

Ana Pervan

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Education

Ph.D. in Mechanical Engineering

NORTHWESTERN UNIVERSITY

Evanston, IL

Sept. 2016 - Sept. 2021

- **Thesis:** Co-design of bodies and strategies
- **Advisor:** Todd D. Murphey

M.S. in Mechanical Engineering

NORTHWESTERN UNIVERSITY

Evanston, IL

Sept. 2016 - Sept. 2018

- **Thesis:** Low complexity control policy synthesis for embodied computation in micro-state machines
- **Advisor:** Todd D. Murphey

B.S. in Mechanical Engineering, Cum Laude

UNIVERSITY OF NOTRE DAME

Notre Dame, IN

Aug. 2012 - May 2016

Experience

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ROBOTICS ENGINEER

London, UK

Nov. 2021 - Nov. 2023

- **Localization and State Estimation.** Researched and designed algorithms and software as an early member of the Deep Robotics team. Focused on sensor fusion for simultaneous localization and mapping (SLAM) by leveraging multiple cameras, radar, GPS, and wheel odometry to enable self-driving cars to navigate complex and dynamic environments.
- **Camera Calibration Expertise.** Designed and implemented novel optimization algorithms for precise camera calibration, elevating visual odometry, computer vision, and neural network performance. This led to a significant boost in vehicle navigation accuracy and stability.
- **Robust Software Engineering.** Developed optimized, documented, and maintainable code in both **Python** and **C++**. Ensured the seamless execution of critical autonomous vehicle functionalities. Regularly deployed code to be driven daily on London roads.
- **Cross-functional Collaborations.** Collaborated closely with interdisciplinary teams, including model development, perception, NeRF, and hardware, to ensure holistic development and training of machine learning models. Proactively pursued connections and encouraged collaborative efforts between teams by identifying common research threads and fostering effective communication.
- **DEI Initiatives.** Founded an employee resource group called Women Who Code, which grew to over 25 actively participating members and included monthly meetings and outreach events. Organized and led a foundational Python course, upskilling colleagues with no prior coding experience. Facilitated events and initiatives as a member of the Diversity, Equity, and Inclusion (DEI) Committee.

Center for Robotics and Biosystems

PH.D. CANDIDATE, NORTHWESTERN UNIVERSITY

Evanston, IL

Sept. 2016 - Sept. 2021

- **Flexible Tools.** Created algorithms for simultaneous co-design of a flexible wire tool and an optimized control strategy for using the tool to attempt a given task. Physically experimented with a Baxter robot manipulating soft materials, including processing visual information, modelling shape deformation using deep neural networks, and planning control strategies with reinforcement learning.
- **Minimal Multi-Agent Cooperation.** Designed a multi-agent robotic system for applications on the micro-scale, limited in size and therefore computational capabilities. Proved minimal information requirements for exploration, programmed high-dimensional simulations in Python, and built custom robots for real-time experiments on autonomous navigation in a resource-constrained environment.
- **Algorithmic Design.** Developed novel algorithms in which physical designs for minimal robots were autonomously created from projecting optimized control policies onto physically feasible interconnections of sensors and actuators. Resulting designs reduced error in task performance by over 98% when compared to non-optimized designs.
- **Interdisciplinary Collaborations.** Collaborated with multiple universities and lead diverse teams to implement algorithms and evaluate theories across various experimental platforms of different scales, media, and abilities: from macroscopic robots with deterministic dynamics to microscopic devices operating under extreme uncertainty.

Active Learning in Robotics Course

CO-TEACHER, NORTHWESTERN UNIVERSITY

Evanston, IL

April 2019 - June 2019

- Lectured a graduate seminar class, responsibilities included writing and editing lecture notes and homework assignments, holding office hours, and assisting students with conceptual and coding questions
- Topics included optimal control, probability, filtering, entropy and information, and function approximation (e.g., Gaussian processes)

