

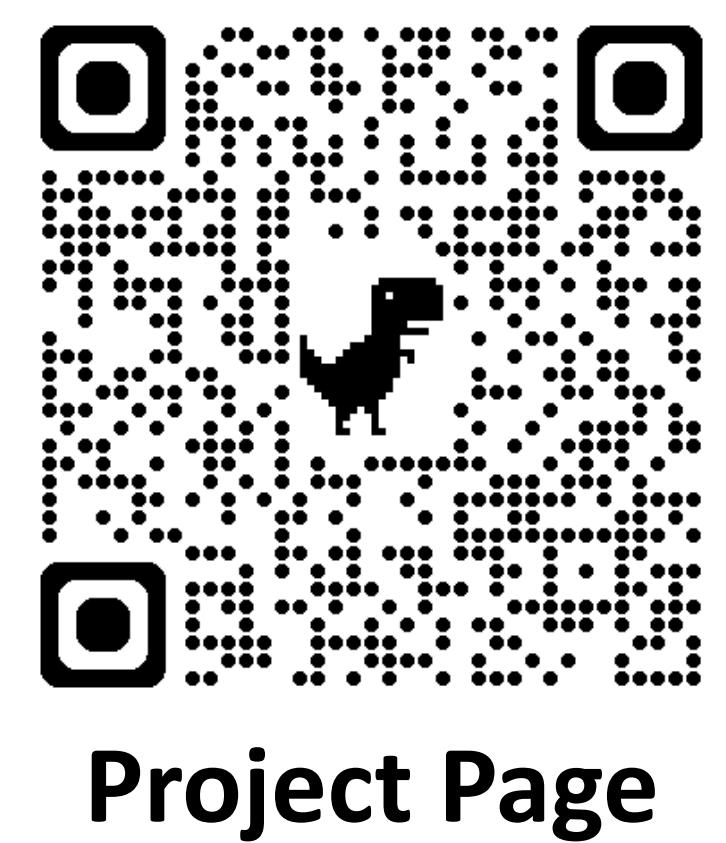


DexWorld: Learning Particle-Based World Model from Human for Robot Dexterous Manipulation

Zhengdong Hong¹*, Yulin Liu¹*, Haowen Hou¹, Bo Ai¹, Jun Wang¹, Tongzhou Mu¹, Yuzhe Qin¹, Jiayuan Gu¹, Hao Su¹ †

