KRISTAN HILBY

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RESEARCH VISION

My research focuses on finding innovative ways to incorporate compliance into traditionally rigid systems to improve their performance envelope. By systematically integrating and utilizing compliance in the design of machines, I aim to create more adaptable and efficient systems that can perform a wide range of tasks with greater accuracy and precision. Through my research, I aim to develop a deeper understanding of the underlying principles of compliance and how they can be effectively harnessed to improve the functionality of machines across a range of industries and applications.

RESEARCH EXPERIENCE

Graduate Student Researcher *08/2019 - Current*
BioInstrumentation Laboratory
Massachusetts Institute of Technology Cambridge, MA

PhD Research: May 2021 – May 2024 (Anticipated)

- Launched open source stop-rotor aircraft platform using CAD to optimize aerodynamic performance, stability, and control.
- Designed morphing tapered wing capable of reversing leading and trailing edges and subsequently analyzed using CFD and FEA.
- Developed custom flight control system in PX4, incorporating sensor feedback and control algorithms to ensure stable flight across all flight regimes.

M.S. Research: August 2019 – May 2021

- Designed reconfigurable soft robot modules inspired by Yoshimura origami that elongate to 1715% and are driven by reversible electrolysis of water
- Conducted experimental tensile testing and analytical FEA tests to evaluate module's mechanical performance under different loading conditions, including maximum elongation, tensile strength, bending, and buckling.
- Evaluated energetic and compatibility performance of reversible electrolysis of water for untethered pneumatic actuation

Undergraduate Student Researcher *04/2017 – 06/2019*
Lipomi Research Group
University of California, San Diego La Jolla, CA

- Expanded upon methods for quantifying ductile fracture behavior of conjugated semiconducting polymer thin films
- Established effect of conjugation break spacers on poly(3-alkylthiophene) polymers

Summer Undergraduate Research Assistant (UROP) *06/2018 - 08/2018*
Collaborative Robotics and Intelligent Systems (CORiS) Group – Cindy Grimm
Oregon State University Corvallis, OR

- Instrumented door to provide data of robotic grasping including pressure distribution and interaction evolution, improving previous temporal resolution by 3X
- Developed visualization software to reconstruct robot to door interactions in Unity

TEACHING EXPERIENCE

Visiting Instructor *01/2023*
American University of Bahrain Riffa, Bahrain

- Instructed 25 university students on the fundamentals of robotics and prototyping, culminating in independently designed robotic manipulators to sort building blocks.
- Formulated curriculum aimed at enabling creativity in the students including rapid prototyping techniques, overview on artificial intelligence, and creative guidance.

Visiting Instructor *01/2023*
Riffa Views International School Riffa Views, Bahrain

- Instructed 20 high school student on introductory rapid prototyping techniques including CAD, 3D Printing, Laser Machining, and Arduino.
- Crafted hands on curriculum from scratch including design of a pulley system, gravity driven car, ball sorting machine, and arm for throwing balls.

Workshop Organizer *01/2023*
Yateem Center Bahrain Manama, Bahrain

- Instructed 20 students from the ages of 14 to 24 through a two-day free workshop
- Introduced students to computer aided design (CAD) and rapid prototyping methods

Course Aide *09/2022 – 12/2022*
Massachusetts Institute of Technology Cambridge, MA

- 6.9970 Academic Job Search

Teaching Assistant *02/2022 – 05/2022*
Massachusetts Institute of Technology Cambridge, MA

- 2.131 Advanced Instrumentation and Measurement

EDUCATION

Massachusetts Institute of Technology Cambridge, MA

- **Ph.D.**, Mechanical Engineering [GPA 5.0/5.0] *05/2021 – 05/2024*
- **M.S.**, Mechanical Engineering [GPA 4.9/5.0] *(Anticipated)*
  Thesis: Hydrogen Fuel Cell Driven Origami-Inspired Large Elongation Soft Robot Modules *08/2019 – 05/2021*

