Charlie Street

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Research

I am a research fellow in the School of Computer Science at the University of Birmingham. My research goal is to develop robotic systems with a guaranteed quality of service under uncertainty. To achieve this, I apply decision-making and verification techniques to formal data-driven models of robot behaviour. A core achievement of my research has been multi-robot decision-making solutions which use model checking techniques to reason over the temporal behaviour of robots and other processes in the environment. These results are presented in my DPhil thesis titled 'Multi-Robot Coordination Under Temporal Uncertainty'.

Research Interests

- Formal Verification for Robotics

- Robot Decision-Making Under Uncertainty

- Multi-Robot Coordination

- Continuous-Time and Non-Stationary Models of Uncertainty

Research Positions

- **University of Birmingham**   **Jan 2023 - Present**

    – Research Fellow in Computer Science

- **Oxford Robotics Institute, University of Oxford**   **July 2022 - Dec 2022**

    – Postdoctoral Research Assistant in AI for Autonomous Systems

Education

- **DPhil in Engineering Science at the University of Oxford**   **2018-2022**

    – Thesis: *Multi-Robot Coordination Under Temporal Uncertainty*
    – Supervisors: Nick Hawes, Bruno Lacerda, and Manuel Mühlig

- **MSci in Computer Science at the University of Birmingham**   **2014-2018**

    – Thesis: *IntelliJam: An Intelligent Agent for Musical Improvisation*
    – Supervisor: Peter Tino
    – First class with honours (average: 92%)

Projects

- **CONVINCE**   **2023-Present**
  - Context-Aware Verifiable and Adaptive Dynamic Deliberation (UKRI grant number 10042096)
  - Technical lead on work package titled 'Task and Motion Planning in Dynamic Environments'

- **External Collaboration with Accenture Labs**   **2021-2022**
  - Developed a congestion-aware simulation for warehouses
  - Led technical development and paper writing

- **First Fleet**   **2020-2021**
  - Deploying multi-robot systems in agriculture
  - Implemented a multi-robot planning system

- **Team ORIon (RoboCup Competition Team)**   **2019-2021**
  - Deploying service robots in domestic environments
  - Led team ORIon and task-level planning sub-team

Supervision

PhD Students

- **Stefano Bernagozzi (with M. Mansouri and L. Natale)**   **2023-Present**
  - Topic: *Behaviour Trees for Robotics*

- **Weijian Zhang (with M. Mansouri)**   **2023-Present**
  - Topic: *Human-Aware Formation Control for Multi-Robot Systems*

Final Year Projects/MSc Dissertations

- **Jonah Loughlin (with M. Mansouri)**   **2024**
  - Topic: *Constrained Planning in Radioactive Environments*
  - Designed idea for dissertation project

- **Rushikesh Bagul (with M. Mansouri)**   **2023**
  - Topic: *Statistical Model Checking for Behaviour Trees*
  - Designed idea for dissertation project

- **Alex Rutherford (with B. Lacerda and N. Hawes)**   **2021-2022**
  - Topic: *Multi-Agent Reinforcement Learning with a Model-Based Simulator*

- **Yifeng Wei (with B. Lacerda)**   **2020-2021**
  - Topic: *Trial-Based Search for Generalised Stochastic Petri Nets*

- **James Wheadon (with N. Hawes)**   **2019-2020**

– Topic: *Multi-Agent Path Finding in Continuous Time*

- **Han Zhou (with B. Lacerda)**   **2018-2019**

    – Topic: *Auctioning for Multi-Robot Coordination*

Internships

- **Tom Liu (with N. Hawes)**   **2021**

    – Topic: *Generalising Duration Distributions Across Topological Maps*

- **Clarissa Costen (with N. Hawes)**   **2019**

    – Topic: *Continuous-Time Markov Chains for Shared Autonomy*

Outreach/Demonstrations

- Led robot demonstrations at Goodwood Festival of Speed   **2021**

- Led robot demonstration at University of Oxford open day   **2019**

- Prepared robot demonstration for opening of Oxford college building   **2019**

- Assisted with robot demonstration at Blenheim Palace   **2019**

Service

- **Grant Reviewing:** UKRI EPSRC Standard Research Grant (2025).

- **Journal Reviewing:** IEEE Transactions on Robotics (T-RO); IEEE Robotics and Automation Leters (RA-L); Frontiers in Robotics and AI; Journal of Artificial Intelligence Research (JAIR).

- **Conference Programme Committee:** AAAI Conference on Artificial Intelligence (AAAI) - 2023, 2024; International Conference on Autonomous Agents and Multiagent Systems (AAMAS) - 2023, 2025; AAMAS Demo Track - 2024; European Conference on Artificial Intelligence (ECAI) Demo Track - 2024; International Conference on Principles of Knowledge Representation and Reasoning (KR) Special Track on Reasoning, Learning, & Decision Making - 2024.