* Equal Contribution †University of California, San Diego

Welcome to discuss with us: yul266@ucsd.edu or hzddltql@gmail.com

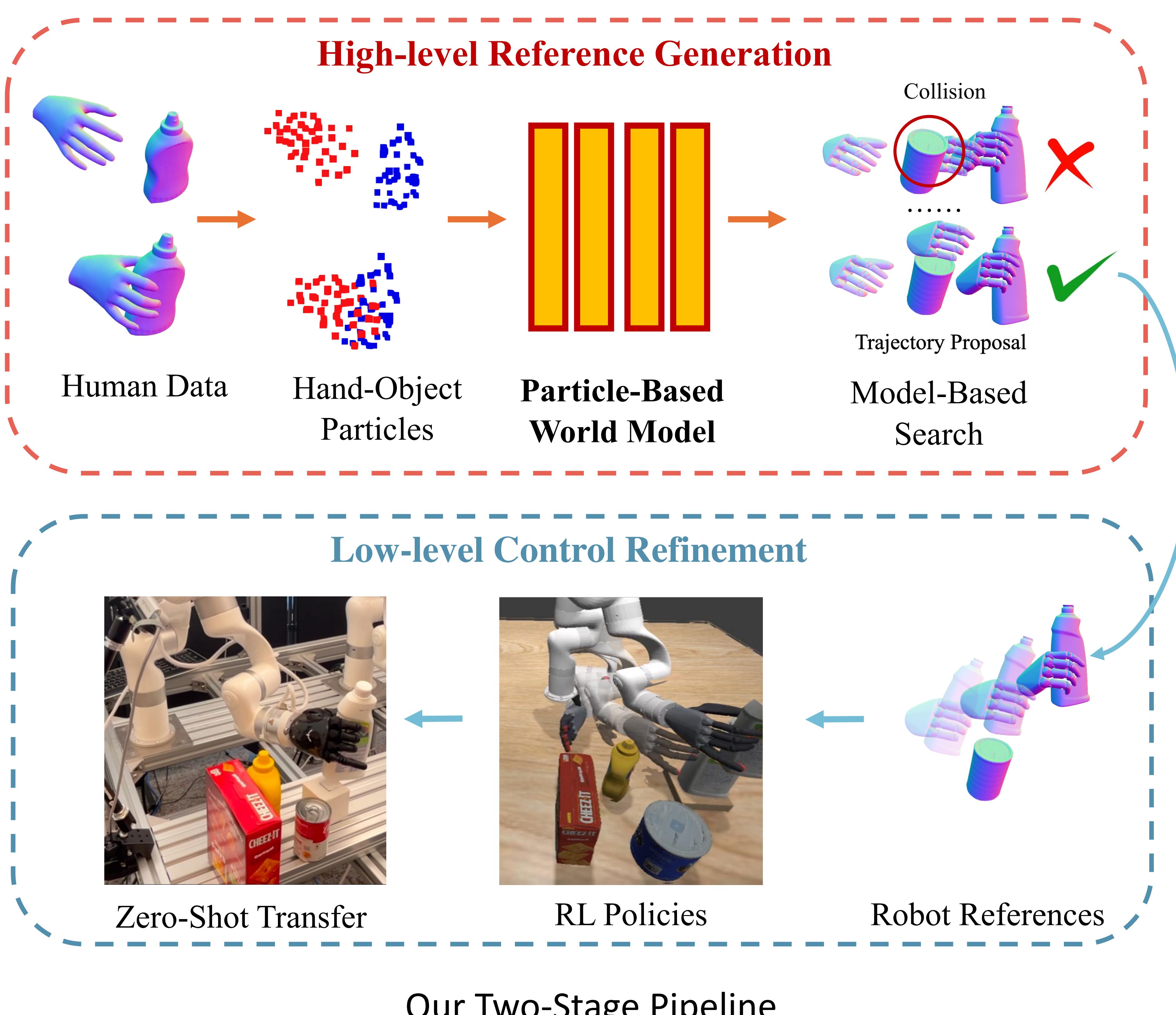


Project Page

Motivation

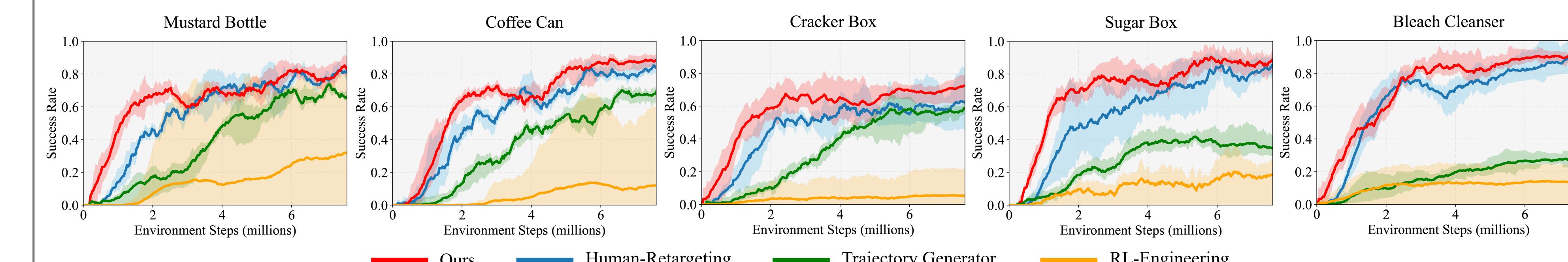
- Q1: What should we learn from the human data?
- Q2: How to learn efficient, generalizable robot dexterous manipulation?
- Our answer is **learning a generative model from human**:

1. We want to build a **simplified physical world with human experience**, which **contains** human hand-object interaction priors but **simplifies** the complex physics (e.g. contact, friction).
2. The model is **generalizable** and can adaptively **search** for diverse trajectories according to different task settings (**novel objects, novel poses, cluttered environments**, which is **unseen** in the world model training).
3. The searched trajectories can efficiently guide the low-level policy learning.



