Soumya Ranjan Mishra

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SUMMARY

Ph.D. graduate in Mechanical and Industrial Engineering with interdisciplinary expertise in research and development, product design, and medical device innovation. Proven track record in leading end-to-end development of complex healthcare technologies, with specialization in systems engineering, computational modeling, and design maturity evaluation. Adept in applying data-driven approaches—including machine learning, simulation, and business intelligence tools—for design optimization and decision support. Seeking impactful opportunities in R&D, product development, medical device design, systems integration, or data analysis, where engineering rigor and cross-functional collaboration drive innovation from concept to deployment.

EDUCATION

University of Toronto, St. George. **Toronto, ON.**
PhD in Mechanical and Industrial Engineering 2021 - 2025
Cumulative GPA: 3.8/4.0

University of Toronto, St. George. **Toronto, ON.**
MASc in Mechanical and Industrial Engineering 2019 – 2021
Cumulative GPA: 3.8/4.0

IFHE- ICFAI TECH **Hyderabad, IN.**
Bachelor's in Mechanical Engineering 2015 – 2019
Cumulative GPA: 9.3/10

TECHNICAL SKILLS

Mechanical Design & Simulation: SolidWorks, ANSYS, COMSOL, CATIA V5, Autodesk Inventor.
Product Development & Prototyping: 3D Printing, Laser Cutting, CNC Machining.
Business Intelligence & Data Visualization: Power BI, Tableau, SQL, Microsoft Exce, JIRA.
Statistical Modeling & Machine Learning: Python (Pandas, NumPy, SciKit Learn), MATLAB.
Process Optimization & Strategy: Lean Six Sigma, BPMN, Agile Methodologies.
Regulatory & Compliance Frameworks: ISO 13485, ISO 14971, IEC 62366, ISO 80601-1-84, IEC 60601-1.

WORK EXPERIENCE

Data Science & Systems Analyst (PhD Research Assistant) **05/2021 – 04/2025**
University of Toronto, St. George. Toronto, ON.

- **Conceived a cardinal-scale Design Readiness Level (DRL) framework** to assess design maturity across components, subsystems, and systems, integrating usability, manufacturability, and regulatory metrics—validated with >90% expert consensus consistency.
- **Designed, prototyped and validated respiratory sensor through simulation and experimental studies**, capable of detecting apnea and deep breathing with ±0.35 V signal fidelity while shortening simulation time by 60%.
- **Deployed Power BI dashboards** that highlighted performance trade-offs in design spaces using surrogate models; presented findings to fix the three biggest causes of sensor performance degradation.
- **Built an interactive design evaluation dashboard** using Power BI and Python, enabling real-time readiness tracking and data-driven decision-making across 12+ subsystem parameters.

Clinical Research Data Analyst (PhD Research Assistant) **05/2023 – 04 /2025**
Hospital for Sick Children (SickKids) Toronto, ON.

- **Designed a machine learning-integrated 0D Fontan physiological model** that simulated patient-specific hemodynamic responses across activity levels, achieving real-time predictions of respiratory support needs and guiding system optimization.
- **Implemented a closed-loop machine learning algorithm** that classified user activity and autonomously adjusted ventilator parameters, resulting in high responsiveness (<50 ms latency) and reducing manual intervention by 25%.
- **Designed and prototyped a portable Non-Invasive External Ventilator (NIEV)** with biphasic negative-pressure delivery, incorporating lightweight materials (<2.5 kg), smart/manual control modes, and validated through structural, functional, and controller performance test.

Decision Support Analyst – Emergency Ventilator Evaluation (MASc Research Assistant)   **05/2023 – 04 /2025**
University of Toronto, St. George & Toronto General Hospital   Toronto, ON.

- Enabled rapid decision-making in ventilator procurement by building an Excel-based scoring framework using **forecasting and quality assurance metrics for 20+ devices.**
- Identified key process inefficiencies by utilizing PowerBI to analyze usability, regulatory, and readiness data during ventilator market analysis.
- **Raised global awareness** of quality assurance by applying end-to-end evaluation principles and publishing MASc research in **HardwareX by Special Invitation.**
- **Achieved promotion to MASc program for outstanding research** by excelling in forecasting, data analysis, and healthcare technology evaluation.

