Michael J. Bennington

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Education

Doctor of Philosophy – Mechanical Engineering Aug 2021 –
Carnegie Mellon University – Pittsburgh, PA
Advisor: Dr. Victoria Webster-Wood

Bachelor of Science – Bioengineering Aug 2017 – Jun 2021
University of California, San Diego – La Jolla, CA
Minor: Economics

Coursework of Interest:

Tissue Biomechanics	Linear and Nonlinear Dynamical Systems	Quantitative Neural Physiology
Mathematical Methods for Bioengineering	Finite Elements for Mechanics	Mechanics of Soft Materials
Soft Robotics Modeling	Robotic Kinematics	Bioinspired Mobile Robotics
Biomedical Microfluidics	Biophysics	Biomechanics and Motor Control

Awards and Fellowships

Fellowships:
Presidential Fellowship, Carnegie Mellon University, College of Engineering
G. Sundback Graduate Fellowship, Carnegie Mellon University, College of Engineering
Graduate Research Fellowship (GRFP), National Science Foundation

Awards:
Best Oral Presentation (co-author), Living Machines 2025
Best Student Presentation (Finalist) – Division of Comparative Biomechanics – Soc. of Integrative and Comparative Biology
Best Poster Award – Graduate Research Symposium, CMU Mechanical Engineering, March 2024
2nd Best Talk, Living Machines 2023
2nd Best Talk, Living Machines 2022
Magna Cum Laude, UC San Diego
Provost Honors, UC San Diego, 10 quarters

Research Experience

Graduate Research Assistant
Biohybrid and Organic Robotics Group – Carnegie Mellon University
Department of Mechanical Engineering Aug 2021 –

- Investigating the role of soft body interactions and musculostructural reconfiguration in the control of *Aplysia californica* feeding using combinations of *in vivo* behavioral experiments, muscle lesion studies, and computational neuromechanical models
- Developing modular neuromechanical models of *Aplysia californica* for the development of hypotheses related to adaptive feeding and for comparing different degrees of model complexity

- Developing generative biomechanical models of *Aplysia* feeding
- Designing and characterizing soft robotic actuators and systems for use as *in roboto* platforms to study neuromechanics of *Aplysia* feeding
- Investigating the jumping mechanics of the spotted lanternfly (*Lycorma delicatula*) using high-speed videography and 3D microscopy
- Characterization and modeling of soft polymeric materials for use in bioinspired robotic actuators and platforms

Undergraduate Research Assistant
Daniela Valdez-Jasso Lab – University of California, San Diego
Department of Bioengineering May 2019 – Aug 2021

- Performed biaxial mechanical testing on rat right ventricle myocardium and extracellular matrix to determine mechanical changes associated with pulmonary arterial hypertension
- Developed pseudoelastic constitutive models of the right ventricle myocardium and tools to assist in mechanical analysis
- Developed image analysis tools for studying microstructural properties of pulmonary vessels from multiphoton microscopy images

Publications and Presentations

Bold: self
Underlined: student mentored by MJB
* : co-first author

Journal Publications:

1. **Bennington, M. J.**, Rogers, S. M., Sutton, G. P., Chiel, H. J., Webster-Wood, V. A., The hinge muscle in the *Aplysia* buccal mass is dominated by rotational stiffness. ***In preparation***
2. Liao, A. S., **Bennington, M. J.**, Dai, K., Irez, A. B., Sun, A., Schaffer, S., Chopra, B., Seok, J. M., Adams, R., Zhang, Y. J., Webster-Wood, V. A., Impacts of sterilization and prolonged exposure to cell culture environments on material properties of 3D printable resins. ***Under revision.***
3. Liao, A. S., Dai, K., Irez, A. B., Sun, A., **Bennington, M. J.**, Schaffer, S., Chopra, B., Seok, J. M., Adams, R., Zhang, Y. J., Webster-Wood, V. A., (2025) Cytotoxic and Mechanical Properties of Resins 3D Printed with Low-Cost Hardware for C2C12 Biohybrid Actuators. *Scientific Data*, **12**, 1416, [doi]
4. Fernandez, C. J., **Bennington, M. J.**, Sukhnandan, R., Gill, J. P., Li, Y., McManus, J. M., Dai, K., Quinn, R. D., Chiel, H. J., Webster-Wood, V. A., Analysis Pipeline for Demand-driven Complexity Improvements of Models in Neurorobotics and Neuromechanics. ***Under Revision.***
5. Hardie, B. A., Huberts, J., **Bennington, M. J.**, Valdez-Jasso, D., Ovarian Hormones Attenuate Right Ventricular Remodeling in a Rat Model of Pulmonary Arterial Hypertension. *Biomech. Model. Mechanobio.* 25, 8 (2026). [doi]
6. **Bennington, M. J.**, Liao, A. S., Sukhnandan, R., Kundu, B., Rogers, S. M., Gill, J. P., McManus, J. M., Sutton, G. P., Chiel, H. J., Webster-Wood, V. A., (2025) Incorporating buccal mass planar mechanics and anatomical features improves neuromechanical modeling of *Aplysia* feeding behaviors. *Biological Cybernetics, **119**, 17*, [doi]

