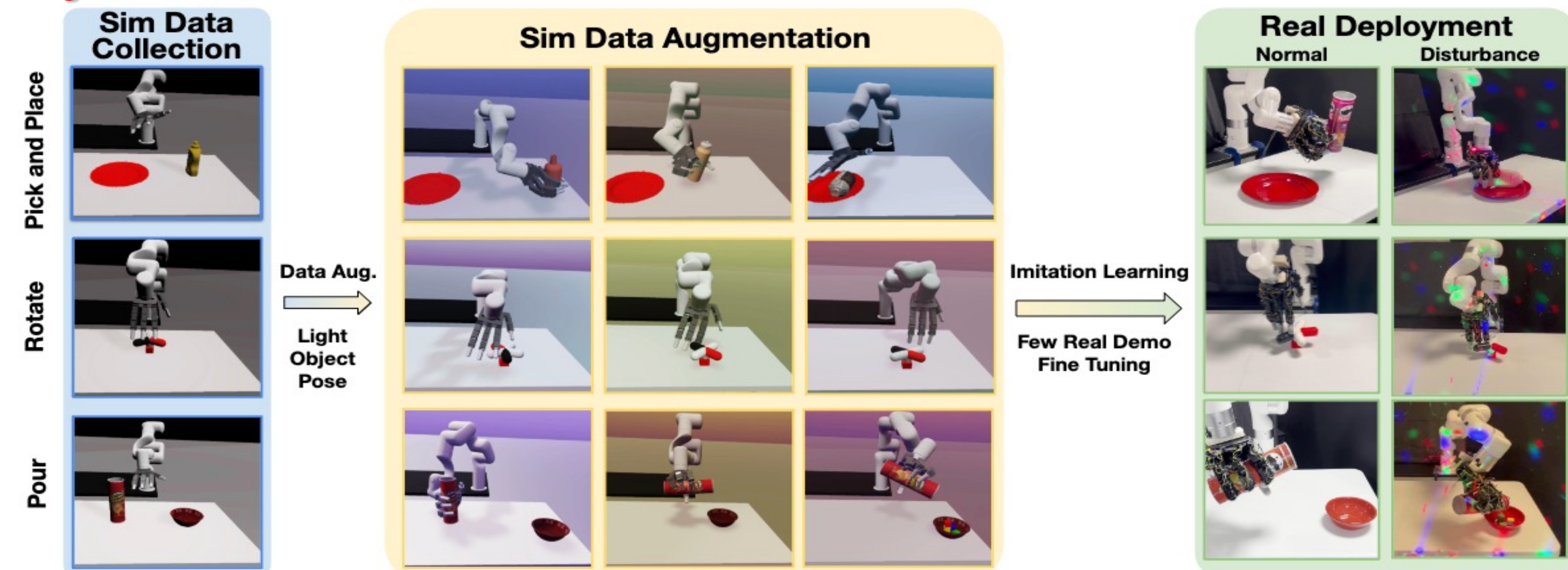


CyberDemo: Augmenting Simulated Human Demonstration for Real-World Dexterous Manipulation

Jun Wang^{1*} Yuzhe Qin^{1*} Kaiming Kuang¹ Yigit Korkmaz² Akhilan Gurumoorthy¹ Hao Su¹ Xiaolong Wang¹
¹UC San Diego ²University of Southern California

