Harsharaj Birendrasingh Parmar

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Education

University of Toronto — Toronto, ON, CA
Doctor of Philosophy, Mechanical and Industrial Engineering — *09/2021 - 01/2026*
Cumulative GPA: 4.0/4.0

Purdue University — West Lafayette, IN, US
Master of Science, Mechanical Engineering — *08/2019 - 05/2021*
Cumulative GPA: 3.89/4.0

Indian Institute of Technology Guwahati — Guwahati, India
Bachelor of Technology, Mechanical Engineering — *07/2015 - 05/2019*
Cumulative GPA: 8.89/10 — Major GPA: 9.49/10

Research Interests

In-Situ/Operando Electrochemical and X-ray Characterizations, Transport Phenomena in Energy Systems

Research Experience

Research Assistant, Bazylak Group, University of Toronto — *09/2021 - 01/2026*
Advisor: Dr. Aimy Bazylak, Dept. of Mechanical and Industrial Engineering
Ph.D. Thesis: Multiscale water management in proton exchange membrane fuel cells

- Investigating the *in-situ* and *operando* behaviour of catalyst coated membranes in proton exchange membrane fuel cells using nanoscale synchrotron X-ray imaging.
- Developing nature derived basswood gas diffusion layers for exceptional mass transport selectivity in proton exchange membrane fuel cells.

Graduate Researcher, Warsinger Water Lab, Purdue University — *08/2019 - 07/2021*
Advisor: Dr. David Warsinger, Dept. of Mechanical Engineering
M.S. Thesis: Nanomaterials for high efficiency membrane distillation

- Achieved a maximal 18% improvement in energy efficiency of membrane distillation after using a novel nanofluid working medium. Experimentally determined the optimal nanofluid concentration and preparation conditions.
- Modelled novel condensation regimes in SLIPS enabled air gap membrane distillation systems operating at a maximum first law efficiency of 95%.
- Investigated porous copper condensers to double the energy efficiency of membrane distillation and to mitigate gap flooding issues.

Computation of Heat and Fluid Flow using Domain Decomposition — *07/2018 - 05/2019*
Advisor: Dr. G. Madhusudhana, Mechanical Engineering, IIT Guwahati — *Bachelor's Thesis*

- Formulated high accuracy Chebyshev spectral codes for fluid flow and heat transfer problems. Maximum deviation of 0.05% from benchmark results for a lid-driven square cavity problem.
- Implemented domain decomposition on heat conduction and channel flow problems with a maximum computational speed-up of 2.83 for four subdomains.

Undergraduate Researcher, MEMS Lab, Hanyang University — *05/2017 - 07/2017*
Advisor: Dr. Yoomin Ahn, Dept. of Mechanical Engineering
Development of Membrane-less Microfluidic Microbial Fuel cells

- Performed microfluidic simulations in ANSYS Fluent to study the effect of varying flow conditions on the performance of a microfluidic microbial fuel cell. Achieved an improvement of 12.5 % in maximum power density and presented the work in IIT Guwahati's research conclave.

A list of curriculum courses and independent projects and can be found on my personal website: `harsharajp.github.io`

Skills

Software Packages and Languages: SolidWorks, Engineering Equation Solver, ANSYS Fluent, FreeFEM, ABAQUS CAE, Python, MATLAB/Octave, C++, Fortran

Imaging Techniques and Analysis: Scanning Electron Microscopy, Cryo-Transmission Electron Microscopy, Scanning Transmission X-ray Microscopy, X-ray Computed Tomography and Radiography, ImageJ, Dragonfly, HyperSpy, Etomo, aXis2000

Technical writing and Graphics: Latex, Tecplot, Adobe Illustrator, Origin

Academic Achievements

- Recipient of the Hatch Graduate Scholarship for Sustainable Energy Research from the Institute for Sustainable Energy at the University of Toronto. *03/2025, 03/2024, 03/2023*
- First place award in the MIE Graduate Research Symposium at the University of Toronto *07/2024*
- Received the Ron D. Venter Graduate Fellowship at the University of Toronto. *01/2024*
- Received the C. W. Bowman Graduate Scholarship in Energy Research from the Center for Global Engineering at the University of Toronto. *03/2023*
- Recipient of the Pierre Rivard Hydrogenics Graduate Fellowship at the University of Toronto. *12/2022*
- Recipient of the Connaught scholarship for doctoral students - one of the most prestigious graduate admissions awards at the University of Toronto. *09/2021*
- First place in the Hawkins Memorial Lecture: Best Poster Award at Purdue University. *04/2021*
- Quarterfinalists in the US Department of Energy's $9 million Solar Desalination Prize - NoAir team member. *10/2020*
- $1000 FIITJEE reward and a silver medal for securing an All India Rank of 2567 (top 1.7% in the country) in the Joint Entrance Exam (Advanced). *08/2015*

