Karlsruhe Institute of Technology

Autonomous Learning Robots(ALR)
Prof. Gerhard Neumann

## Project Type

- [x] Master Thesis
- [ ] Bachelor Thesis
- [ ] Research Project

## Supervisors

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## Difficulty

Algorithmic

Math

Application

# Instructing Robots using Verbal Feedback

## Description

Verbal communication is often the most natural and informative mode of interaction for humans. However, using unrestricted speech commands presents significant challenges. In recent years, we have seen significant progress in the development of large language models (LLM) and we are now starting to also witness their use in robotics [2].
Learning from demonstrations has been a common approach for teaching robot skills by providing them with an example of the desired behavior. While this is informative, it's not always feasible for a humans to do that. Therefore, we are also considering other types of feedback, such as preference-based feedback, where the human teacher is presented with two options and asked to select the better one. This pairwise comparison is then used to improve the robot policy.
This project aims to study various existing language models and incorporate them into a framework for learning from other feedback types, namely demonstrations and preferences.

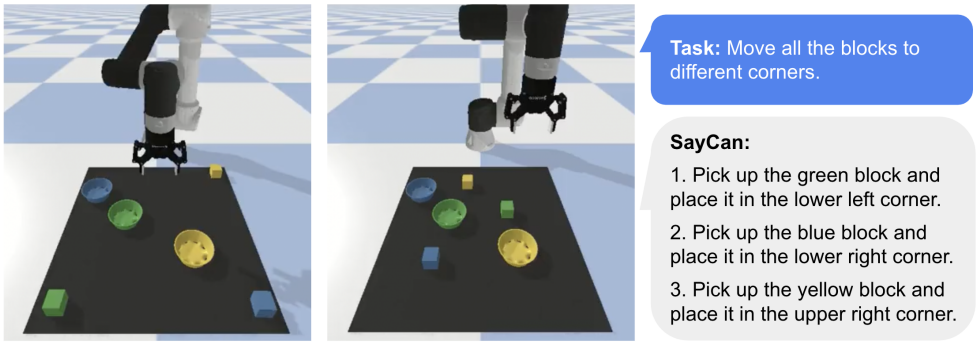


Figure 1: Illustration taken from [1] showing a possible scenario.

In this project, we want to investigate how LLMs can be used together with a novel algorithm that uses demonstrations and preferences, Adversarial Imitation Learning with Preferences (AILP)[3]. The development and evaluation of the extended algorithm will be performed on simulated robotic manipulation tasks.

## Tasks

The tasks in this project will involve:

- Testing baselines: Evaluating existing LLM and their applications in various robotics.
- Combining with Preferences Learning: Design and implement a new method that combines LLM and AILP.
- Evaluations: The combined algorithm will be evaluated in various common simulated manipulation tasks.

## References

[1] Michael Ahn et al. Do as i can and not as i say: Grounding language in robotic affordances. In *Proceedings of the 6th Conference on Robot Learning (CoRL)*, 2022.

[2] Mohit Shridhar, Lucas Manuelli, and Dieter Fox. Cliport: What and where pathways for robotic manipulation. In *Proceedings of the 5th Conference on Robot Learning (CoRL)*, 2021.

[3] Aleksandar Taranovic, Andras Kupcsik, Niklas Freymuth, and Gerhard Neumann. Adversarial imitation learning with preferences. In *International Conference on Learning Representations*, 2023.