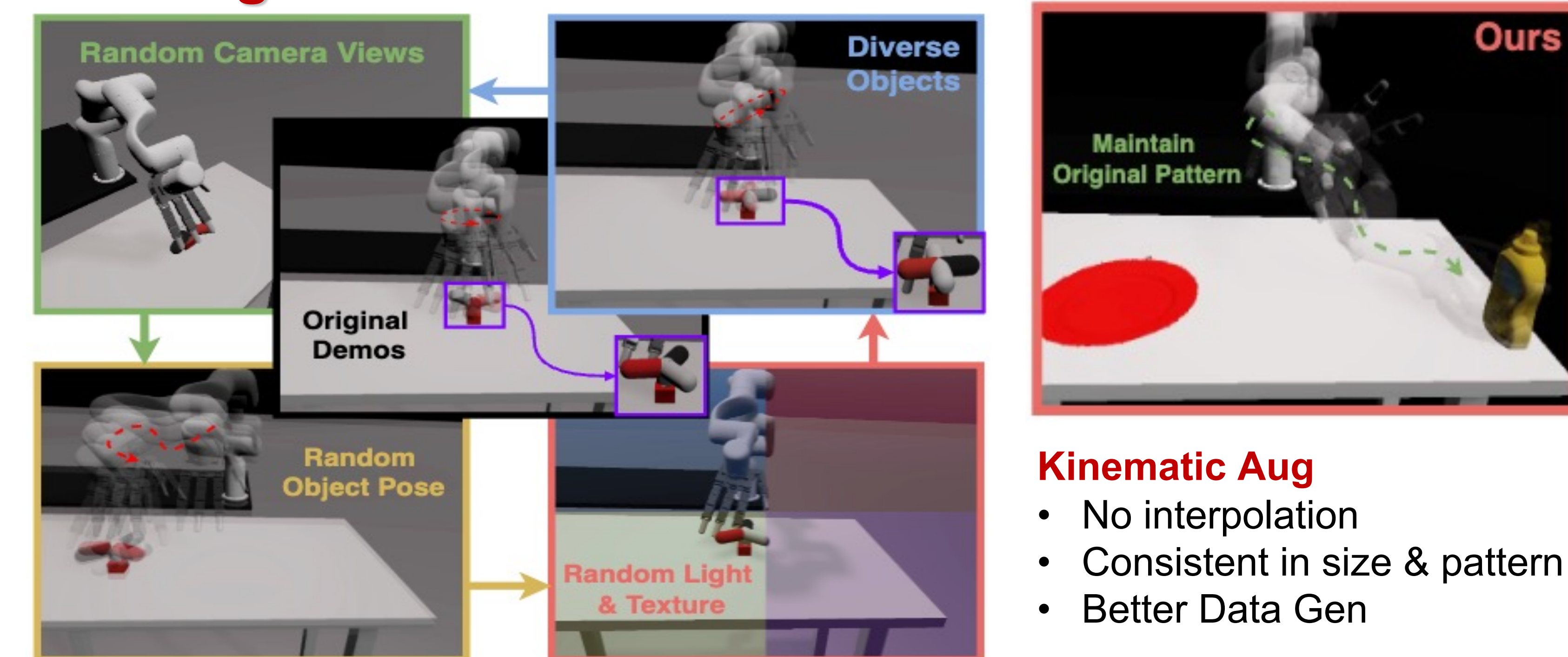


CyberDemo



We introduce **CyberDemo**, a novel approach to robotic imitation learning that leverages simulated human demonstrations for real-world tasks. By incorporating extensive data augmentation in a simulated environment, CyberDemo outperforms traditional in-domain real-world demonstrations when transferred to the real world, handling diverse physical and visual conditions. Regardless of its affordability and convenience in data collection, CyberDemo outperforms baseline methods in terms of success rates across various tasks and exhibits generalizability with previously unseen objects. For example, it can rotate novel tetra-valve and penta-valve, despite human demonstrations only involving tri-valves. Our research demonstrates the significant potential of simulated human demonstrations for real-world dexterous manipulation tasks

