Ethan Alexander Canzini

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MOTIVATION & INTERESTS

Throughout my academic career, I have been motivated by the design & control of novel dynamical systems in robotics. My interests lie in the application of physics-informed machine learning, nonlinear control & optimization, and dynamics modeling in fields such as the control of mobile autonomous robots, manipulation & assembly tasks and real-world applications of novel technologies. My research seeks to combine the flexibility of machine learning methods with a grounding in engineering, mathematics and physics to develop bio-inspired solutions to complex real-world problems in manufacturing, agriculture and aeronautics. This has led me to purse research and a future career in the novel robotics research by combining formal methods in physics and mathematics with engineering problem-solving in fields such as robotics, control theory and metamaterial system development in real-world applications in manufacturing, robotics and aerospace.

ACADEMIC BACKGROUND

PhD in Systems & Control 2021 - Present
University of Sheffield, Sheffield, UK

- Undertaking a PhD in the School of Mechanical, Aerospace & Civil Engineering, supervised by Prof. Ashutosh Tiwari and Dr. Simon Pope. Research is centered around learning-based methods for robotics.
- Thesis titled: *Learning-Based Methods for Decision-Making, Planning & Control* working in partnership with Airbus UK
- Specialisations include reinforcement learning, differential geometry for dynamics & control, optimal transport, physics-based modeling and optimal control

MEng Aerospace Engineering w/ Year In Industry 2016 - 2021
University of Sheffield, Sheffield, UK

- Graduated with 1st Class (4.0 GPA) degree in aerospace engineering
- Undertook studies in aerospace and robotics with an emphasis on control theory
- Undergraduate project: UAV design for hazardous search and rescue operations
- Graduate thesis: *Metrology-Assisted Assembly Process to Improve Landing Gear Installation Accuracy*

EMPLOYMENT HISTORY

Research Associate Oct 2024 - Present
University of Sheffield, Sheffield, UK

- Working as a research associate in systems & control on the EPSRC COATIN project
- Research focuses on closed-loop parameter optimization & control of data-driven dynamical systems
- Techniques include nonlinear dynamics, physics-informed machine learning, optimal control
- Supervising multiple undergraduate and graduate students in their dissertations
- Award **Fellow of the Higher Education Academy (FHEA)** in recognition of my teaching and supervision

Teaching Assistant Sept 2021 - Present
University of Sheffield, Sheffield, UK

- Working as a Graduate Teaching assistant (GTA) for a variety of modules within the faculty for undergraduate, graduate and postgraduate students
- Topics of the modules include embedded systems, optimal control, hardware-in-the-loop control, aerospace automation, control theory
- Co-lead of the RAMS Lab, leading the space systems and multi-agent themes and managing the robotic systems development.

Research Intern in Space Robotics Jul 2024 - Sept 2024
Growbotics, Didcot, UK

- Working as a research intern in the field of autonomous satellites & robotics for sustainable space exploration
- Work package included liasing with 3rd party companies with producing space-suitable hardware and control interfaces
- Developed low-cost sensor-based state estimators for full 6-DOF satellites using microcontrollers
- Used elements of optimal control and dynamics modelling for the develop of full state feedback analysis and control of satellites

Research Scientist in Robotics Sept 2021 - Jul 2024
Airbus UK, Broughton, UK

- Academic consultant for manufacturing robotics as part of the requirements for the scholarship from Airbus UK
- Assisted on the development and deployment of an intelligent jigless fixturing system for wing assembly
- Worked as part of the *Made Smarter Centre for Connected Factories*
- Research was conducted in partnership with Airbus to ensure that research aligned with their manufacturing aims

Visiting Researcher July 2022
ETHZ Robotics Summer School ETH Zürich, Switzerland

- One of 30 candidates selected from over 400 to take part in an intensive robotics course for hazardous environments
- Focused on learning to deploy real-world robotics when facing non-permissive enviroments
- Topics covered include: *trajectory optimisation, multi-sensor fusion, SLAM, navigation, full-stack ROS and open source robotics*

Automation Engineer July 2019 - July 2020
ASM Assembly Systems Ltd. Weymouth, UK

- Developed a SLAM-guided AGV for the transportation of large parts and machines
- Maintained the SQL server used to store all machine test data and wrote the Python back-end that was used to insert data into the server and generate data analysis tools
- Started production of an anomaly detection algorithm for machine failure prediction
- Deployed multiple autonomous solutions for manufacturing processes

SPECIAL ACHIEVEMENTS

Awards & Scholarships

- RS Grassroots Student Project Fund, March 2021
- EPSRC ICASE Award for Outstanding Research, University of Sheffield, 2021
- Airbus UK Scholarship for Industrial Robotics, Airbus UK/University of Sheffield, 2021

Invited Lectures

- "Scaling Robotic Capability In Industry Using Multi-Agent Systems - Applications in Agriculture, Construction & Manufacturing", *National Polytechnic Institute of Mexico*, Mexico City, Mexico, June 2023

Professional Activities

- Fellow of the Higher Education Academy (FHEA)
- Member of Institute of Electrical & Electronic Engineers (IEEE), 2020 - present
- Member of the Royal Aeronautical Society (RAeS), 2023 - present

RESEARCH FUNDING

Research at UoS focuses on multi-agent systems using reinforcement learning and optimal control within industrial robotics applications

