

Research Statement

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1 Introduction

My research interests lie in human-AI interactions in the real world. One challenge is that human preferences are often inconsistent or contradictory with each other, which require AI agents to reason about human strategic actions to provide better assistance. Moreover, real-world interaction requires estimation of human motion in 3D space, involving multimodal algorithms combining camera and sensor data.

1.1 Alignment with Your Lab

The Precognition Lab proposed excellent works in robotic manipulation, including robotic arms and dexterous hands, as well as human motion trajectory forecasting. My research interests match your previous works well. Previously, I conducted published works on opponent modelling and human pose estimation, which can be helpful for human-robot interaction by precepting the human pose and actively forecasting the human intent. I will introduce my relevant experience in the following section.

2 Related Experience

2.1 Opponent Modelling

I have explored the problem of cooperating with an unseen partner in the setting of mixed cooperative-competitive games[2], from the perspective of multi-agent reinforcement learning (MARL) and game theory. Technically, we leverage contrastive learning to learn a consistent representation of the opponent's policy.

2.2 3D Hand Reconstruction from Blurry Monocular Images

Most current approaches focus on the blurriness problem in video, where the temporal information helps to reconstruct human motion. We recover hand motion from a single blurry image to utilise temporal information inherent in the image [1]. To overcome the ambiguity, we make multiple estimations for one image in a generative manner, and select the plausible ones with a learned selection module.

3 Future Plan

My proposed research directions include:

- 3D estimation in hand-robot interaction scenarios for interaction safety.
- Inverse Reinforcement Learning to manipulate following inconsistent human preferences with a given dataset or active interaction.

These ideas are preliminary, and I am eager to refine them to better align with the team. I am also open to any other related topics.

References

- [1] Yuming Chen, Rongyu Chen, Zhongqun Zhang, Yihua Cheng, and Hyung Jin Chang. Multi-hypothesis 3d hand mesh recovering from a single blurry image. In *International Conference on Multimedia and Expo (ICME)*, 2025.
- [2] Yuming Chen and Yuanheng Zhu. Policy representation opponent shaping via contrastive learning. In *International Conference on Neural Information Processing (ICONIP)*, 2023.