessions for classes of 300-325 students to assist them in early engineering management skills, such as time management and engineering ethics.

Teaching Assistant – MIE221 Manufacturing Engineering – University of Toronto *Term: Winter 2024*
Toronto, Ontario, Canada

- Topics taught: Machining, Injection Molding, Powder Processing, Material Handling, Metal Casting
- Graded and provided detailed, constructive feedback on assignments and exams for over 200 students, ensuring fairness and consistency while improving students' understanding of key concepts and enhancing overall course performance.

Research Assistant, University of Toronto *September 2020 – December 2024*

- **Jerry Lu** – Previous undergraduate student in BASC in Mechatronics, Robotics, and Automation Engineering at the University of Waterloo. Mentored him towards developing web-scraping and natural language processing to collect and process course curricula for assessing the prevalence of AI in mechanical engineering programs. [*Link to publication*] [*Link to dataset*]
- **Mohammad Gad** – Previous undergraduate student in BASC Biomedical Engineering. Guided him in developing and applying natural language processing techniques for a study to assess AI prevalence in the 2021-2022 University of Toronto and University of Waterloo mechanical engineering course curricula. [*Link to publication*]
- **Jessica Liao** – Previous undergraduate student in BASC Architectural Engineering. Guided her in conducting and presenting an effective literature review and academic writing for research for the aforementioned research project. [*Link to publication*]

Section Editor, Engineering – The Canadian Science Fair Journal *July 2022 – June 2024*
Toronto, Ontario, Canada

- Monitored a team of five graduate students and researchers across different universities in Canada to review and publish research projects conducted by high-school students (aged 12-18 years).
- Reviewed and published research articles by mentoring young authors through the process of writing their first scientific paper.

Research Assistant, The Pennsylvania State University *September 2020 – December 2024*

- **Aaron Abraham** – Previous undergraduate student in B.S. Industrial Engineering at The Pennsylvania State University. Currently a Master's student in Industrial Engineering at the University of Southern California. Mentored him on the fundamentals of deep learning for my graduate research work. [*Link to publication*]

AWARDS

- University of Toronto MIE Teaching Assistant Award *2024-2025*
- University of Toronto MIE Conference Travel Grant *2023-2024*
- MITACS Accelerate Internship Award *2021-2022*

LANGUAGES

- English, Hindi, Marathi, German (Level A1, A2; Goethe Institute certified)