

Thomas A. Berrueta

CONTACT	tberrueta@u.northwestern.edu tberrueta.github.io	
EDUCATION	Northwestern University, Evanston, IL Ph.D. Candidate in Mechanical Engineering	Harvey Mudd College, Claremont, CA B.S. Engineering, Graduated with Honors
HONORS	<ul style="list-style-type: none">• Microsoft Ada Lovelace Fellowship Finalist (top 20 of 600+ applicants) 2019• Walter P. Murphy Fellowship (Northwestern University) 2017-2018• Harvey S. Mudd Merit Scholarship (Harvey Mudd College) 2013-2017• Dean's List (Harvey Mudd College) 2013-2017	
RESEARCH	Center for Robotics and Biosystems <ul style="list-style-type: none">• I study complex physical systems and their emergent capabilities through the lens of robotics. I look to the physics of self-organization for designing control strategies in settings where most methods fail.• I develop algorithms that identify emergent simplicity and discrete structure arising from the interactions of robot swarms, many-body systems, and human-machine systems.• I derive techniques that simultaneously leverage modern machine learning, control theory, statistical physics, and information theory towards making complex systems controllable.	
PUBLICATIONS	<i>Journal Papers</i> <ul style="list-style-type: none">• P. Chvykov, T. A. Berrueta, A. Vardhan, W. Savoie, A. Samland, T. D. Murphey, K. Wiesenfeld, D. I. Goldman, J. L. England, "Low rattling: A predictive principle for self-organization in active collectives." <i>Science</i>, vol. 371, no. 6524, pp. 90-95 (2021).• J. F. Yang, A. T. Liu, T. A. Berrueta, G. Zhang, A. M. Brooks, V. B. Koman, S. Yang, X. Gong, T. D. Murphey, M. S. Strano, "Memristor circuits for colloidal robotics: Temporal access to memory, sensing, and actuation." <i>Advanced Intelligent Systems</i>, 2100205 (2021).• A. Taylor, T. A. Berrueta, T. D. Murphey, "Active learning in robotics: A review of control principles." <i>Mechatronics</i>, vol. 77, 102576, (2021).• W. Savoie, T. A. Berrueta, Z. Jackson, A. Pervan, R. Warkentin, S. Li, T. D. Murphey, K. Wiesenfeld, D. I. Goldman, "A robot made of robots: Emergent transport and control of a smarticle ensemble." <i>Science Robotics</i>, vol. 4, no. 34 (2019).• T. A. Berrueta, A. Pervan, K. Fitzsimons, T. D. Murphey, "Dynamical system segmentation for information measures in motion." <i>IEEE Robotics and Automation Letters</i>, 4 (1), 169-176 (2019). <i>Conference Papers</i> (* indicates equal authorship) <ul style="list-style-type: none">• A. Q. Nilles*, A. Pervan*, T. A. Berrueta*, T. D. Murphey, S. M. LaValle, "Information requirements of collision-based micromanipulation." <i>Proceedings of the Workshop on the Algorithmic Foundations of Robotics (WAFR)</i> (2020).• A. Kalinowska, T. A. Berrueta, T. D. Murphey, "Data-driven gait segmentation for walking assistance in a lower-limb assistive device." <i>IEEE International Conference on Robotics and Automation (ICRA)</i> (2019). <i>Book Chapters</i> <ul style="list-style-type: none">• T. A. Berrueta, I. Abraham, T. D. Murphey, "Experimental applications of the Koopman operator in active learning for control." <i>The Koopman Operator in Systems and Control</i>, Springer (2020). <i>Workshop Papers</i> <ul style="list-style-type: none">• A. Taylor, T. A. Berrueta, T. D. Murphey, "Optimizing the locomotion of a robotic active matter system of smarticles." <i>Bulletin of the American Physical Society</i>, (2021).• A. Q. Nilles, A. Pervan, T. A. Berrueta, T. D. Murphey, "Controlling active Brownian particles with "active billiard" particles." <i>Bulletin of the American Physical Society</i>, (2020).• T. A. Berrueta, A. Pervan, T. D. Murphey, "Towards robust motion planning for synthetic cells in a circulatory system." <i>Workshop on Robust Task and Motion Planning at Robotics: Science and Systems</i>, (2019).	
INVITED TALKS	<ul style="list-style-type: none">• T. A. Berrueta, "Online learning in physical systems." <i>SIAM Dynamical Systems</i>, Symposium on Leveraging Machine Learning for Dynamics and Control, May 26th, 2021, YouTube Video.• T. A. Berrueta, "Low Rattling: Predicting Driven Self-Organization." <i>Center for Robotics and Biosystems Seminar Series</i>, Northwestern University, Dec. 4th, 2020, YouTube Video.	

EXPERIENCE

Northwestern University

ME314: Theory of Machines - Dynamics

Co-teacher (2019), Grader (2018, 2021)

- Lectured large senior-level course (~70 students) on rigid body dynamics and Lagrangian mechanics.
- Redesigned class content and homeworks as it pivoted to an online-friendly format.

Harvey Mudd College

Kaia Corporation Capstone

2016-2017

- Designed a MEMS-based laser diode burn-in platform for the testing of optical transceivers.
- Implemented embedded temperature and current control for 30 microscopic laser diodes in parallel.

Amazon Lab126 Capstone

2016

- Designed hardware testbench for the Amazon Echo with the goal of automatically maneuvering the device around a room while avoiding obstacles.
- Programmed embedded microcontroller to drive a ceiling mounted cart along rails, as well as a linear actuator to vary the device height for flexible testing.

Northrop Grumman

IR and Visual Control Systems Intern: Survivability Group

2016

- Developed an IR signature estimator model in C++ for aircraft, and optimized aircraft trajectory to minimize IR exposure in real-time.

SpaceX

Vehicle Engineering Intern: Engine Dynamics Group

2014-2015

- Modelled and characterized flight environments experienced by M1D and MVacD rocket engines.

LEADERSHIP

Northwestern University

- Board member of the Northwestern Mechanical Engineering Graduate Student Society (2017-2019).
- Organizer of recruitment activities for incoming mechanical engineering graduate students (2018).
- Mentor to 8 Ph.D. and Masters students through the department mentorship program (2017-current).

Harvey Mudd College

- Member of the Harvey Mudd College Entrepreneurial Network (2017).
- Mentor in the Harvey Mudd College mentorship program (2016-2017).

SKILLS

Technical

- Professional experience in Python, C++, and MATLAB.
- Expertise in control theory and analysis of dynamical systems, as well as machine learning, information theory, statistical physics, and optimization.

Other

- Natively fluent in Spanish, English, and conversational in French.
- Have played jazz guitar/bass since 2008.
- I enjoy music composition and production.
- I love to run, and ran competitively in college.