- (2021 - Present) ICASE Award for Research - £16,000
- (2021 - Present) EPSRC Research Scholarship - £6,000
- (2021 - Present) Airbus UK Scholarship for Robotics Research
- (March 2021) RS Online Grassroots Research Grant - £1,000

TEACHING (at UoS)

- *Introduction to Control Systems (ACS219)* *2021-2022*
  Delivered a second year module focusing on control theory tutorials aimed at creating a foundation for future control systems design
- *Mechatronics Group Design Project (AC330)* *2021-Present*
  Provided assistance to third year robotics and mechatronics students working on a group design project. Topics included reinforcement learning, robotics, trajectory optimization and MATLAB programming
- *Industrial Training Programme for Avionics (ACS402)* *2021-Present*
  Led the lab-based section of the module and prepared content regarding industrial deployments of mechatronics and artificial intelligence for automation. Additionally, provided lecturing capabilities for topics including control theory, industrial design and machine vision
- *Real-Time Embedded Systems (ACS6127)* *2021-Present*
  Assisted in lab sessions and moderated assessment tasks. Additionally, helped deliver the module and presented the lectures during the academic year and provided demonstrations
- *Hardware-In-The-Loop & Rapid Control Prototyping (ACS336)* *2022-Present*
  Worked in the lab sessions as a GTA and helped teach content related to programming optimal control algorithms on real hardware using simulation and testing methods
- *Physical Systems (ACS133)* *2023-Present*
  Worked in the lab sessions as a GTA helping students with MATLAB and Simulink projects to model and control real-world physical systems

STUDENT SUPERVISION (at UoS)

- Joaquin Barawed, *Accurate Feature Detection and Tracking for Relative Pose Estimation in Assembly*, M.Eng. thesis, 2024
- Maxwell Bird, *Relative Dynamics Estimation of Orbiting Spacecraft*, B.Eng. thesis, 2024
- Elena Manoli, *Towards Industry 5.0: Dynamic Robot Behaviour Manipulation Based on Human Proximity and Movement*, M.Sc. thesis, 2024

RESEARCH

POSTER Ethan Canzini, Chris Brunskill, "Robotics & Sustainable Satellite Design: Sensing & Control For Autonomous Gripping", *UKSpace Space-Comm Expo*, Glasgow, Scotland, September 2024

PAPER Ethan Canzini, Simon Pope, Ashutosh Tiwari, "Generating Continuous Paths On Learned Constraint Manifolds Using Policy Search", *IEEE/RSJ International Conference on Intelligent Robots & Systems (IROS)*, Abu Dhabi, UAE, October 2024, doi: 10.1109/IROS58592.2024.10802531

POSTER Néstor Sanchez-Arriaga, Ethan Canzini, Nathan Plumb, Michael Farnsworth, Adrian Leyland, Ashutosh Tiwari, "Enhancing Robotic Wafer Inspection with Sensor Fusion and Learned Manifolds", *IEEE Robotics & Automation Society Chapter Conference 2024*, Sheffield, UK, February 2024

PAPER Ethan Canzini, Marc Auledas-Noguera, Simon Pope, Ashutosh Tiwari, "Decision Making For Multi-Robot Fixture Planning Using Multi Agent Reinforcement Learning", in *IEEE Transactions on Automation Science & Engineering*, doi: 10.1109/TASE.2024.3424677

POSTER Ethan Canzini, Marc Auledas-Noguera, Simon Pope, Ashutosh Tiwari, "Decision Making For Multi-Robot Fixtures: A Reinforcement Learning Approach", *Sustainable Manufacturing Presentation for the Engineering Research Symposium 2023*, Sheffield (UK), 2023

PAPER Ethan Canzini, Marc Auledas-Noguera, Dominique Chasteau and Ashutosh Tiwari, "A Novel Sensing Template Using Data Fusion for Large Volume Assembly", *14th IFAC Workshop on Intelligent Manufacturing Systems*, Tel Aviv-Yafo (Israel), March 2022, doi: 10.1016/j.ifacol.2022.04.207

PROFESSIONAL DEVELOPMENT

- Attended the Satellite Applications Catapult IOSM 2024 Conference on behalf of the University of Sheffield
- Co-wrote the University of Sheffield's proposal for the EPRSC IOSM Network+ alongide King's College London
- Presented work undertaken through Growbotics and the University of Sheffield at the UKSpace SpaceComm Expo in Glasgow, UK
- Co-wrote the EPSRC Landscape Award PhD proposal for space systems research alongside Dr. Pope

SKILLS & PROFICIENCY

- Proficient in robotics and ML orientated programming languages (C/C++, Python, Java, C#, MATLAB, Lua, Julia, Rust) including relevant ML/DL libraries (PyTorch, TensorFlow, W&B) and considerable experience with software testing software and hardware deployment tools (MATLAB, LabVIEW)
- Proficient using various robotics-based simulation tools (ROS/ROS 2, CoppeliaSim/V-REP, MUJOCO) for testing and deployment

PERSONAL I am a dual national, holding British (Birth country) and Israeli (2nd nationality) citizenship. I speak English and Hebrew fluently, and understand conversational German. I hold a level 1 qualification in basketball coaching (Assistant Coach level), and have coached teams in the U16 to Men's brackets.