

Ilan M. L. Upfal

Department of Civil and Environmental Engineering, MIT

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Education

Massachusetts Institute of Technology

Ph.D. student, Civil and Environmental Engineering

September 2023 – Present

Specializing in advanced renewable energy systems, sustainable infrastructure, and computational modeling and optimization of wind farms.

Brown University

Sc.B. in Electrical Engineering, with Honors

Graduated December 2022

Completed an award-winning capstone project on the development of next-generation tidal turbines by testing custom built soft-material turbine designs using water flume experiments.

Publications

- **Ilan M. L. Upfal et al.** "Shape-morphing membranes augment the performance of oscillating foil energy harvesting turbines" *Physical Review Fluids* (2025) **Selected as an Editor's Suggestion article**

Research Experience

Research Assistant

Howland Lab, Civil and Environmental Engineering, MIT

August 2023 – Present

- Leading research on co-optimization of wind farm layout and collective turbine control to enhance energy production, reduce environmental impact, and lower capital costs.
- Developing custom wind farm design codes that integrate advanced control strategies, including yaw and induction control, at the design stage, improving efficiency and sustainability.
- Leveraging advanced fluid dynamics models to inform and optimize wind farm layouts and control strategies.
- Contributing to open-source research tools, advancing reproducibility and collaboration within the renewable energy research community.

SULI Research Intern

Building Technologies and Science Center, NREL

January – May 2023

- Led research on innovative smart control solutions to enable residential electrification while avoiding costly electrical panel upgrades, facilitating more accessible pathways to decarbonization.
- Developed a Python package for simulating and optimizing home energy controllers, as well as a tool for accurately sizing residential electrical panels based on housing database insights.
- Designed code-compliant, smart home energy management systems, leveraging advanced insights from the National Fire Protection Code to maximize safety, efficiency, and cost savings.

Undergraduate Research Assistant

Breuer Lab, Brown University

March 2021 – December 2022

- Designed and built a novel flexible material wing to investigate the effects of material flexibility and extensibility on energy extraction efficiency, contributing to advancements in next-generation tidal energy turbine design and optimization.
- Conducted extensive water tunnel experiments in a 5-meter facility, collecting and analyzing datasets on force dynamics, membrane deformation, fluid velocities, and power output.
- Performed laser measurements of the membrane to connect force and power data with membrane kinematics, providing new insights into energy harvesting mechanisms.
- Presented research findings at two conferences and authored a journal article in *Physical Review Fluids* on experimental methodologies and results.
- Recognized with the Halpin Prize for exceptional contributions to renewable energy research.

Honors and Awards

- **Best Poster Award**, MIT CEE Research Day Symposium February 2025
- **Editor's Suggestion**, *Physical Review Fluids* January 2025
- **MathWorks Fellowship**, MIT September 2024 – Present
- **Exemplary Mentoring Fellowship**, MIT September 2023 – Present
- **Robert E. Thurber and Louis Berger Fellowship**, MIT September 2023 – May 2024
- **Halpin Prize for Senior Capstone Projects**, Brown University May 2022
- **Sigma Xi Honors Society**, Brown University May 2022
- **Tau Beta Pi Engineering Honors Society**, Brown University December 2021

Conference Presentations

- **Ilan M. L. Upfal** and Michael F. Howland. "Co-optimization of wind farm layout with collective turbine control", *CEE Research Day Symposium*, Cambridge, Massachusetts, February 24th, 2025.
- **Ilan M. L. Upfal** and Michael F. Howland. "Control co-design of wind farms using joint yaw-induction control", *American Physical Society: Division of Fluid Dynamics Meeting*, Salt Lake City, Utah, November 24th-26th, 2024.
- **Ilan M. L. Upfal** and Michael F. Howland. "Co-optimizing layout and joint yaw-thrust control to design cost-effective and profitable wind farms". *North American Wind Energy Association (NAWEA/WindTech) Conference*, Rutgers University, New Brunswick, New Jersey, October 28th-November 2nd 2024.
- **Ilan M. L. Upfal** and Michael F. Howland. "Improving wind farm profitability and space efficiency by co-designing turbine layout and control". *MIT CEE Research Symposium*, Cambridge, Massachusetts, February 26th 2024.
- **Ilan M. L. Upfal**, Yuanhang Zhu, Eric Handy-Cardenas, Joel Newbolt, and Kenneth Breuer. "Compliant membranes to augment oscillating foil energy harvesting". *American Physical*

Society: Division of Fluid Dynamics Meeting, Indianapolis, Indiana, November 20th-22nd, 2022.

- **Ilan M. L. Upfal**, Yuanhang Zhu, and Kenneth Breuer.”Optimal energy harvesting kinematics for compliant membrane hydrofoils”. *American Physical Society: Division of Fluid Dynamics Meeting*, Phoenix, Arizona, November 21st-23rd 2021.

Service

CEE Graduate Application Advisor

CEE Graduate Assistance Program, MIT

September – December 2024

- Volunteered to promote equity in graduate admissions, assisting with outreach efforts and mentoring prospective students from underrepresented backgrounds.
- Supported applicants by answering questions and offering guidance during admissions process to ensure fair access to application opportunities.