

# Paul Duckworth

Oxford Robotics Institute, 23 Banbury Road, University of Oxford, UK

robots.ox.ac.uk/~pduckworth/   pduckworth@robots.ox.ac.uk   github.com/pduckworth

## RESEARCH ACTIVITIES

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- 2021 – **Postdoctoral Research Assistant:** *Department of Oncology*  
WITH: PROFESSOR KATHERINE VALLIS  
Deep RL for Radiotherapy Planning, Cancer Research UK  
University of Oxford, UK
- 2019 – **Postdoctoral Research Assistant:** *Oxford Robotics Institute*  
WITH: PROFESSOR NICK HAWES  
Planning under Uncertainty for Mobile Robotics  
Projects: i) *Offshore Robotics for Certification of Assets* and ii) *Robotics and AI in Nuclear*  
Co-Supervision: four dphil students and two fourth year eng projects.  
University of Oxford, UK
- 2017 – 2019 **Postdoctoral Research Assistant:** *Machine Learning Research Group.*  
WITH: PROFESSOR MICHAEL A. OSBORNE  
Projects: i) *Future of Healthcare* and ii) *Creative Algorithmic Intelligence*  
University of Oxford, UK
- 2013 – 2017 **Ph.D:** *Machine Learning for Mobile Robotics*  
WITH: PROFESSOR ANTHONY G. COHN & PROFESSOR DAVID C. HOGG  
Thesis: “*Unsupervised Human Activity Analysis for Intelligent Mobile Robots*”  
University of Leeds, UK

Frontier Development Lab: Researcher (Jun 2021 - Aug 2021)

NASA & SETI Institute, CA, USA / Remote

*Project:* Space Medic: Causal Inference for Out-Of-Distribution Generalization

Data Study Group: Principal Investigator (Jan 2020 - Apr 2021)

Alan Turing Institute, London, UK / Remote

*Project:* Exploring AI Supported Decision-Making for Early Stage Diagnosis of Colorectal Cancer

## EDUCATION

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- 2009 – 2010 **MSc: Mathematics and Computational Science**  
PASS WITH DISTINCTION  
Thesis: “*Formal Verification of an Electromechanical System with Discontinuous Properties.*”  
University of Manchester, UK
- 2005 – 2008 **BSc: Mathematics and Statistics**  
FIRST CLASS HONOURS  
Lancaster University, UK

## TEACHING EXPERIENCE

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Stipendiary Lecturer/Tutor, Brasenose College (Jan 2020 - )

University of Oxford, UK

Engineering Mathematics Tutor: P1/A1, Vector Calculus, ODEs & PDEs.

Study Abroad Programme, St Antony's College (Jan 2020 & 2022)

University of Oxford, UK

Interdisciplinary Winter School: Introduction to ML and AI's Impact on Jobs.

Teaching Assistant (Oct 2017 & May 2019)

University of Oxford, UK

AIMS CDT: Data Estimation & Inference course assistant.

Advanced Machine Learning MSc: Reproducibility challenge coursework assessor.

## Teaching Assistant (Sep 2015 - Jul 2017 )

University of Leeds, UK

Undergraduate courses: Introduction to Programming (Python) and Introduction to Web Technology (html).

MSc Machine Learning module assistant: setting lab assignments and marking coursework.

## SOFTWARE

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ADVANCED **Python, PyTorch, TensorFlow, GFlow**, ROS, **git**, Pandas, sklearn, Linux

BASIC C++, Matlab, MongoDB, R, SAS

CONTRIBUTED **QSRLib.readthedocs.io, STRANDS-Project.eu**

## WORK EXPERIENCE

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### Machine Learning Researcher: Consultant (Apr 2017)

Mind Foundry, Oxford, UK

### Statistical Programmer II (Sep 2010 - Sep 2013)

ICON Clinical Research, UK

Team lead of 20+ global programmers. Study resourcing, communications and delivery of analysis to clients.

### Portfolio Modelling Analyst (Nov 2008 - Sep 2009)

HBoS, Lloyds Banking Group, UK

Building, maintenance and running of portfolio stress-testing forecast models to plan capital in varying economic climates.

## SELECT INVITATIONS

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- Invited Reviewer: IEEE Transactions on Pattern Analysis and Machine Intelligence 2020.
- Invited Talk and Panellist at Rhodes Trust *AI Frontiers Conference*, Rhodes House, Oxford. (Jun 2019)
- PC member and reviewer: AAAI & IJCAI 2018. AAAI, ECAI & ICAPS 2019. IEEE IROS & ACS 2020
- Guest Lecture: Business Psychology MSc at Sigmund Freud University. (Mar 2019)
- Invited Talk: Robotics@Leeds Conf. 2018.
- Invited Reviewer: Special Issue of Journal of Computational Intelligence and Neuroscience 2018.

## PUBLICATIONS LIST

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### *"Probabilistic Planning for AUV Data Harvesting from Smart Underwater Sensor Networks"*

Budd, M., . . . Harris, C., Duckworth, P. Hawes N. and Lacerda, B.

International Conference on Intelligent Robots and Systems (IROS) 2022

### *"Mission Planning in Unknown Environments as Bayesian Reinforcement Learning"*

Budd, M., Duckworth, P., Hawes, N. and Lacerda, B.

Under Review.

### *"Planning for Risk-Aversion and Expected Value in MDPs"*

Rigter, M., Duckworth, P., Lacerda, B. and Hawes, N.

