Ethan Alexander Canzini

School of Mechanical, Aerospace & Civil Engineering
University of Sheffield, Mappin Building, Mappin Street, Sheffield, S1 3JD
ecanzini1@sheffield.ac.uk

PRINCIPAL INTERESTS

Machine learning, optimal control, robotics & automation, multi-agent systems, artificial intelligence, reinforcement learning, applications of multi-agent systems in robotics, space systems and aerospace control, traditional optimal control methods alongside machine learning and reinforcement learning, game and decision theoretic approaches to multi-agent systems, nonlinear dynamics modelling and control, physics-based modelling, stochastic control.

ACADEMIC BACKGROUND

PhD in Systems & Control Engineering 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 Robotic Decision-Making, Planning & Control*
- Specialisations include game theory, decision theory, multi-agent systems, reinforcement learning, differential geometry for dynamics & control, Hamiltonian dynamics, optimal transport 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 with double minor in control systems and robotics
- Undertook studies in aerospace, space systems and robotics with an emphasis on control theory
- Undergraduate project: Design of a UAV for completing hazardous search and rescue operations
- Graduate thesis: *Metrology-Assisted Assembly Process to Improve Landing Gear Installation Accuracy*

EMPLOYMENT HISTORY

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

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

- 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

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

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

SPACE RESEARCH

- 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