Publications

- **A. Pervan**, J. Weber, K. Baird, T. Berrueta, M. Elwin, A. Chaturverdi, A. W. Richa, T. D. Murphey, “Circulatory networks enable efficient distributed learning”, *In Review*, 2023.
- Liu A. T., M. Hempel, J. F. Yang, A. M. Brooks, **A. Pervan**, V. B. Koman, G. Zhang, D. Kozawa, S. Yang, D. I. Goldman, M. Miskin, A. W. Richa, D. Randall, T. D. Murphey, T. Palacios, and M. S. Strano, “Colloidal Robotics”, *Nature Materials*, 2023.
- **Pervan, A.**, and T. D. Murphey, “Algorithmic Design for Embodied Computation in Synthetic Cells”, *IEEE Transactions on Automation Science and Engineering (T-ASE)*, 2020.
- **Pervan, A.**, and T. D. Murphey, “Bayesian Particles on Cyclic Graphs”, *IEEE Int. Conf. on Intelligent Robots and Systems (IROS)*, 2020.
- **Pervan, A.**, A. Q. Nilles, T. Berrueta, T. D. Murphey, and S. M. LaValle, “Information Requirements of Collision-Based Micromanipulation”, *Workshop on the Algorithmic Foundations of Robotics (WAFR)*, June 2020.
- Nilles, A. Q., **A. Pervan**, T. Berrueta, and T. D. Murphey, “Corralling Active Brownian Particles With ‘Active Billiard’ Particles”, *Bulletin of the American Physical Society*, March 2020.
- Liu, A. T., J. F. Yang, L. N. LeMar, G. Zhang, **A. Pervan**, T. D. Murphey, M. Strano, “Autoperforation of Two-Dimensional Materials to Generate Colloidal State Machines Capable of Locomotion”, *Faraday Discussions*, Royal Society of Chemistry, 2020.
- Savoie, W., T. 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”, *Science Robotics*, vol. 4, issue 34, September 2019.
- Berrueta, T., **A. Pervan**, and T. D. Murphey, “Towards Robust Motion Planning for Synthetic Cells in a Circulatory System”, *Robotics Science and Systems (RSS) Workshop on Robust Task and Motion Planning*, June 2019.
- **Pervan, A.**, and T. D. Murphey, “Algorithmic materials: Embedding computation within material properties for autonomy”, *Robotic Systems and Autonomous Platforms*: Woodhead Publishing, pp. 197-221, 2019.
- Berrueta, T., **A. Pervan**, K. Fitzsimons, and T. D. Murphey, “Dynamical System Segmentation for Information Measures in Motion”, *IEEE Robotics and Automation Letters*, vol. 4, issue 1, pp. 169-176, January 2019.
- **Pervan, A.**, and T. D. Murphey, “Low Complexity Control Policy Synthesis for Embodied Computation in Synthetic Cells”, *Workshop on the Algorithmic Foundations of Robotics (WAFR)*, December 2018.

Students Advised

Bowen Feng

M.S. NORTHWESTERN UNIVERSITY, 2022

Advised: 2021

- Simulation and optimization of a robot manipulating a flexible tool

Karalyn Baird

M.S./B.S. NORTHWESTERN UNIVERSITY, 2021

Advised: 2019-2021

- Design and execution of experiments for multi-agent robot learning, communication, spatial coverage, and convergence

Scott Odland

B.S. NORTHWESTERN UNIVERSITY, 2021

Advised: 2020-2021

- Analysis of multi-agent robot experiments for learning and communication

Joshua Cohen

M.S. NORTHWESTERN UNIVERSITY, 2020

Advised: 2020

- Design and construction of novel robots for learning, communication, spatial coverage, and convergence

Alex Samland

M.S./B.S. NORTHWESTERN UNIVERSITY, 2020

Advised: 2018-2020

- Design and construction of swarm robots and experiments for emergent computation

Jenny Kim

B.S. NORTHWESTERN UNIVERSITY, 2020

Advised: 2019

- Visual tracking of microscopic robots and data analysis

Jusong Cai

M.S. NORTHWESTERN UNIVERSITY, 2018

Advised: 2019

- Neural networks for direction search in active learning for robots

Honors

- **National Science Foundation Graduate Research Fellowship** 2018
- **Murphy Fellowship** 2016
- **Boeing Scholar** 2015, 2016
- **Pi Tau Sigma** 2015, 2016
- **Notre Dame Engineering Honors Program** 2015, 2016