Peer-Reviewed Conference Publications:

1. Williamson, A. S.*, **Bennington, M. J.***, Sukhnandan, R.*, Nakhre, M., Mao, Y., Webster-Wood, V. A., PB&J: Peanut Butter and Joints for Damped Articulation, Living Machines, July 2025 [doi] (**Award: Best Oral Presentation**)
2. **Bennington, M. J.**, Webster-Wood, V. A., Towards Biophysical Network Simulation of Stochastically-Formed Neurospheres, Living Machines, July 2024 [doi]
3. Fernandez, C. J., McManus, J. M., Li, Y., **Bennington, M. J.**, Quinn, R. D., Chiel, H. J., Webster-Wood, V. A., Analysis Pipeline for High-Dimensional Neuromechanical Model Improvement, Living Machines, July 2024 [doi]

4. Sukhnandan, R., Li, Y., Wang, Y., Bhammar, A., Dai, K., **Bennington, M. J.**, Chiel, H. J., Quinn, R. D., Webster-Wood, V. A., Synthetic Nervous System Control of a Bioinspired Soft Grasper for Pick-and-Place Manipulation, Living Machines, July 2023 [doi]
5. Cockrell, T., Dai, K., **Bennington, M. J.**, Webster-Wood, V. A., Slug Battery: An enzymatic fuel cell tested in *Aplysia californica* hemolymph, Living Machines, July 2023 [doi] (**Award: 2nd Best Talk**)
6. **Bennington, M. J*.**, Wang, T*., Yin, J., Bergbreiter, S., Majidi, C., Webster-Wood, V. A., Design and Characterization of Viscoelastic McKibben Actuators with Tunable Force-Velocity Curves, RoboSoft, April 2023 [doi]
7. Dai, K.*, Sukhnandan, R.*, **Bennington, M. J.***, Whirley, K., Bao, R., Lu, L., Gill, J. P., Chiel, H. J., Webster-Wood, V. A., SLUGBOT, an *Aplysia*-inspired Robotic Grasper for Studying Control, Living Machines, July 2022 [doi] (**Award: 2nd Best Talk**)
8. Abdelrahman, Y.*, **Bennington, M. J.***, Huberts, J.*, Sebt, S.*, Talwar, N.*, Cauwenberghs, G., Sensory Substitution for Tactile Feedback in Upper Limb Prostheses, IEEE Engineering in Medicine and Biology Society (EMBC), October 2021 [doi]

Conference Abstracts / Posters:

