

RICARDO CANNIZZARO

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OBJECTIVE

Third-year causal ML & robotics PhD Student at Oxford Robotics Institute | Aerial autonomy Defence Research Scientist at Australia Defence Science & Technology | 8+ years of building software and hardware systems that perceive, understand and make decisions autonomously in complex real-world applications | Passionate about STEM education, outreach and diversity | **Seeking PhD internship roles in causal AI/ML**

Research Interests: Probabilistic generative causal modelling, Bayesian causal inference, probabilistic planning under uncertainty, causal explanations, autonomy assurance, explainable AI, robot knowledge representation and reasoning.

EDUCATION

DPhil (PhD) Engineering Science, Oxford Robotics Institute, University of Oxford *Expected 2024*
Supervisor: Dr Lars Kunze, Cognitive Robotics Group. Funded by Defence Science and Technology Group Australia.

I am researching probabilistic generative causal models to encode robot formal knowledge representations and world uncertainty, built from domain expertise and learned from data. I am investigating the use of causal Bayesian inference for prediction, decision-making, and causal explanations for robots operating in challenging complex, uncertain, and partially-observable real-world environments. I am exploring the benefits of applying these methods to assure the autonomy of robots undertaking tasks in manipulation, assistive robotics and mine survey applications.

Courses: Oxford Scientific Entrepreneurship Course, Oxford Language Centre Italian Fast-Track Course Parts 1-2

Bachelor of Engineering (Robotics & Mechatronics)(Hons), Swinburne University, Australia *2013 - 2016*
First Class Honours - GPA 4.0/4.0. Highest achieving graduate (Dux). Industry-based learning year with DSTG.

Bachelor of Science (Mechatronic Systems), University of Melbourne, Melbourne, Australia *2010 - 2012*
Awarded the Kwong Lee Dow scholarship for demonstrating excellence in leadership and academia

WORK EXPERIENCE

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| Robotics Specialist (Defence Research Scientist) (S&T 3/4 Above) | Sep 2020 - Present |
| (S&T 3/4 Below) | Jan 2017 - Aug 2020 |
| Australian Defence Science and Technology Group (DSTG) | <i>Melbourne, Australia</i> |

- Performed R&D of aerial autonomous systems for the Australian Defence Force and provided trusted advice
- Undertook deputy manager role for the Fishermans Bend Flight Laboratory, performed lab training and inductions, maintained critical scientific infrastructure, and ensured health and safety compliance
- Published papers at top-tier international and Australian conferences (e.g., ICRA, Australasian Conference on Robotics and Autonomous Systems) on topics including robot swarming and teaming, navigation and SLAM
- Supported 5+ key strategic robotics and autonomy research agreements with local and international partners across academia, industry and government/Defence. Performed UAS technology demonstrations at four international Defence joint trials in Australia, US, Canada, and Singapore.

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| Defence Research Scientist Cadet | Jul 2015 - Dec 2016 |
| Australian Defence Science and Technology Group (DSTG) | <i>Melbourne, Australia</i> |

- Contributed to aerial autonomous systems R&D outcomes for the Australian Defence Force
- Empirically validated a novel chemical source localisation with a bespoke sensor and ground robot using hardware design, C++/ROS/MATLAB software, and signal processing skills

PROJECTS

- Causal Reasoning & Explanations for Robot Manipulation: [\[Project\]](#)
- Causal Discovery, Inference & Counterfactual Explanations for Drones in Mines: [\[Project\]](#)
- Causally-Informed POMDP Planning for Robots Under Confounded Decision-Making: [\[Project\]](#)
- Decentralised MCTS for Robot Intelligence, Surveillance & Reconnaissance Missions: [\[Project\]](#)
- Scalable Multi-Robot Exploration & Return in Apriori Unknown Environments: [\[Project\]](#)
- Team ORIon Team Lead (2021/22) [\[Project\]](#)
- Team ORIon Task-Level Planning Sub-Team Lead (2021/22): [\[Project\]](#)
- Autonomous Drone Navigation & Mapping in Mixed GNSS-Available Environments: [\[Project\]](#)
- Random-Finite-Set-based SLAM algorithm for drones with scanning & solid-state LIDARS: [\[Project\]](#)

AWARDS & FUNDING

- USD \$250 IEEE Robot Learning TC travel grant for the IROS 2023 [Causality for Robotics workshop](#)
- USD \$305 IEEE Robotics and Automation Society (RAS) member support program grant for IROS 2023
- £340 St Edmund Hall Postgraduate College Grant for IROS 2023 conference attendance
- £350 St Edmund Hall Postgraduate College Grant for the [Causal Learning and Reasoning conference 2023](#)
- DST Group PhD Study Support Programme Award for doctoral research at the University of Oxford on causal inference for the assurance of robot autonomy (3-year PhD stipend funding + 1-year extension)
- [Best Paper Award](#) at the ICRA 2021 [Robot Swarms in the Real World Workshop](#)

ACADEMIC TALKS

- Invited talk: causality for confounded POMDP robot planning, IROS 2023 [Causality for Robotics workshop](#)
- Gave a series of Cognitive Robotics Group lab research overview presentations and demonstrations to international visitors at the Oxford Robotics Institute as part of official [ICRA 2023 lab tours](#)

ACADEMIC SERVICE

- Assisted coordination of the ICRA 2023 [Multidisciplinary Approaches to Co-Creating Trustworthy Autonomous Systems workshop](#). Recorded workshop discussion minutes, coordinated breakout groups, social media coverage.
- Manuscript reviews: IROS (2022, 2023), KI - Künstliche Intelligenz Journal (2023)