Business Development Partner   **05/2019 – 08/2019**
Infuse 3D (Start Up)   Hyderabad, IN.

- **Increased seed revenue by 40**% by leveraging PowerBI to analyze client requirements and support strategic decision-making for custom 3D-printed projects, ensuring solutions were tailored to client needs.
- **Enhanced project forecasting accuracy** and delivery timelines by implementing forecasting techniques to optimize resource allocation and track project milestones throughout the end-to-end design, prototyping, and testing of 3D-printed components.
- Improved product reliability and client satisfaction by **supervising onsite technicians and enforcing quality assurance standards** during the fabrication of fully customized products, including CNC, Milling, Welding, and Powder Coating processes.
- **Streamlined business operations and reduced production errors** by developing and documenting standard operating procedures to ensure consistent quality and efficient end-to-end project execution in a fast-paced start-up environment.

LEADERSHIP EXPERIENCE

Teaching Assistant   **05/2021 – 04/2025**
University of Toronto, St. George.   Toronto, ON.

- **Guided 20 student teams through iterative design processes**, incorporating lean startup principles; teams identified novel solutions that addressed the three biggest pain points for users in the systems engineering for new product development course.
- Facilitated new product innovation framework labs, **guiding 100+ students through hands-on exercises**, and resulting in identifying 12 novel product concepts ready for prototyping.

Lab Manager   **05/2021 – 05/2023**
Advanced Research Laboratory for Multifunctional Lightweight Structures (ARL-MLS)   Toronto, ON.

- Supervised the decommissioning of 50+ pieces of outdated lab equipment, **reclaiming 200 sq ft of usable lab space** and decreasing monthly utility costs by 8%, improving overall lab efficiency and sustainability.
- Introduced standardized onboarding documentation, including a lab manual and safety guidelines; **reduced onboarding time by 3 days**, freeing up senior researchers to focus on core project deliverables.
- Orchestrated content strategy and design for research websites, leading to streamlined stakeholder communication and increased site traffic.
- Managed day-to-day lab operations and safety protocols, ensuring compliance with workplace safety standards and efficient task execution.

INTERNSHIPS

Rapid Prototyping Engineer   **12/2018 –05/2019**
Maker Global 3D   Hyderabad, IN.

- Applied reverse engineering to develop cost-effective product models, optimizing material usage and manufacturing feasibility.
- Pioneered additive manufacturing techniques using 3D printing to create lightweight, high-strength prototypes, **decreasing material waste by 15% and accelerating product development cycles by 20%.**
- **Achieved a 42% reduction in manufacturing costs** by redesigning and optimizing the UVGI sterilizer, improving efficiency and scalability.

Mechanical Engineer in Training   **05/2017 –07/2017**
Central Institute for Tool Design   Hyderabad, IN.

- Gained hands-on experience in product design, safety compliance, and precision manufacturing, contributing to high-precision tooling solutions.
- Developed technical documentation and standard operating procedures (SOPs) for machining processes, ensuring consistency in manufacturing practices.

PUBLICATIONS

1. **Mishra, S. R.**, & Behdinan, K. (2024). "Design of Biocompatible Piezoelectric Thin-Film Respiratory Sensor for Health Monitoring". Proceedings of the Canadian Society for Mechanical Engineering International Congress, 31st Annual Conference of the Computational Fluid Dynamics Society of Canada (CSME/CFD2024), May 26–29, Toronto, Ontario, Canada.

2. **Mishra, S. R.**, & Behdinan, K. (2024). "Computational Method for Analyzing Performance of Thin Film PZT Based Wearable Sensors". Proceedings of the Canadian Society for Mechanical Engineering International Congress, 31st Annual Conference of the Computational Fluid Dynamics Society of Canada (CSME/CFD2024), May 26–29, Toronto, Ontario, Canada.