1. **Bennington, M. J.**, Hu, Y., Tiwari, S., Chin, K, Sutton, G. P., Webster-Wood, V. A., Scaling Analysis of Spotted Lanternfly (*Lycorma delicatula*) Jumping Mechanics, Society of Integrative and Comparative Biology, 2026
2. **Bennington, M. J.**, Webster-Wood, V. A., A generative model of hinge biomechanics in *Aplysia californica* using Approximate Bayesian Computation, Society for Integrative and Comparative Biology, Jan 2025 (**Finalist for Best Student Presentation – Division of Comparative Biomechanics**)
3. Williamson, A. S., **Bennington, M. J.**, Schaffer, S., Gladson, K., Webster-Wood, V. A., Concept for a 3D-Printed Hydrogel Enclosure for Invertebrate Biohybrid Actuators Towards Deployment, Living Machines, July 2024
4. Zimmerer, N., Desatnik, R., **Bennington, M. J.**, Webster-Wood, V. A., Majidi, C., LeDuc, P. R., A biohybrid mechanosensory integrated with a soft robot, Biophysical Society, 2024
5. **Bennington, M. J.**, Liao, A. S., Sukhnandan, R., Kundu, B., Rogers, S. M., Gill, J. P., Sutton, G. P., Chiel, H. J., Webster-Wood, V. A., Neuromechanical Model of Feeding in *Aplysia californica*. Society for Neuroscience Annual Meeting, November 2023
6. **Bennington M. J.**, Sun S., Gill J. P., Chiel H. J., Webster-Wood V. A., Behavioral Investigation of the I5 Buccal Mass Muscle in *Aplysia californica* Feeding Behavior, Society for Neuroscience Annual Meeting, November 2022
7. **Bennington M. J.**, Dai K., Sukhnandan R., Whirley K., Bao R., Li L., Gill J. P., Chiel H. J., Webster-Wood V. A., SLUGBOT: A soft gripper with a bio-inspired neural controller, Society for Neuroscience Annual Meeting, November 2022
8. Dai, K., Sukhnandan, R., **Bennington, M. J.**, Whirley, K., Bao, R., Lu, L., Gill, J. P., Chiel, H. J., Webster-Wood, V. A., SLUGBOT: A soft robotic platform with bio-inspired control, BRAIN Initiative Meeting, June 2022
9. Odeigah O., Sundnes J., **Bennington M. J.**, Valdez-Jasso D., A computational model of right ventricular remodeling in the presence of pulmonary arterial hypertension, Biophysical Society, 2022
10. **Bennington, M. J.**, Valdez-Jasso, D., Biaxial Mechanical Properties of Right Ventricular Myocardium in Advanced Pulmonary Hypertension, Summer Biomechanics, Bioengineering, and Biotransport Conference, June 2021
11. **Bennington, M. J.**, Valdez-Jasso, D., Application of U-NET to Multiphoton Microscopy Scans of Pulmonary Arteries, Biomedical Engineering Society Annual Meeting, October 2020

Invited Presentations

Non-Axial Deformations Govern the Behavior of the Hinge Muscle in *Aplysia*
Mechanical Engineering PhD Research Symposium
Carnegie Mellon University
28 March 2025

Neuromechanical Modeling of the *A. californica* Feeding System
I-79 Neuromechanical Modeling Workshop
West Virginia University
4 April 2024

Mentorship and Outreach

Mentorship of Undergraduate Students:

Yutong (Lily) Hu — May 2025 – Aug 2025
Carnegie Mellon University, Electrical Engineering
Developed protocols for and performed high-speed videography experiments of spotted lanternfly (*Lycorma delicatula)* jumping. Captured wild spotted lanternflies for experimentation.

Sid Tiwari — May 2025 – Aug 2025
Carnegie Mellon University, Mechanical Engineering
Investigate techniques for 3D microscopy and photogrammetry of spotted lanternflies (*Lycorma delicatula*). Prototype imaging enclosure for 3D scanning.

Ema Cojerian — Mar 2025 – Dec 2025
Carnegie Mellon University, Mechanical Engineering
Developing stochastic computational models of neuron growth in 2D and 3D to produce physically realistic neurosphere geometries and connectomes.

Luca Melfin — Mar 2025 –
Carnegie Mellon University, Mechanical Engineering
Designing and prototyping a biomechanical testing platform to characterize the tissue mechanics of the buccal mass of *Aplysia californica*.

Steven Powell — Sep 2024 – Dec 2024
Carnegie Mellon University, Mechanical Engineering
Designed a mechatronic system for automated saltwater mixing and monitoring.

Andrew Hung — Mar 2024 – Jul 2024
Carnegie Mellon University, Mechanical Engineering
Designed of a mechanical testing device for the failure mode characterization of McKibben actuators. Designed a system to test multiple actuators in parallel and under different loading conditions relevant to biomimetic robots (Summer Undergraduate Research Fellowship).

Theo Cockrell — Apr 2023 – Jul 2023
Carnegie Mellon University, Electrical and Computer Engineering
Designed, fabricated, and characterized an enzymatic fuel cell (EFC) for implantation in *Aplysia* hemolymph. Integrated the EFC with a sensor payload for biohybrid sensor platforms.

Riti Krishna — Sep 2022 – May 2025
Carnegie Mellon University, Material Science/Biomedical Engineering
Designed and prototyped a soft sensor to measure the closing pressure of the *Aplysia* feeding structure during feeding. Designed and characterized anatomically-inspired thin McKibben actuator composite structures.

