J. Diego Caporale, Ph.D.

Roboticist, Controls/Software/Mechatronic Engineer
linkedin.com/in/j-diego-caporale diegocaporale.com

◇ Education

University of Pennsylvania **Aug. 2016 – May 2024**
Doctor of Philosophy (Ph.D.) in Mechanical Engineering and Applied Mechanics *Philadelphia, PA*

Thesis: "Do the Twist: Legged Control Strategies with Axial Twisting Toward Agile Self-Manipulation"
Advisors: Daniel E. Koditschek and Mark Yim

University of Pennsylvania **Aug. 2016 – Aug 2019**
Master of Science (M.S.) in Robotics *Philadelphia, PA*

California Institute of Technology **Sep. 2009 – June 2013**
Bachelor of Science (B.S.) in Mechanical Engineering *Pasadena, CA*

◇ Relevant Experience

University of Southern California **May. 2024 – Present**
Postdoctoral Research Fellow *Los Angeles, CA*

- Built terrain property and traversal risk maps integrating online, proprioceptive, geotechnical surface measurements through each step of a quadrupedal, legged robot allowing risk-aware planning for scientific exploration and operations as well as collaborative robot rescue on NASA-funded grants
- Collaborated with large multi-disciplinary teams of scientists building/planning experimental design, deployment, and field testing in hard-to-traverse environmental analogues: White Sands, NM and Mt Hood, Oregon
- Lab management tasks: grant and review writing, developing research questions, project organization, and task assignment for LASSIE($2.9M), LASSIE-M($1.4M), and TRUSSES($2M) grants
- Mentor >15 UG, MS, and Ph.D.'s in controls, state estimation, mechatronic design, analysis, and dynamical systems

University of Pennsylvania **Aug. 2016 – May 2024**
PhD Researcher *Philadelphia, PA*

- Brought several legged robots from design to deployment, e.g. Twist Quadruped and Delta Hopper V2
- Built and maintained the open source Kod*Lab Mjbots SDK, a C++ library, simplifying setup and enabling high speed control of agile robots. The SDK included control loop, robot description, state estimation, communication (LCM), rigid body kinematics and dynamics, control behaviors, simulation via mujoco, and hardware abstractions
- Designed controllers using composed, reduced-order dynamical models and the template-and-anchors framework for improved agility and analysis
- Investigated the use of flexible torsos in quadrupedal robotic locomotion in collaboration with biomechanists and a paleontologist, especially on isolated twisting in quadrupedal torsos.
- Created a trajectory optimization workflow for energetically optimizing tasks with the spined Twist Quadruped
- Mentored >15 Master's and Undergrad students in controls, robotic design, dynamic analysis, and coding best practices
- Received teaching certification through Penn's CTL office and experience as a TA and guest lecturer
- Supported outreach, working with artists, K-12 teachers, and young people

Iris Technology Corporation **September 2013 – July 2016**
Innovation Lead *Irvine, CA*

- Led rapid prototyping team investigating new products and burgeoning technologies, evaluating their possible integration
- Worked directly with C-suite proposing solutions, requesting funding, presenting results, and suggesting next steps

Project Engineer

- Lead Integration Engineer for multimillion dollar Forward Operating Base power system government-contracted projects
- Oversaw system, electrical, software, and mechanical engineers for hybridized 3kW and 10kW FOB power systems
- Wrote proposals for new business development and worked closely with customers before and after delivery

Mechanical Engineer

- Performed thermal, shock, and random vibration simulations in Solidworks for rugged-tactical and space-flight systems
- Mechanical design for manufacturing and ruggedization; created CAD models and detail drawings

◇ Technical Skills

Languages: C++ 20, Python 3, C, Mathematica, MATLAB
Technologies: CMake, Git, LaTeX, Linux, Docker, ROS 2, Doxygen, Drake, Solidworks, OnShape
Topics: Dynamical Systems, Reduced Order Models, Underactuated Control Systems, Hybrid Dynamical Systems, Trajectory Optimization, Model Predictive Control, Machine Learning, Robotic Software Design
Certifications: Solidworks Professional-Mechanical Design (C-SUK7BTV9CZ), UPenn CTL Teaching Certification

◇ Relevant Publications

[1] **J. D. Caporale**, Z. Feng, S. Rozen-Levy, A. M. Carter, and D. E. Koditschek, "Twisting Spine or Rigid Torso: Exploring Quadrupedal Morphology via Trajectory Optimization," in *2023 IEEE International Conference on Robotics and Automation (ICRA)*, May 2023, p. 8