- **Conference/Symposium Reviewing:** AAAI - 2020; AAMAS - 2020, 2021; KR - 2021; ECAI - 2024; International Joint Conference on Artificial Intelligence (IJCAI) - 2019; International Conference on Automated Planning and Scheduling (ICAPS) - 2020-2022; Conference on Neural Information Processing Systems (NeurIPS) - 2020, 2021, 2024; IEEE International Conference on Robotics and Automation (ICRA) - 2020, 2024; IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) - 2021-2024; European Conference on Mobile Robots (ECMR) - 2019; Advances in Cognitive Systems - 2020; Robotics: Science and Systems (RSS) - 2023, 2024; AAAI Fall Symposium Series: Unifying Representations for Robot Application Development (UR-RAD) - 2024.

- **Workshop Programme Committee:** ICAPS 2023 Workshop on Planning and Robotics (PlanRob).

- **Tutorial Organiser & Instructor:** AAMAS 2023 Tutorial on Multi-Robot Planning Under Uncertainty, London.

Teaching

- **Lecturer for Advanced Robotics, University of Birmingham   2023, 2024**
    - Taught lecture on Multi-Robot Planning Under Uncertainty
    - Helped write 2024 exam paper

- **Teaching Assistant for CDT Robotics Course, University of Oxford 2020**
    - Developed a localisation exercise
    - Prepared robot software and student robot competition

Publications

[1] Charlie Street, Yazz Warsame, Masoumeh Mansouri, Michaela Klauck, Christian Henkel, Marco Lampacrescia, Matteo Palmas, Ralph Lange, Enrico Ghiorzi, Armando Tacchella, Razane Azrou, Raphaël Lallement, Matteo Morelli, Ginny I. Chen, Danielle Wallis, Stefano Bernagozzi, Stefano Rosa, Marco Randazzo, Sofia Faraci, and Lorenzo Natale. "Towards a Verifiable Toolchain for Robotics". In: *Proceedings of the AAAI Fall Symposia*. **Awarded Best Paper**. 2024.

[2] Charlie Street and Masoumeh Mansouri. "Covered for Life: Lifelong Area Coverage under Spatiotemporal Uncertainty". In: *Proceedings of the European Conference on Artificial Intelligence (ECAI)*. 2024.

[3] Weijian Zhang, Charlie Street, and Masoumeh Mansouri. "A Decoupled Solution to Heterogeneous Multi-Formation Planning and Coordination for Object Transportation". In: *Robotics and Autonomous Systems* 180 (2024). URL: https://doi.org/10.1016/j.robot.2024.104773.

[4] Charlie Street, Bruno Lacerda, Manuel Mühlig, and Nick Hawes. "Right Place, Right Time: Proactive Multi-Robot Task Allocation Under Spatiotemporal Uncertainty". In: *Journal of Artificial Intelligence Research* 79 (2024), pp. 137–171. URL: https://jair.org/index.php/jair/article/view/15057.

[5] Charlie Street, Masoumeh Mansouri, and Bruno Lacerda. "Formal Modelling for Multi-Robot Systems Under Uncertainty". In: *Current Robotics Reports* 4.3 (2023), pp. 55–64. URL: https://link.springer.com/article/10.1007/s43154-023-00104-0.

[6] Weijian Zhang, Charlie Street, and Masoumeh Mansouri. "Multi-Formation Planning and Coordination for Object Transportation". In: *Proceedings of the European Conference on Mobile Robots (ECMR)*. 2023.

[7] Charlie Street, Sri Sadhan Jujjavarapu, Michael Nai-An Chen, Sanjoy Paul, and Nick Hawes. "Analysing the Effects of Congestion on Hybrid Order Picking Systems using a Discrete-Event Simulator". In: *Proceedings of the 18th International Conference on Intelligent Autonomous Systems*. 2023. URL: https://link.springer.com/chapter/10.1007/978-3-031-44851-5_30.

[8] Bruno Lacerda, Anna Gautier, Alex Rutherford, Alex Stephens, Charlie Street, and Nick Hawes. "Decision-Making under Uncertainty for Multi-Robot Systems". In: *AI Communications* 35.4 (2022), pp. 433–441.

[9] Charlie Street, Bruno Lacerda, Michal Staniaszek, Manuel Mühlig, and Nick Hawes. "Context-Aware Modelling for Multi-Robot Systems Under Uncertainty". In: *Proceedings of the 21st International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*. 2022. URL: `https://www.ifaamas.org/Proceedings/aamas2022/pdfs/p1228.pdf`.

[10] Charlie Street, Sebastian Pütz, Manuel Mühlig, Nick Hawes, and Bruno Lacerda. "Congestion-Aware Policy Synthesis for Multirobot Systems". In: *IEEE Transactions on Robotics* 38.1 (2022), pp. 262–280. URL: `https://ieeexplore.ieee.org/document/9477767`.

[11] Charlie Street, Bruno Lacerda, Manuel Mühlig, and Nick Hawes. "Multi-Robot Planning Under Uncertainty with Congestion-Aware Models". In: *Proceedings of the 19th International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*. 2020. URL: `https://dl.acm.org/doi/abs/10.5555/3398761.3398913`.

References

- Masoumeh (Iran) Mansouri (University of Birmingham) - `m.mansouri@bham.ac.uk`

- Nick Hawes (University of Oxford) - `nickh@robots.ox.ac.uk`

- Lorenzo Natale (Italian Institute of Technology) - `lorenzo.natale@iit.it`