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Vincent Pacelli, PhD

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Education

PhD in Mechanical and Aerospace Engineering, *Princeton University* — Fall 2017 — Spring 2023
MSE in Robotics, *University of Pennsylvania* — Fall 2016 — Summer 2017
BSE in Electrical Engineering, *University of Pennsylvania* — Fall 2012 — Spring 2016

Research and Teaching Experience

Postdoctoral Fellow, Autonomous Control and Decision Systems Laboratory — **2023 — Present**
Georgia Institute of Technology, Principle Investigator: Evangelos Theodorou — *Atlanta, GA*

- Derived a new **semi-supervised generative diffusion model** that supplements small amounts of labeled data using feedback control. Verified empirically that this model improves convergence and generalization for many generative modeling tasks.
- Developed a **generalization bound** quantifying the performance of **deep unfolded optimizers** (optimization methods with learned parameters). Certified using this bound that a new unfolded distributed quadratic program solver outperforms classical solvers.
- Co-authored a successful grant application proposing multiple methods to quantify and improve the capabilities of generative diffusion models using optimal control principles. **Awarded $700k in funding** from the **DARPA AI Quantified** program.

Graduate Research Assistant, Intelligent Robot Motion Laboratory, — **2017 — 2023**
Princeton University, Advisor: Anirudha Majumdar — *Princeton, NJ*

- Created a **mathematical model of task-relevant information for decision-making** identified to produce fast, robust strategies in humans. Proved using concepts from **information theory**, **statistical mechanics**, and **differential privacy** that this model captures the same benefits found in humans.
- Designed **optimal control** and **reinforcement learning** algorithms that use this model to synthesize task-relevant control policies. Verified empirically that robots endowed with these policies exhibit the benefits found in humans and predicted mathematically.
- Collaborated in deriving the **first fundamental performance limit** for robots on a given task using s.o.t.a. techniques in information theory and statistical physics. Demonstrated that this limit is reliably estimated for non-trivial robot tasks.

Course Instructor of Record — **2023 — Present**
Georgia Institute of Technology — *Atlanta, GA*

- Designed and taught a special topics course, **Robotics & Autonomy** (AE4803 ROB) for upper-level undergraduates.
- Created a new curriculum that introduces students to algorithms, methods, and challenges in modern robotics. Some course topics include: nonlinear optimal control, state estimation and mapping, computer vision, and reinforcement learning.

Graduate Teaching Assistant — **2019 — 2020**
Princeton University — *Princeton, NJ*

- Helped modernize the course, **Introduction to Robotics** (MAE345 / MAE549), by contributing to the curriculum design, making homework assignments, and providing class lectures when needed. Received the **Crocco Award for Teaching Excellence** for my performance as an assistant instructor.
- Built the hardware, software, and prototypes necessary for lab assignments, including a final project in which students program quadrotors to dynamically avoid obstacles using computer vision.

Skills

Theory and Modeling Optimization Methods, Reinforcement Learning / Control Theory, Generative AI, Statistical Physics
Software Python, C / C++, R, PyTorch, Embedded Systems, Jax, PyTorch, Pandas, SQL, Git

Selected Peer-Reviewed Publications (5 of 12)

Feedback Schrödinger Bridge Matching 2025
P. Theodoropoulos, N. Komianos, V. Pacelli, G-H. Liu, E. Theodorou. *Intl. Conf. on Learning Representations*.

Fundamental Performance Limits for Sensor-Based Robot Control and Policy Learning 2022
A. Majumdar and V. Pacelli. *Robotics: Systems and Science*.

Robust Control Under Uncertainty via Bounded Rationality and Differential Privacy 2022
V. Pacelli and A. Majumdar. *IEEE Intl. Conf. on Robotics and Automation*.

Learning Task-Driven Control Policies via Information Bottlenecks 2020
V. Pacelli, and A. Majumdar. *Robotics: Systems and Science*.

Task-Driven Estimation and Control via Information Bottlenecks 2019
V. Pacelli and A. Majumdar. *IEEE Intl. Conf. on Robotics and Automation*.