3. **Mishra, Soumya Ranjan**, and Kamran Behdinan. "Multidisciplinary Design Analysis and Optimization Framework for Regulatory Driven Medical Device Development." Proceedings of the Design Society 3 (2023): 2735-2744.

4. **Mishra, S. R.**, Hassani Fard, S., Sheikh, T., & Behdinan, K. (2022, June). "Electromechanical performance of biocompatible piezoelectric thin-films." In Actuators (Vol. 11, No. 6, p. 171). MDPI.

5. **Mishra, Soumya Ranjan**, and Kamran Behdinan. "Cardinal Maturity Determination of Technology Development: Medical Device Development Case Study." *Proceedings of the Design Society* 2 (2022): 1313-1322.

6. Behdinan, Kamran, and **Soumya Ranjan Mishra**. "Cardinal WTRL: Technology Maturity, Schedule Slippage And Trend Forecasting." *Proceedings of the Design Society* 1 (2021): 601-610.

7. Chandrashekhar, A., et al. "Static Structural Analysis of Hybrid Honeycomb Structures Using FEA." *Recent Trends in Mechanical Engineering: Select Proceedings of ICIME 2020*. Springer Singapore, 2021.

CERTIFICATIONS & TRAINING

Foundations: Data, Data Everywhere - Google Data Analytics

Ask Questions to Make Data-Driven Decisions - Google Data Analytics

Preparing Data for Analysis with Excel - Microsoft

Data Science & Business Analytics – University of Toronto

Business Process Management & Lean Six Sigma – BKO Accreditation

Power BI for Business Intelligence (Foundational) – Microsoft

ACHIEVEMENTS

Grant Challenge Winner | CGCA - Energy Harvesters for Biomedical Applications (10/2021)

Spearheaded novel thin film energy harvester project, demonstrating leadership by guiding a team of 3 PhD Candidates and fostering a collaborative environment that resulted in winning a $5000 Research Grant.

Award Mentor | John Sender's Award

Mentored Capstone Teams won the Johns Sender's Award for Outstanding Impact in Medical Device Innovation (2022 - 25).

PROJECTS

1. **Loan Application Analysis (2025)**
   Led a data analytics initiative to improve decision-making in loan approvals by developing advanced Power BI dashboards and visualization pipelines, resulting in a 30% reduction in manual reporting time. Identified key risk factors and applicant profiles using multivariate analysis, directly informing strategic policy changes and improving applicant screening accuracy by 25%. Applied statistical forecasting techniques to enhance risk assessment models, increasing the reliability of loan outcome predictions by over 20%. Maintained end-to-end data integrity through rigorous quality checks and systematic handling of missing values, ensuring consistency across business reporting outputs

2. **Non-Invasive External Ventilator (NIEV) for Fontan Patients (2024)**
   This project involved the end-to-end design, simulation, and prototyping of a portable, non-invasive ventilator tailored to the unique hemodynamic needs of patients who have undergone the Fontan procedure—a palliative surgery for congenital heart disease resulting in single-ventricle circulation. The ventilator architecture featured a biphasic negative-pressure mode for pulmonary blood flow (PBF) enhancement, diaphragm pump integration, and Arduino-based smart/manual control logic. A 0D physiological model of Fontan circulation was developed and coupled with a supervised ML controller to predict ventilation settings based on user activity.

3. **Piezoelectric Respiratory Sensor – Data-Driven Design & Optimization (2023)**
   This project focused on the development of a biocompatible, piezoelectric-based wearable sensor capable of real-time detection of respiratory events such as apnea and deep breathing. The sensor utilized PVDF films and was designed to operate on the transverse vibration principle. COMSOL Multiphysics simulations were integrated with a surrogate model to optimize design parameters. The sensor achieved a signal fidelity of ±0.35 V and was validated through both finite element simulation and bench testing. The system met early-stage design control requirements and was benchmarked for manufacturability, usability, and integration using the DRL methodology.