Karen Whirley — Jun 2022 – Jun 2023
Carnegie Mellon University, Mechanical Engineering/Biomedical Engineering
Designed biomimetic robot systems for studying *Aplysia* neuromechanics. Designed and prototyped an artificial muscle testing system for characterization of McKibben actuators (Summer Undergraduate Research Fellowship).

Summer Sun — Jan 2022 – Aug 2023
Carnegie Mellon University, Mechanical Engineering/Biomedical Engineering

Performed feeding experiments with *Aplysia*. Assisted in the development of a behavioral arena for *Aplysia* feeding experiments. Developed soft actuator architectures to replicate *Aplysia* muscular structures (Summer Undergraduate Research Fellowship).

STEM Education Outreach:

National Biomechanics Day Jan 2023 –

Carnegie Mellon University

Served as a Director and Registration Coordinator for National Biomechanics Day at CMU, an outreach project aimed at introducing middle and high school students to biomechanics through hands-on activities. Developed a hands-on workshop revolving around cardiopulmonary sensors in healthcare.

Developed lessons on cardiovascular monitoring and the scientific method for middle to high school students in the local Pittsburgh area. Brought these lessons to a summer program aimed at providing students from underrepresented minority groups with access to high-quality STEM education.

Gelfand Center Saturday Series Nov 2021 –

Carnegie Mellon University

Assisted in developing and implementing lessons about biohybrid and bioinspired robotics for middle school students.

External Outreach:

Bioengineering Experience May 2022

Biomedical Engineering Society – UC San Diego

Panel presentation to undergraduate engineering students about bioengineering and its application in different fields.

Graduate Student Panel Mar 2022

International Society for Pharmaceutical Engineering – UC San Diego

Panel presentation to undergraduate engineering students about experiences in engineering and the path from undergraduate programs to graduate school.

Teaching Experience

Guest Lectures

Experimentation and Statistical Analysis 10 March 2025

Course: 24-775 Robot Design and Experimentation
Instructor: Dr. Victoria Webster-Wood

Graduate Teaching Assistant

Mechatronics Applications in Mechanical Engineering Aug 2023 – Dec 2023
Department of Mechanical Engineering, Carnegie Mellon University
Faculty: Dr. Victoria Webster-Wood

- Provided hands-on mentorship to students on both mechatronic systems analysis and design through a flipped classroom.
- Created video lectures for circuit analysis, sensor system design, and Lagrangian mechanical system analysis.
- Developed assignment solution keys and grading rubrics
- Helped facilitate conflict resolution between teammates during the course project
- Held office hours to assist students with assignments and course projects

Numerical Methods Jan 2023 – May 2023
Department of Mechanical Engineering, Carnegie Mellon University
Faculty: Dr. Yongjie Jessica Zhang

- Led recitation lectures related to MATLAB coding and numerical methods

- Held office hours to assist students with coding assignments and understanding the mathematical background for numerical methods
- Developed assignment solution keys and grading rubrics

Leadership

National Biomechanics Day at CMU
Carnegie Mellon University
Session Leader — Dec 2023 –
Co-director — Nov 2022 –

Graduate Student Assembly
Carnegie Mellon University
Representative – Mechanical Engineering — Jun 2023 – Jul 2025

Mechanical Engineering Graduate Student Organization
Carnegie Mellon University
VP Finance — Jun 2023 – Jul 2025
Social Co-chair — Jun 2022 – Jul 2024

Biomedical Engineering Society
University of Californica, San Diego
Co-President — 2020-2021
Vice President (External Affairs) — 2019-2020
Project Team Co-Chair — 2018-2019

Grant Writing Experience

1. National Science Foundation Graduate Research Fellowship: *Investigation of the Neuromechanics of Buccal Muscle I5 in Aplysia Multifunctional Behaviors*, 2023, awarded
2. National Science Foundation Emerging Frontiers Research Initiative BEGIN OI, *Biocomputing with Scalable Biohybrid Neurosphere Chips*, PI: Victoria A. Webster-Wood, 2023, not funded
3. National Institutes of Health: *Developing a technology framework for personalized closed loop neuromechanical control*. PI: Hillel J. Chiel, 2025, submitted

Media Appearances

1. "Sea slug research advances soft robotics." *TechXplore*. [link]