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PUBLICATIONS

BiGym: A Demo-Driven Mobile Bi-Manual Manipulation Benchmark 2024
Nikita Chernyadev*, **Nicholas Backshall***, Xiao Ma, Yunfan Lu, Younggyo Seo, and Stephen James
CoRL 2024

Redundancy-aware Action Spaces for Robot Learning 2023-2024
Pietro Mazzaglia*****, **Nicholas Backshall***, Xiao Ma, and Stephen James
IEEE Robotics and Automation Letters, 2024

EXPERIENCE

Senior Robotics Research Engineer, Dyson Robot Learning Lab 2022-2024
Research Lab lead by Dr Stephen James

- Conducted cutting-edge research in robot learning, focusing on sample-efficient imitation learning and reinforcement learning algorithms for robot manipulation.
- Co-authored two publications:
    - Journal paper in IEEE Robotics and Automation Letters: "Redundancy-aware Action Spaces for Robot Learning" – Developed a novel action space formulation, ER (End-effector Redundancy), addressing redundancies in over-actuated robot arms. My approach combined the advantages of both joint and task spaces, offering fine-grained comprehensive control while achieving highly efficient robot learning. We successfully demonstrated superior performance in tasks requiring precise control over the robot configuration.
    - Conference paper for CoRL 2024: "BiGym: A Demo-Driven Mobile Bi-Manual Manipulation Benchmark" – Created BiGym, a new benchmark and learning environment for mobile bi-manual demo-driven robotic manipulation. Designed 40 diverse tasks set in home environments, ranging from simple target reaching to complex kitchen cleaning. Implemented support for various observations, including proprioceptive data and visual inputs from multiple camera views. Benchmarked state-of-the-art imitation learning and demo-driven reinforcement learning algorithms within the environment.
- Engineered a custom embedded system using RS-485 protocol for a project on dexterous manipulation with a simple 2-fingered Robotiq gripper, enabling high-frequency communication and reduced latency for rapid, dynamic tasks like mid-air object flipping and repositioning.
- Developed and maintained an internal imitation learning (IL) and reinforcement learning (RL) environment for real-world robots, controlling Franka Panda and UR5 robots using ROS2 with packages like MoveIt.
- Contributed to the development of efficient and robust robot learning training infrastructure.
- Lead the BiGym project; created learning environments for mobile bi-manual demo-driven robotic manipulation.
- Engaged in all aspects of algorithm development, from initial problem scoping to model development.
- Rapidly acquired expertise in robot learning and machine learning, translating theoretical knowledge into practical contributions.
- **Technologies used:** Python, C#, C++, ROS, PyTorch, Docker

Software Application Engineer, Dyson 2021-2022
New-Product-Innovation Software team

- Designed and developed iOS and Android applications to support testing and validation of new product concepts in upstream product development.
- Solely developed an Android Bluetooth Low Energy (BLE) Library tailored to Dyson-specific BLE protocols, enabling seamless communication between mobile devices and Dyson Connected Products.
    - This library became a core component used across multiple team projects.
- Collaborated with the Embedded Systems team to design a versatile cross-platform messaging protocol for communication between diverse devices (embedded systems, iOS apps, Android apps, websites).
    - Implemented the protocol in GoLang, JavaScript, Python, and other languages.
- **Technologies used:** Android (Java, Kotlin), iOS (Swift), Bluetooth Low Energy (BLE), GoLang, JavaScript (Node.js), Python, REST APIs

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* Joint first author

iOS Developer, Dyson 2020-2021

New-Product-Innovation Software team

- Created an AR application rendering high-fidelity particle systems with 0.5 million particles on an iPhone using Metal and Metal-Shading-Language.
    - Created an intuitive experience for users to observe airflow patterns in their room.
    - Wrote custom shaders and developed a rendering pipeline using Metal and Metal-Shading-Language to achieve optimal performance on mobile devices.
- Developed the Dyson AQ App which connected with an air-quality device via Bluetooth to upload data to the cloud and visualise historical and live air quality data (https://www.dyson.co.uk/discover/insights/air-quality/air-purifiers/backpacks).
    - Implemented features for displaying both historical and live air quality data through graphs and other interactive elements using SwiftUI.
- Created a data mocking tool using AWS Lambda to generate realistic air quality data, significantly speeding up the development process by enabling parallel front-end and back-end work.
- **Technologies used:** Swift, SwiftUI, Metal, Metal-Shading-Language, AR Kit, Core Bluetooth, AWS Lambda

Android Developer, Dyson 2019-2020

MyDyson Application team

- Contributed to the development of the MyDyson Android application, focusing on connected light features: implemented new front-end features, fixed bugs and improved existing functionality.
- Practised Test-Driven Development (TDD) to ensure high code coverage and reliability.
- **Technologies used:** Kotlin, Android Studio, Java

Engineer, Dyson 2017-2019

Worked in six teams across the engineering departments: Mechanical, Electrical, and Software

- **Mechanical Pick-up Team (V10 Vacuum Cleaner):** Developed a manufacturing strategy to tune cleaner heads, improving vacuum performance consistency. Created a MATLAB data processing tool, automating weekly data trimming and saving engineers hours per week.
    - ***Skills/Tech:*** *Manufacturing process optimization, Data analysis, MATLAB, Process automation*
- **Electronics Team (Dyson Supersonic™ Professional Hair Dryer):** Analysed circuit board schematics, identifying and correcting op-amp errors, saving time and resources. Conducted comparative analysis of digital and analog temperature sensors for cost optimization.
    - ***Skills/Tech:*** *Circuit analysis, Embedded systems, Cost-benefit analysis*
- **Cloud Computing Team (Dyson 360 Eye™):** Developed a debug platform for rendering robot cleaning maps from cloud data, for diagnosing faults in live robots.
    - ***Skills/Tech****: JavaScript, npm, Web development, Cloud data integration, Debugging tools*
- **Anthropometric Research Team (Dyson Zone™):** Conducted user studies for product perception, including the Dyson Zone. Engineered an automated rig for hand measurements using image processing.
    - ***Skills/Tech:*** *User research, Image processing, Automation, Ergonomic design*
- **Electric Vehicle High Voltage Architecture Team (Dyson EV):** Created the high voltage system architecture document, integrating various subsystems through working with respective team leads. Tracked and analysed safety regulations across different countries.
    - ***Skills/Tech:*** *High Voltage Electronics, Systems integration, Technical documentation, Regulatory compliance*
- **Hair Care Product Innovation Team (Dyson AirWrap™):** Designed and prototyped new attachments for the AirWrap. Planned and executed user trials to diagnose issues with existing attachments.
    - ***Skills/Tech:*** *Product design, Prototyping, User testing, Market research*

EDUCATION

First Class Bachelors of Engineering (with Honours) in Engineering (Electronics - Software) 2017 – 2021

The University of Warwick & Dyson Institute of Engineering and Technology

- 1 of 33 selected out of 900+ applicants for the paid Degree-Apprenticeship.
- **Relevant Modules:** Applied Programming, Software Development for Engineers, Agile Software Development, Systems and Network Architecture, Embedded Systems, Internet of Things, Data Science and Machine Learning, Vision and Processing.

SKILLS & TECHNOLOGIES

Programming Languages: *Python, C#, C++, Java, Kotlin, Swift, GoLang, JavaScript*
Frameworks & Libraries: *PyTorch, ROS2, MoveIt, SwiftUI, Android SDK*
Technologies: *Reinforcement Learning, Imitation Learning, Robotics, AR/VR, Bluetooth Low Energy (BLE)*
Cloud & DevOps: *Ubuntu, AWS Lambda, RESTful APIs*