

## Faculty of Engineering

### Summer Research Program 2023-2024

Project Title: Adaptive human-robot handover using reinforcement learning

Supervisor(s): Dr Leimin Tian, Dr Pamela Carreno-Medrano

Department: ECSE

Email: Leimin.Tian@monash.edu, Pamela.Carreno@monash.edu

Website profile of project supervisor: <https://tianleimin.github.io/>

---

### Objective

Develop an RL model using data collected from human-robot collaborative crafting sessions (additional data annotation may be required) to achieve adaptive object handovers:

1. Construct a suitable reward function for learning a robot action policy in offline RL
2. Conduct experiments on the dataset to evaluate performance of the offline RL model
3. Conduct further experiments on fine-tuning the learned policy
4. Learn a human action policy for developing a handover simulation environment (optional)
5. Conduct simulation experiments to develop and evaluate an online RL model for robot policy (optional)

### Project Details

Physical exchange of an object, or a handover, is a common task in human-robot collaboration and interaction. A successful handover requires both parties to coordinate in the time and location of the exchange. When and where a handover needs to happen depends on the task context and personal preferences, which can be observed via social cues during the interaction, such as gaze or gestures.

In a previous study, a Fetch mobile manipulator robot was teleoperated to serve as a crafting assistant of the user, resulting in a dataset of handovers in various contexts. The goal of this project is to develop an RL model using the data collected to achieve adaptive auto handovers. This includes formulating the problem by identifying suitable state and action spaces and reward function, as well as developing and evaluating the performance of offline RL models. If time permits, additional objectives include developing and evaluating online RL approaches in a simulation environment, or potential user studies.

### Relevant Reference

Leimin Tian, Kerry He, Shiyu Xu, Akansel Cosgun, and Dana Kulić. 2023. Crafting with a Robot Assistant: Use Social Cues to Inform Adaptive Handovers in Human-Robot Collaboration. In Proceedings of the 2023 ACM/IEEE International Conference on Human-Robot Interaction (HRI '23), March 13–16, 2023, Stockholm, Sweden. ACM, New York, NY, USA, 9 pages. ([ACM](#) copy, [arXiv](#) copy, [dataset](#) on Bridges, [repo](#) on Github)

### Prerequisites

Candidates in Year 3 or later are preferred. Experience in machine learning (reinforcement learning) and data analysis is required.

### Additional Information

Applicants may be required to attend an interview.