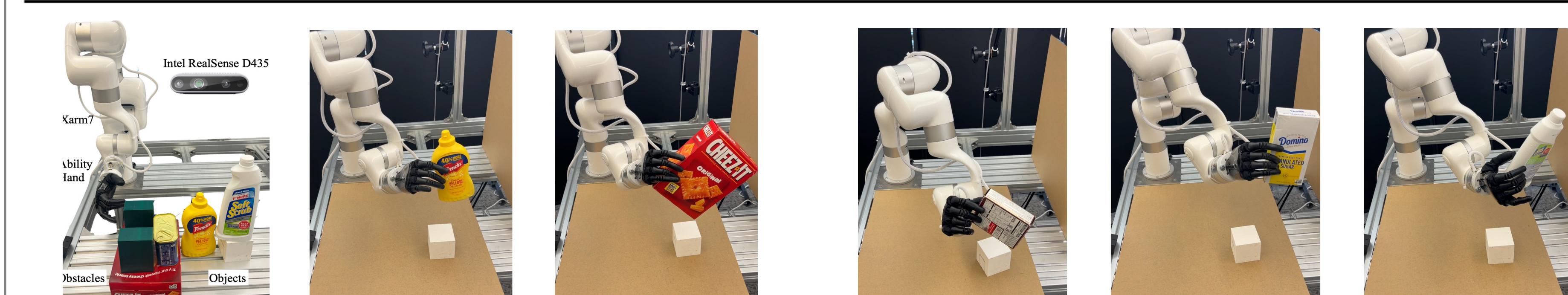
Experiments

Merit 1: Sample-Efficient RL-Policy Learning



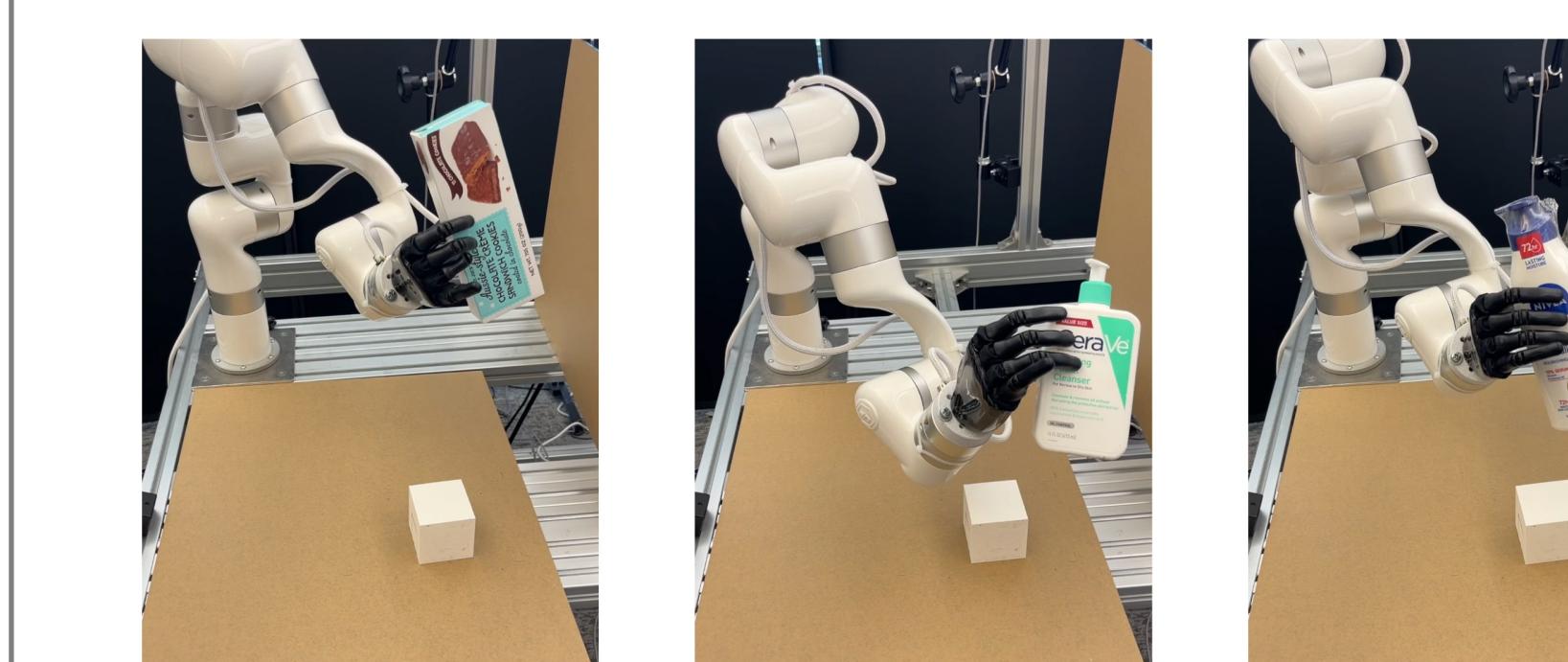
Merit 2: Generalize to Novel Object Configurations