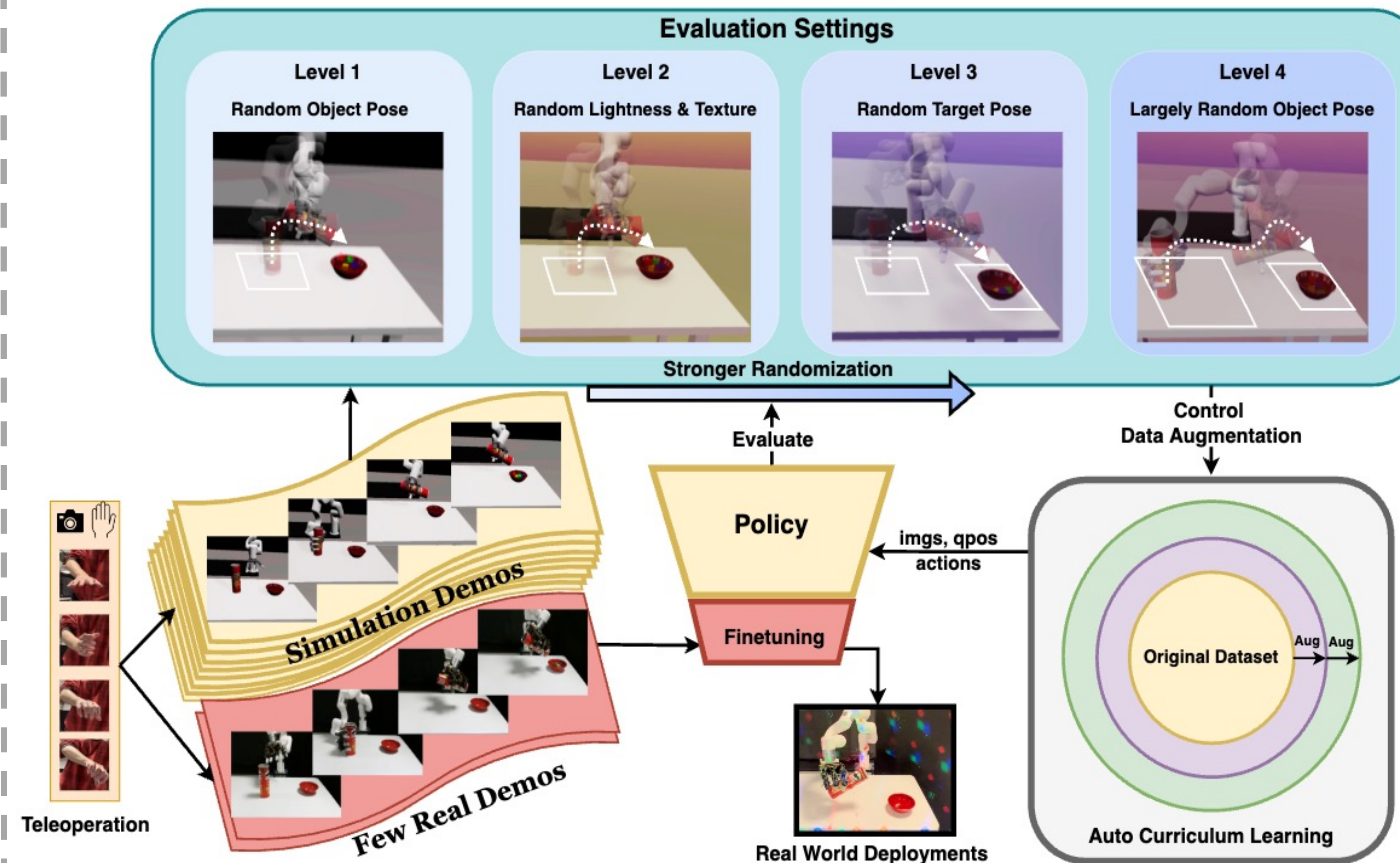
Data Aug



Kinematic Aug

- No interpolation
- Consistent in size & pattern
- Better Data Gen

Method



First, we collect both simulated and real demonstrations via vision-based teleoperation. Following this, we train the policy on simulated data, incorporating the proposed data augmentation techniques. During training, we apply automatic curriculum learning, which incrementally enhances the randomness scale based on task performance. Finally, the policy is fine-tuned with a few real demos before being deployed to the real world