TEACHING

- Final Year Research Project Co-supervisor, University of Oxford Masters of Engineering Science (2021-2024)
 - Co-supervised four projects on: causal discovery, causal Bayesian planning and natural language counterfactual explanation methods for 1) robot manipulation tasks, and 2) autonomous drones in mines
 - Wrote project proposals and on-boarding materials, performed candidate selection, delivered educational tutorials. Provided guidance on research methods, project management, robotics and causal ML expertise.
- Teaching Assistant, University of Oxford third-year Information Engineering Systems course (2021/22)
 - Taught three tutorial class cohorts on topics: image & digital signal processing, estimation, inference
 - Consistently rated outstanding for quality of teaching and student support from student evaluations

SKILLS

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|------------------------|---|
| AI/ML/CS Skills | Probabilistic generative causal modelling, Bayesian inference, stochastic variational inference, POMDP planning, MCTS, graph theory, search, shortest-path algorithms, image & signal processing, finite state machines, SLAM |
| Software Skills | C++, Python, OOP, software design patterns, Pyro PPL, PyTorch, pgmpy, ROS, MATLAB, bash, tmux, Linux networking, Linux/Windows/Mac OS, VSCode, Git |
| Robotics Skills | Robot systems design & deployment, field trial coordination, simulation & verification, UAS design, flight controller firmware design, sensor & actuator integration, control |
| Soft Skills | Leadership, management, research project management, scientific entrepreneurship |

LEADERSHIP

- A 15+ year demonstrated record of leadership and teamwork ability. Demonstrated skills in planning, organising, communicating, managing resources, motivation, conflict resolution, stakeholder liaison.
- Have undertaken many leadership positions in work, university and volunteer contexts
- Project management: organised several large-scale events with 100+ attendees: youth camps, outreach events
- Executive Committee Member, Young Scientists of Australia Melbourne Chapter Inc. (2008-2019)
 - Immediate Past President (2016-2019), President (2013-2016), Social Coordinator (2009-2012)
 - As President, I led the 12-person executive committee to realise the organisation’s goal of promoting science to the youth of Australia by delivering science outreach and social events for our 200+ membership base
 - Under my leadership, the organisation annually delivered 12 social events and provided 40+ staff members across five 3-day STEM outreach programs for secondary school students. I further expanded the member services and outreach activities, directing the creation of 7 new initiatives.

PUBLICATIONS

- CAR-DESPOT: Causally-Informed Online POMDP Planning for Robots in Confounded Environments. Ricardo Cannizzaro, Lars Kunze. IEEE/RSJ IROS 2023. [\[Paper\]](#)
- Towards a Causal Probabilistic Framework for Prediction, Action-Selection & Explanations for Robot Block-Stacking Tasks, Ricardo Cannizzaro*, Jonathan Routley*, Lars Kunze. IEEE/RSJ IROS 2023 Workshop on Causality for Robotics. [\[Paper\]](#)
- Towards Probabilistic Causal Discovery, Inference & Explanations for Autonomous Drones in Mine Surveying Tasks. Ricardo Cannizzaro*, Rhys Howard*, Paulina Lewinska, Lars Kunze. IEEE/RSJ IROS 2023 Workshop on Causality for Robotics. [\[Paper\]](#)
- An Upper Confidence Bound for Simultaneous Exploration and Exploitation in Heterogeneous Multi-Robot Systems. Ki Myung Brian Lee, Felix Kong, Ricardo Cannizzaro, Jennifer L Palmer, David Johnson, Chanyeol Yoo, Robert Fitch. IEEE ICRA 2021. [\[Paper\]](#)
- Decentralised Intelligence, Surveillance, and Reconnaissance in Unknown Environments with Heterogeneous Multi-Robot Systems. Ki Myung Brian Lee, Felix H Kong, Ricardo Cannizzaro, Jennifer L Palmer, David Johnson, Chanyeol Yoo, Robert Fitch. IEEE ICRA 2021 Workshop on Robot Swarms in the Real World: From Design to Deployment. [\[Paper\]](#)
- ColMap: A Memory-Efficient Occupancy Grid Mapping Framework. Alex Fisher, Ricardo Cannizzaro, Madeleine Cochrane, Chatura Nagahawatte, Jennifer L Palmer. Robotics and Autonomous Systems 2021. [\[Paper\]](#)
- Evaluation of LIDAR and X-Band Radar Sensors in a Particle-Dense Environment. Ricardo Cannizzaro, Meaghan G Smith, Alexander W Blain, Thomas Baum, Kelvin Nicholson, Jennifer L Palmer. AIAC18: 18th

Australian International Aerospace Congress (2019): HUMS-11th Defence Science and Technology (DST) International Conference on Health and Usage Monitoring (HUMS 2019): ISSFD-27th International Symposium on Space Flight Dynamics (ISSFD) 2019. [\[Paper\]](#)

- Experimental Validation of a Random-Finite-Set-Based SLAM Algorithm for Micro UAS. Ricardo Cannizzaro, Madeleine Cochrane, Lance Fang, Jennifer L Palmer. Australasian Conference on Robotics and Automation (ACRA) 2019. [\[Paper\]](#)
- Data Ferrying with Swarming UAS in Tactical Defence Networks. Robert Hunjet, Bradley Fraser, Thomas Stevens, Laura Hodges, Karina Mayen, Jan Carlo Barca, Madeleine Cochrane, Ricardo Cannizzaro, Jennifer L Palmer. IEEE ICRA 2018. [\[Paper\]](#)
- Source Localisation with a Bernoulli Particle-Filter-Based Bearings-Only Tracking Algorithm. Jennifer L Palmer, Ricardo Cannizzaro, Branko Ristic, Thomas Cheah, Chatura Nagahawatte, John Gilbert, Sanjeev Arulampalam. Australasian Conference on Robotics and Automation (ACRA) 2015. [\[Paper\]](#)