SR (%) ↑ Ref. Trajectory	Seen YCB Objects		Unseen YCB Objects		Unseen In-the-Wild Objects				Avg.
	mustard	cracker	sugar	bleach	cerave	chocolate	gelsheet	moisture	
None	33	6	22	16	3	0	8	12	13
Human-Motion-Retargeting	78	61	-	-	-	-	-	-	-
Trajectory Generator	64	58	42	27	0	28	42	0	33
Ours	82	69	81	90	69	53	83	58	73

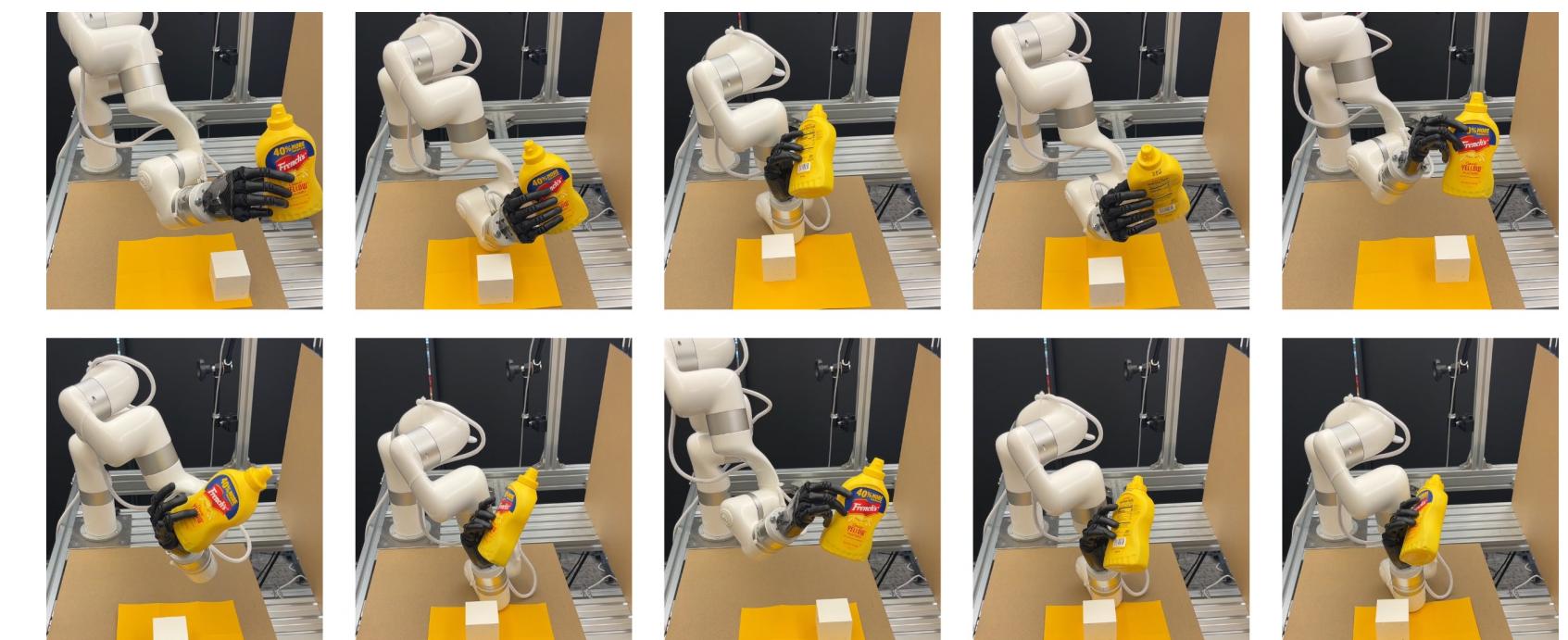


a) Seen objects in datasets

a) Unseen objects in datasets