4. **Energy Harvesters for Biomedical Applications (2022)**
   Led a multidisciplinary team to design thin-film piezoelectric energy harvesters for use in wearable biomedical sensors. The project involved multiphysics simulations of mechanical, electrical, and physiological interaction domains and optimization of film geometry and material characteristics. The project won the Connaught Global Challenge Award with a $5000 research grant. A validated simulation pipeline was created for assessing energy conversion efficiency and feasibility of integration in low-power biomedical devices. Results were published in *Actuators (MDPI)*.

5. **Emergency Use Ventilator Evaluation and Assessment (NSERC-funded) (2021)**
   Conducted during the COVID-19 pandemic, this project involved a comparative analysis of open-source emergency use ventilators against regulatory frameworks from Australia, Canada, the UK, and the US. The study synthesized clinical, technical, and regulatory parameters to develop a decision-support framework. Published in *HardwareX*, this framework offered a synthesized benchmark for emergency ventilator evaluation and informed rapid development guidelines. It helped identify critical gaps in usability, reliability, and compliance in low-cost open-source ventilators and shaped procurement strategies in emergency healthcare settings.

6. **Reverse Engineering of Open Source FDM 3D Printer (2019)**
   This project aimed to analyze and improve the design of an open-source Fused Deposition Modeling (FDM) 3D printer by applying reverse engineering principles. The goal was to enhance print reliability, material efficiency, and mechanical precision. The study involved deconstructing the original hardware, digitizing components using CAD tools, and systematically redesigning key modules such as the extrusion head, heated bed, and motion system for improved manufacturability and operational stability. The reverse-engineered model lowered the bill of materials cost by 15%, facilitating in-house production for academic and startup use.

7. **Prototype of Portable UVGI Sterilizer (2019)**
   Designed a portable Ultraviolet Germicidal Irradiation (UVGI) device for sterilizing baby products and personal items. The system utilized additive manufacturing for component prototyping and integrated a modular UV light source for flexible use. The assembly was redesigned to reduce mating parts, saving approximately one-third of the original manufacturing budget. The project enhanced sterilization accessibility during field conditions and informed subsequent product commercialization strategies.

8. **Solar Powered Metro Station – Feasibility Study for Urban Transit Electrification (2018)**
   This undergraduate capstone project evaluated the feasibility of implementing solar-powered metro stations across the Delhi Metro Rail Network. The study assessed key scientific and engineering parameters including regional solar insolation, energy consumption patterns of transit infrastructure, photovoltaic (PV) panel efficiency, battery storage requirements, and grid integration strategies. Environmental and economic factors such as carbon offset potential and return on investment were also analyzed. The project demonstrated that, under optimal orientation and irradiance conditions, up to 35% of a typical station's energy demand could be met through rooftop solar installations.

EXTRACURRICULARS & VOLUNTEERING

1. **Founder & President – Undergraduate Music Club (IFHE Hyderabad)**
   Established the university's first undergraduate-led music collective. Organized and performed at university events, national festivals, and regional competitions. Coordinated cross-department collaborations and grew club membership from 4 to 35 students.

2. **Lead Performer – Airtel Hyderabad Marathon (2018)**
   Performed with Rewind India at the HITEX Center Stage, representing the university as the first undergraduate band invited to a public health and wellness initiative.

3. **Organizer – Road Safety Awareness Campaign (2018)**
   Collaborated with the Hyderabad Traffic Police to organize a student-led public safety drive near Cyber Towers. Managed event logistics, student participation, and on-ground messaging as part of the civic engagement initiative.

4. **Event Marshal – Triathlon Event (2017-2018)**
   Supported timing, coordination, and route management for student-organized triathlons starting at the IFHE campus pool. Enhanced safety and continuity during the university's first multi-discipline endurance event.

5. **Volunteer Coordinator – IFHE National Conferences (2017)**
   Led logistics, speaker onboarding, and session planning for over 200 participants during national and international technical symposiums.