Publications and Book Chapter

1. **Parmar H. B.**, Seip T., Wang J., Hitchcock A. P., Bazylak A., Amorphous silica nanoparticles enhance proton conductivity in polymer electrolyte membrane fuel cells. *submitted to Advanced Energy Materials*, December 2025.
2. **Parmar, H. B.**, Chadwick, E. A., Shrestha P., Bazylak, A., Tailoring flow field channel aspect ratio for efficient multiphase flow in proton exchange membrane fuel cells. *submitted to Green Energy and Environment*, December 2025.
3. Chadwick, E. A., Shrestha P., **Parmar, H. B.**, Bazylak, A., Schulz, V. P.(2025). Biomimetic auxiliary channels enhance oxygen delivery and water removal in polymer electrolyte membrane fuel cells. *Applied Energy*, 389, 125760. (doi)
4. Yogi, Y. S., **Parmar, H. B.**, Fattahi Juybari, H., Nejati, S., Rao, A. K., Roy, R., ... & Warsinger, D. M. (2025). Slippery liquid infused porous surface (SLIPS) condensers for high efficiency air gap membrane distillation. *Communications Engineering*, 4(1), 48. (doi)
5. Fattahijuybari H., **Parmar H. B.**, Rezaei M., Nejati S., Camacho L., Warsinger D. M. (2024). Unifying efficiency metrics for solar evaporation and thermal desalination, *ACS Energy Letters*, 9, 10, 4959–4975. (doi)
6. Fattahi Juybari H., **Parmar H. B.**, Alshubbar A., Young K. L., Warsinger D. M. (2023). Porous condensers can double efficiency of membrane distillation. *Desalination*, 545, 116129. (doi).
7. **Parmar, H. B.**, Juybari, H. F., Yogi, Y., Nejati, S., Jacob, R., Menon, P., Warsinger, D. M. (2021). Nanofluids improve energy efficiency of membrane distillation. *Nano Energy*, 106235. (doi)

Patent and Book Chapter

1. Fattahijuybari H., Nejati S., Rezaei M., **Parmar H. B.**, Alsaati A. A., Swaminathan J., Camacho L., Warsinger D. M. (2023). Performance of Membrane Distillation Technologies. In *The World Scientific Reference of Water Science: Volume 3 Current Status and New Technologies in Water Desalination* (pp. 223-266)(doi).
2. Warsinger D. M., **Parmar H. B.**, Das A., Fattahijuybari H., Thermal Vapor Compression Membrane Distillation Hybrid using Vapor Selective Membrane, *U.S. Full Patent*, Application number: 17533868, 05/2022.

Presentations

1. **Parmar, H.B.**, Seip, T., Wang, J., Hitchcock, A.P., Bazylak, A., Nanoscale in-situ effects of humidity on proton exchange membrane fuel cell catalyst layers using scanning transmission X-ray microscopy. ECS Prime Meeting 2024, CSME Conference 2024.
2. **Parmar H. B.**, Chadwick E., Shrestha P., Bazylak A., Tailoring parallel channel flow fields for efficient mass transport and compression in proton exchange membrane fuel cells. 244th ECS meeting, 10/2023, 242nd ECS Meeting, 09/2022, ISPE-17, 09/2022.
3. **Parmar H. B.**, Fattahijuybari H., Yogi Y., Warsinger D. M., A novel flow based energy efficiency enhancement on membrane distillation. Borchardt Conference, 25th Triennial Symposium on Advancements in Water and Wastewater, 02/2020.
4. **Parmar H. B.**, Cho H., Lee C., Choi T., Kim M., Jung D., Ahn Y., Development of membrane-less microfluidic microbial fuel cells. Research Conclave, IIT Guwahati, 03/2018.

Personal Achievements

- Serving as a key leader of the spectromicroscopy team within the Bazylak group and mentoring 2 master students *03/2022 - Present*
- Laboratory teaching assistant at the University of Toronto for an undergraduate course - MIE 303: Thermal Energy Conversion. *2023 - 2025*
- Served as the laboratory teaching assistant at the University of Toronto for MIE 311 - Thermal Energy Conversion. *2022 - 2025*
- Served as the teaching assistant at Purdue University for a graduate level course: ME 500 - Advanced Thermodynamics. *01/2021 - 05/2021*
- Mentored a team of 7 undergraduate students and successfully guided 4 of them to serve as co-authors in journal articles. *01/2020 - 05/2021*
- Conducted an extensive (500+ households) energy consumption survey, and developed a low-cost vertical axis wind turbine for rural areas in Assam, India. *02/2018 - 04/2018*
- Instructed workshops on ANSYS Fluent, and delivered lectures on Vehicle Aerodynamics to a 100+ audience within IIT Guwahati. *01/2018 - 04/2018*
- Best Project Award in TechEvince 2018 - the annual research exhibition of IIT Guwahati, for making a formula student car as the aerodynamics head under the SAE collegiate club. *03/2018*
- Secured 2nd position among 12 teams in a competition for making an automated toilet cleaner, held under IIT Guwahati's technical festival - Kriti 2017. *11/2017*
- Secured 1st position among 10 teams in Shock-Zorber, a suspension making competition held under the IIT Guwahati's technical festival - Kriti 2016. *10/2016*
- Conducted a national level logic-based examination - Technothlon 2016, with 1000 registered students from 9th to 12th grade in Ahmedabad to give them an opportunity of a guided tour of the NASA Ames Research Center, US. *06/2016 - 07/2016*
- Honorary shield for securing 3rd rank in Anand district of Gujarat, India (150+ schools) in the state level secondary school examination (10th grade). *06/2013*