International Conference on Automated Planning and Scheduling **ICAPS 2022 Best Paper - Runner-up.**

### *"Leveraging Invariance in non-i.i.d Federated Learning"*

Duckworth, P., Ughi G., O'Donoghue O., Scheibenreif, L., . . . and Sanders, L.

Under Review.

### *"Fedated Causal Inference for Predicting Radiation Exposure in Out-of-Distribution Settings "*

Ughi G., Duckworth, P., O'Donoghue O., Scheibenreif, L., . . . and Sanders, L.

NASA Human Research Program IWS, 2022. Oral Presentation.

### *"Invariant Risk Minimisation for Cross-Organism Inference: Substituting Mouse Data for Human Data in Human Risk Factor Discovery "*

O'Donoghue O., Duckworth, P., Ughi G., Scheibenreif, L., . . . and Sanders, L.

Machine Learning 4 Health Workshop at **NeurIPS 2021.**

*“Risk-Aware Motion Planning in Partially Known Environments”*

Barbosa, F. S., Lacerda, B., Duckworth, P., Tumova, J., and Hawes, N.  
In IEEE International Conference on Decision and Control **CDC** 2021

*“Active Inference for Integrated State-Estimation, Control, and Learning”*

Baïoumy, M., Duckworth, P., Lacerda, B. and Hawes N.  
In IEEE International Conference on Robotics and Automation **ICRA** 2021

*“Time-Bounded Mission Planning in Time-Varying Domains with Semi-MDPs and GPs”*

Duckworth, P., Lacerda, B. and Hawes, N.  
In IEEE Conference on Robotic Learning **CORL** 2020

*“Markov Decision Processes with Unknown State Feature Values for Safe Exploration using GPs”*

Budd, M. and Lacerda, B. and Duckworth, P. and West, A. and Lennox, B. and Hawes, N.  
In IEEE Intelligent Robots and Systems **IROS** 2020

*“Towards Better Healthcare: What Could and Should be Automated?”*

Fruehwirt, W. and Duckworth, P.  
In Technological Forecasting & Social Change, Elsevier Journal 2021  
Also appears in: **AI for Social Good** Workshop at **NeurIPS** 2019. Oral Presentation.

*“Qualitative and quantitative approach to assess potential for automating administrative tasks in GPs”*

Willis, M., Duckworth, P., Coulter, A., Meyer, E.T. and Osborne, M.  
In **BMJ Open** Journal 2020

*“Adaptive manipulator control using active inference with precision learning”*

Baïoumy, M., Mattamala, M., Duckworth, P., Lacerda, B. and Hawes N.  
In UK Robotics and Autonomous System (UK-RAS): Robots into the real world. 2020

*“Unsupervised Human Activity Analysis for Intelligent Mobile Robots”*

Duckworth, P., Hogg, D., and Cohn, A.  
In **Artificial Intelligence** Elsevier Journal 2019.

*“Inferring Work Task Automatability from AI Expert Evidence”*

Duckworth, P., Graham, L., and Osborne, M.  
In **AI Ethics & Society** (AAAI/ACM) 2019. Oral Presentation.  
Also appears in: **AI for Social Good** Workshop at **NeurIPS** 2018. Oral Presentation.

*“The Future of Healthcare Protocol Article”*

Willis, M., Duckworth, P., Coulter, A., Meyer, E., Osborne, M.  
In **JMIR** Research Protocols 2019.

*“Grounding of Human Environments and Activities for Autonomous Robots”*

Duckworth, P., Alomari, M., Bore, N., Hawasly, M., Hogg, D. C. and Cohn, A. G.  
In International Joint Conferences on Artificial Intelligence **IJCAI** 2017. **Best Video Award.**

*“Natural Language Grounding and Grammar Induction for Robotic Manipulation Commands”*

Alomari, M., Duckworth, P., Hawasly, M., Hogg, D. C. and Cohn, A. G.  
In ROBONLP Workshop at ACL 2017. **Best Paper Award.**

*“Latent Dirichlet Allocation for Unsupervised Activity Analysis on an Autonomous Mobile Robot”*

Duckworth, P., Alomari, M., Charles, J., Hogg, D. C. and Cohn, A. G.  
In **AAAI** Conference on Artificial Intelligence 2017. Oral Presentation.

*“Semi-supervised Natural Language Acquisition and Grounding for Robotic Systems”*

Alomari, M., Duckworth, P., Hogg, D., and Cohn, A.  
In **AAAI** Conference on Artificial Intelligence 2017.

*“Unsupervised Activity Recognition using Latent Semantic Analysis on a Mobile Robot”*

Duckworth, P., Alomari, M., . . .  
In European Conference on AI **ECAI** 2016. **Best Student Paper Award** - Runner-up. Oral Presentation.

*“The STRANDS project: Long-term autonomy in everyday environments”*

Hawes, N., Burbridge, C., Jovan, F., Kunze, L., Lacerda, B., Duckworth, P., et. al.  
In IEEE Robotics and Automation Magazine **RAM**. 2017.

*“Unsupervised Learning of Qualitative Motion Behaviours by a Mobile Robot”*

Duckworth, P., Gatsoulis Y., Jovan, F., Hawes, N., Hogg, D.C. and Cohn, A. G.  
In International Conference on Autonomous Agents & Multiagent Systems **AAMAS** 2016. Oral Presentation.