Ana Pervan

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Education

Ph.D. Candidate in Mechanical Engineering — Evanston, IL
Northwestern University — Sept. 2016 - Oct. 2021 (Expected)

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

M.S. in Mechanical Engineering — Evanston, IL
Northwestern University — Sept. 2016 - Sept. 2018

- **Thesis:** Low complexity control policy synthesis for embodied computation in micro-state machines

B.S. in Mechanical Engineering, Cum Laude — Notre Dame, IN
University of Notre Dame — Aug. 2012 - May 2016

Experience

Center for Robotics and Biosystems — Evanston, IL
Ph.D. Candidate, Northwestern University — Sept. 2016 - Sept. 2021 (Expected)

- Researcher in Dr. Todd Murphey's lab, partially funded by a National Science Foundation Graduate Research Fellowship awarded in 2018
- Implementing machine learning techniques for simultaneous co-design of a flexible tool and an effective control strategy – including physical prototyping, perceptual processing, analysis of large data sets, modelling using deep neural networks, and nonlinear optimization.
- Designing a multi-agent robotic system, including developing theoretical formulations and proofs, programming and analyzing high-dimensional simulations in Python, evaluating designs and building custom mechanical robots for real-time experiments on autonomous communication, exploration, and spatial coverage in a resource-constrained environment.
- Developing novel algorithms for autonomous robot design, in which physical designs for robotic systems are created from projecting optimized control policies onto physically feasible interconnections of sensors and actuators
- Collaborating with multiple universities and leading 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 — Evanston, IL
Co-teacher, Northwestern University — 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)

Locomotion and Biomechanics Laboratory — Notre Dame, IN
Research Assistant, University of Notre Dame — Jan. 2015 - May 2016

- Modelled humanoid walking on inclines and declines using novel algorithms and MATLAB code
- Results apply to the control of humanoid robots and to downhill treadmill training for patient rehabilitation from stroke and spinal-cord injuries

Baja SAE — Notre Dame, IN
Student Member, University of Notre Dame — Sept. 2014 - May 2016

- Designed and built an off-road vehicle to race in rough terrain against teams from other universities
- Collaborated with a small team to design the structure of the chassis and the dynamics of the suspension, and to understand potential weaknesses and failure modes of each. Modeled parts using SolidWorks and analysed them using Finite Element Analysis (FEA)

Accenture — Chicago, IL
Product Analyst Intern — June 2015 - Aug. 2015

- Supervised development of TouchCast, an app that allows users to create interactive videos
- Oversaw the product from pilot to production, when it was deployed to thousands of employees

Publications

- Liu A. T., M. Hempel, J. F. Yang, **A. Pervan**, V. B. Koman, G. Zhang, D. Kozawa, T. D. Murphey, T. Palacios, and M. S. Strano, "Colloidal Robots: Autonomous Particles with On-Board Computation", Submitted.
- **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, Expected 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

Other

Mentoring

- Meet weekly with a 3rd grade student through an organization called College Mentors for Kids, to introduce her to higher education, engage in community-based and educational activities, and encourage her to pursue her interests and goals

Volunteering

- Demonstrate robots and current research at the Museum of Science and Industry in Chicago during National Robotics Week each year, and interact with families and children of all ages to encourage their interest in science and robotics