University of California, San Diego *06/2016 - 06/2019*

- **B.S**, NanoEngineering [GPA 3.96/4.00] La Jolla, CA
- Minor in Electrical Engineering *06/2016 – 06/2019*
- Graduated Summa Cum Laude

PUBLICATIONS

Conference Proceedings

- **K. Hilby**, P. Morice, M. Aling, and I. Hunter, "Evaluation and Comparison of Reversible Water Electrolysis as a Means for Pneumatic Actuation," IEEE International Conference on Soft Robots, 2023.
- **K. Hilby**, M. Hughes, and I. Hunter, "Design and Analysis of a Novel Reversible Morphing Airfoil Mechanism," IEEE International Aerospace Conference, 2022.

- **K. Hilby**, V. Padia, and I. Hunter, "Design and Analysis of Origami-Inspired, Large-Elongation, Reconfigurable Soft Robot Module," IEEE International Conference on Soft Robots, 2022.
- **K. Hilby**, J. Morrow, Y. H. Ong, R. Balasubramanian, and C. Grimm, "Instrumented door and drawer for comprehensive robot-object kinematic and force data," IROS Experimental Robotic Grasping and Manipulation Workshop, 2018

Journal Articles

- E. Melenbrink, **K. Hilby**, K. Choudhary, S. Samal, N.Kazerouni, J. L. McConn, D. Lipomi, and B. Thompson, "Influence of Acceptor Side-Chain Length and Conjugation-Break Spacer Content on the Mechanical and Electronic Properties of Semi-Random Polymers," ACS Applied Polymer Materials, vol. 1, pp. 1107–1117, 5 May 2019, ISSN: 2637-6105.
- E. Melenbrink, **K. Hilby**, M. Alkhadra, S. Samal, D.Lipomi, and B. Thompson, "Influence of Systematic Incorporation of Conjugation-Break Spacers into Semi-Random Polymers on Mechanical and Electronic Properties," ACS Applied Materials and Interfaces, vol. 10, 38 2018, ISSN: 19448252.
- M. Alkhadra, S. Root, **K. Hilby**, D. Rodriquez, F.Sugiyama, and D. Lipomi, "Quantifying the Fracture Behavior of Brittle and Ductile Thin Films of Semi-conducting Polymers," Chemistry of Materials, vol. 29, 23 2017, ISSN: 15205002.

AWARDS AND FELLOWSHIPS

- MIT 2022 Zakhartchenko Fellowship, awarded $100,000
- MIT 2021 Meredith Kamm Memorial Award for Excellence in a Woman Graduate Student
- UCSD 2019 Department Away for Outstanding Student in NanoEngineering

MENTORSHIP

Summary: 3 undergraduate students, 4 high school students

- Post Graduate of Bethel University, Matthew Carlson — *05/2023 – Present*
- High School Student, Max Hughes — *05/2022 – Present*
- High School Student, Jack McCarthy — *05/2023 – 08/2023*
- High School Student, Arthur Choo — *05/2023 – 08/2023*
- Undergraduate MIT, Liane Xu — *05/2022 – 08/2022*
- Undergraduate MIT, Ryan Xiao — *05/2022 – 08/2022*
- High School Student, Rushil Sharan — *05/2021 – 09/2021*

OUTREACH AND COMMUNITY INVOLVEMENT

- Executive Board, Mechanical Engineering Graduate Associate of Women (MEGAWomen) — *04/2022 – Present*
- Member, Graduate Student Advisory Group (GradSAGE) — *04/2022 – Present*
- Admitted Student Representative, BioInstrumentation Lab — *04/2020 – Present*
- Peer Tutor in Robotics and Dynamics Qualifying Exams — *09/2021 – 05/2022*
- Mentor, Polygence — *05/2021 – 09/2021*
- Member, Middle College Effect — *08/2014 – 06/2016*