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Engineering & Scientific Consulting


# James Lynch, Ph.D., P.E.

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## Professional Profile

Dr. Lynch is a mechanical engineer who specializes in robotic and electromechanical system design, analysis, and control. He has experience designing custom testbeds for mechatronic systems and with rapid prototyping, sensor integration, signal processing, and hardware-in-the-loop control design and evaluation. In addition, Dr. Lynch has significant experience leading cross-disciplinary projects including biomedical laboratory automation, dynamic testing of biological materials, and bio-inspired robotics.

Prior to joining Exponent, Dr. Lynch received his doctoral degree from the University of California San Diego, where he studied the dynamics and control of flapping flight in insects and bio-inspired flying robots. He developed a dynamically scaled flapping robot that mimicked the biomechanical properties of insect flight anatomy and used it to characterize the efficiency, controllability, and resistance to perturbations of biological and robotic flapping systems across a wide range of morphologies. He also invented a novel adaptive control scheme for flapping robots inspired by insect flight muscle dynamics, which was implemented on a centimeter-scale flapping wing. In recognition of this work, Dr. Lynch was awarded a University of California San Diego Graduate and Professional Student Association Interdisciplinary Research Award in 2022.

While at the University of California San Diego, Dr. Lynch was a teaching assistant for the undergraduate mechanical engineering senior design course for four years, teaching mechatronic system design, modeling, and optimization. He developed course materials to promote curiosity in undergraduate engineers through inquiry-based, hands-on lab activities and played an active role in transitioning the course to a hybrid teaching model during the COVID19 pandemic. Those efforts earned him the Department of Mechanical & Aerospace Engineering Teaching Assistant of the Year award in 2021.

## Academic Credentials & Professional Honors

Ph.D., Engineering Science, Mechanical Engineering, University of California, San Diego, 2023

M.S., Engineering Science, Mechanical Engineering, University of California, San Diego, 2019

B.S., Mechanical Engineering, University of Massachusetts, Amherst, 2015

## Licenses and Certifications

Professional Engineer Mechanical, California, #42303

## Academic Appointments

Instructor, Dept. of Mechanical & Aerospace Engineering, University of California San Diego, 2022

Graduate Teaching Assistant, Dept. of Mechanical & Aerospace Engineering, University of California San Diego 2017-2021

## Prior Experience

Graduate Research Assistant, University of California San Diego, 2018-2023

Teacher, C2 Education, 2016-2018

Mechanical Coordinator, Sagamore Plumbing & Heating, 2015-2016

## Professional Affiliations

Institute of Electrical and Electronics Engineers (IEEE)

Pi Tau Sigma International Mechanical Engineering Honor Society

## Publications

Gau J*, Lynch J*, Aiello B*, Wold E, Gravish N, Sponberg S. Bridging two insect flight modes in evolution, physiology and robophysics. 2023 Nature 622, 767–774.

Wold ES., Lynch J, Gravish N, Sponberg S. Structural damping renders the hawkmoth exoskeleton mechanically insensitive to non-sinusoidal deformations. 2023, Journal of the Royal Society Interface. 20:20230141.

Gao H, Lynch J, Gravish N. Soft Molds with Micro-Machined Internal Skeletons Improve Robustness of Flapping-Wing Robots. 2022, Micromachines, 13, 1489.

Lynch J, Gau J, Sponberg S, Gravish N. Autonomous Actuation of Flapping Wing Robots Inspired by Asynchronous Insect Muscle. 2022 International Conference on Robotics and Automation (ICRA), Philadelphia, PA, USA, 2022, pp. 2076-2083

Gau J, Wold ES., Lynch J, Gravish N, Sponberg S. The hawkmoth wingbeat is not at resonance. 2022, Biology Letters,18: 20220063.

Gau J, Gemilere R, (FM subteam) LDS-VIP, Lynch J, Gravish N, Sponberg S. Rapid frequency modulation in a resonant system: aerial perturbation recovery in hawkmoths. 2021 Proceedings of the Royal Society B. 288: 20210352.

Lynch J, Gau J, Sponberg S, Gravish N. Dimensional analysis of spring-wing systems reveals performance metrics for resonant flapping-wing flight. 2021, Journal of the Royal Society Interface. 18: 20200888.

**Presentations**

Lynch, J; Wold, ES; Mountcastle A; Sponberg S; Gravish N; (2023, Jan 6) Wing collision mitigation through stretch-activated muscle dynamics in flying insects. Society of Integrative and Comparative Biology Annual Meeting, Austin, TX

Lynch, J; Gau J.; Sponberg, S.; Gravish, N. (2022, Jan. 6). Revisiting Resonance in Insect Flight 3: A

robophysical system for asynchronous flight. Society of Integrative and Comparative Biology Annual Meeting, Phoenix, AZ

Lynch, J., Gau, J., Sponberg, S., Gravish, N., (2021, Jun. 22-25). Emergent wingstroke in asynchronous insects and robots is governed by time-delayed strain rate feedback. International Symposium on Adaptive Motion of Animals and Machines, Virtual

Lynch, J., Gau, J., Sponberg, S., Gravish, N., (2021, Mar. 15). Synchronous and asynchronous regimes of actuation in robophysical spring-wing systems. American Physical Society March Meeting, Virtual

Lynch, J., Gau, J., Sponberg, S., Gravish, N., (2021, Jan. 2). Dimensional analysis reveals limits on peak efficiency of flapping wing flight due to structural damping. Society of Integrative and Comparative Biology Annual Meeting 2021, Virtual

Lynch, J., Gau J., Sponberg, S., Gravish, N., (2020, Mar. 2–6). Springs and Wings: Robophysical investigation of unsteady flapping wing dynamics. American Physical Society March Meeting, Virtual

Lynch, J., Gau J., Sponberg, S., Gravish, N., (2020, Jan. 3-7). Resonance Properties of Insect-Inspired Series-Elastic Flapping Wings. Society of Integrative and Comparative Biology Annual Meeting, Austin, TX, USA

Lynch, J., Gau J., Sponberg, S., Gravish, N., (2019, Mar. 4-8) Robophysical investigation series-elastic flapping wings. American Physical Society March Meeting, Boston, MA, USA

 