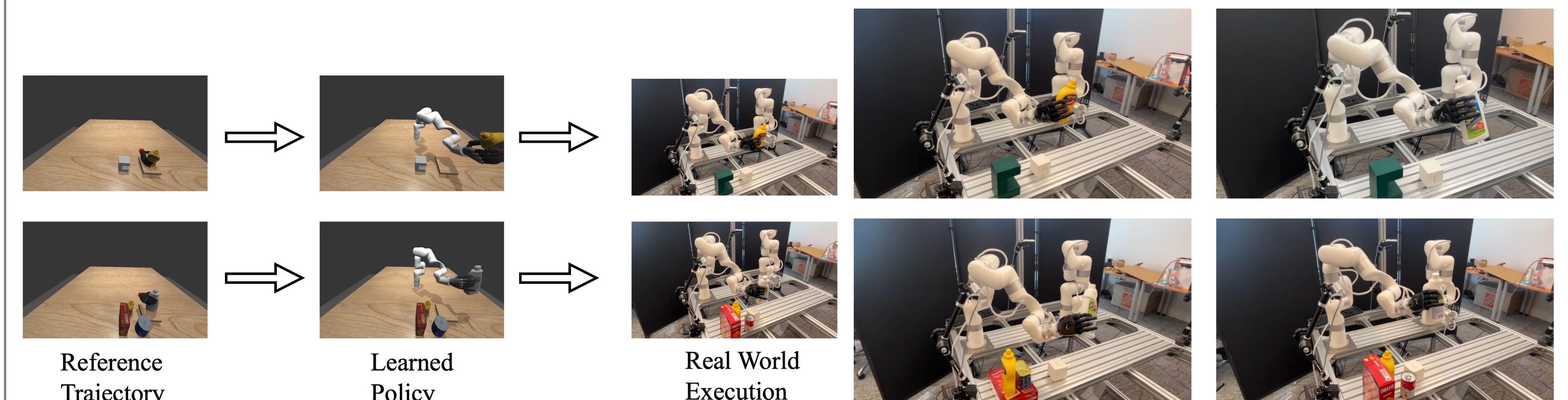
c) In-the-Wild daily objects



d) Novel object poses

Merit 3: Generalize to Novel Tasks (e.g. Grasp with obstacles)

SR(%) ↑ Ref. Trajectory	Cluttered scene-1		Cluttered scene-2		Cluttered scene-3		Avg.
	mustard	bleach	bleach	sugar	bleach	sugar	
None	7	12	0	3	0	0	4
Human-Motion-Retargeting	0	0	0	0	0	0	0
Trajectory Generator	0	0	18	2	0	0	3
Ours	77	85	82	83	78	62	78



e) Novel Tasks (e.g. Grasp with obstacles)