[2] A. De, T. T. Topping, **J. D. Caporale**, and D. E. Koditschek, "Mode-Reactive Template-Based Control in Planar Legged Robots," *IEEE Access*, vol. 10, pp. 16 010–16 027, 2022, doi: 10.1109/ACCESS.2022.3148921

[3] V. Vasilopoulos, G. Pavlakos, S. L. Bowman, **J. D. Caporale**, K. Daniilidis, G. J. Pappas, and D. E. Koditschek, "Reactive Semantic Planning in Unexplored Semantic Environments Using Deep Perceptual Feedback," *IEEE Robotics and Automation Letters*, vol. 5, no. 3, pp. 4455–4462, Jul. 2020, doi: 10.1109/LRA.2020.3001496

[4] W. Chen, S. Misra, **J. D. Caporale**, D. E. Koditschek, S. Yang, and C. R. Sung, "A Tendon-Driven Origami Hopper Triggered by Proprioceptive Contact Detection," in *2020 3rd IEEE International Conference on Soft Robotics (RoboSoft)*, May 2020, pp. 373–380, doi: 10.1109/RoboSoft48309.2020.9116040

[5] **J. D. Caporale**, B. W. McInroe, C. Ning, T. Libby, R. J. Full, and D. E. Koditschek, "Coronal Plane Spine Twisting Composes Shape To Adjust the Energy Landscape for Grounded Reorientation," in *2020 IEEE International Conference on Robotics and Automation (ICRA)*, May 2020, pp. 8052–8058, doi: 10.1109/ICRA40945.2020.9197026

◇ Teaching Experience

Teaching Assistant

University of Pennsylvania — *Philadelphia, PA*

- MEAM 535 Advanced Dynamics, Spring 2018
- MEAM 510 Design of Mechatronic Systems, Fall 2018 (*MEAM Outstanding TA Award*)
- MEAM 510 Design of Mechatronic Systems, Fall 2017

California Institute of Technology — *Pasadena, CA*

- ME 72 Engineering Design Laboratory, Fall/Winter 2012-2013

Center of Teaching and Learning Teaching Certification — **2023**

University of Pennsylvania — *Philadelphia, PA*

Guest Lectures

USC EE 599 Robotic Mobility Fall 2024: Vertical hopper and Raibert's hopper — *Los Angeles, CA*

UPenn MEAM 535 Advanced Dynamics Spring 2018: Calculus of Variation and the Lagrangian — *Philadelphia, PA*

◇ Outreach, Talks, and Demos

LPSC Technical Robot Demo — **March 2024/March 2025**

LASSIE Project Demo, Robotic Legs as Sensors: Geotechnical Property Sampling on the Move — *Philadelphia, PA*

Artist Residency Program — **Summer 2022**

Robotics Mentor for artist Kathleen McDermott, Folding Robotic Techniques and Philosophies into her Art — *Philadelphia, PA*

Technical Consultant on Film: Lapsis — **2019 – 2020**

Robotics Consultant and Wrangler with Director Noah Hutton — *Upstate New York*

GRASP Research Experience with Teachers (RET) — **2017/2018**

Research Mentor for a Local Middle School Teacher — *Philadelphia, PA*

◇ Additional Experience

Ghost Robotics Corporation — **April 2019 – August 2019**

Mechanical Consultant — *Philadelphia, PA*

- Prototyped motor module with an integrated 6:1 gear reduction inside of a BLDC Motor for 12DoF quadruped

California Institute of Technology and Jet Propulsion Laboratory — **June 2012 – August 2012**

Undergraduate Research Fellow — *Pasadena, CA*

- Improved the mechanical design and ran computer vision systems tests for the Axel and DuAxel rover prototypes
- DuAxel docking cone with larger success region and roll flexibility; added yaw flexibility for improved turning radius

Associated Student Body of the California Institute of Technology (ASCIT) — **May 2011 – May 2013**

President (2012-2013) — *Pasadena, CA*

- Chair of the ASCIT Board of Directors, championing student values to faculty and admin and supporting student life

Director of Operations (2011-2012)

- Sat on the ASCIT Board of Directors managing ASCIT-run facilities and student life organization funding

◇ Awards/Competitions

Fall MEAM Outstanding Teaching Assistant Award — *UPenn 2018*

John K. Pierce Patriot Award, Keywords: Thorough, Empathetic, Driven, Patriotic, Conscientious — *Iris Technology 2015*

Frederic W. Hinrichs Jr. Memorial Award For Character, Leadership, and Responsibility — *Caltech 2013*

1st Place in Design of Mechatronics Systems (MEAM 510) Robockey Competition — *UPenn 2016*

1st Place in 27th Annual Mechanical Engineering (ME 72) Robotics Competition — *Caltech 2012*