Experiment

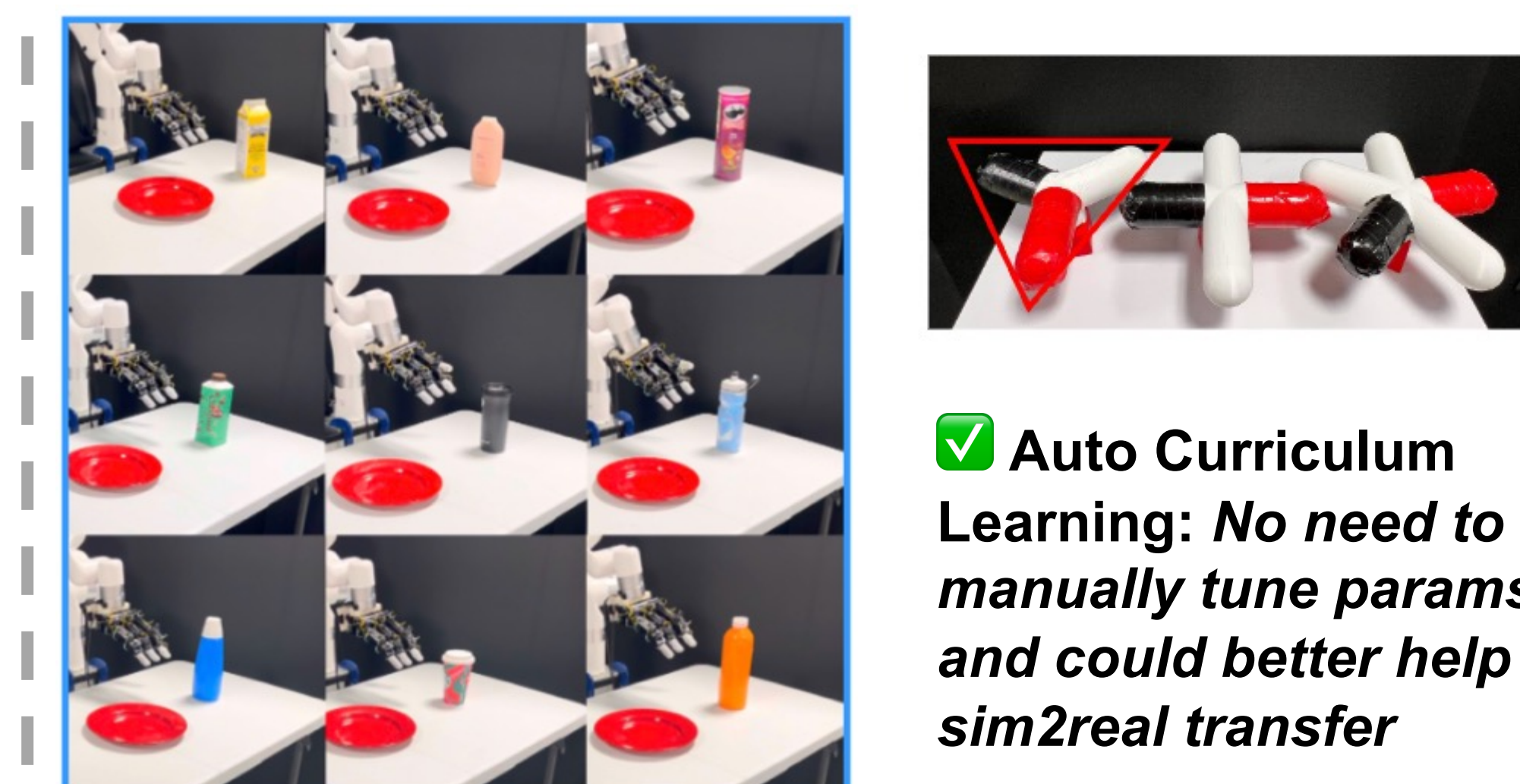
	Pick and Place Mustard Bottle (Single Object)				Pick and Place Tomato Soup Can (Single Object)				Pouring				Rotating			
	Level 1	Level 2	Level 3	Level 4	Level 1	Level 2	Level 3	Level 4	Level 1	Level 2	Level 3	Level 4	Level 1	Level 2	Level 3	Level 4
R3M	2 / 20	0 / 20	0 / 20	0 / 20	7 / 20	3 / 20	4 / 20	0 / 20	3 / 20	0 / 20	0 / 20	0 / 20	11 / 20	2 / 20	6 / 20	2 / 20
PVR	4 / 20	0 / 20	0 / 20	0 / 20	4 / 20	0 / 20	3 / 20	0 / 20	2 / 20	0 / 20	1 / 20	0 / 20	8 / 20	3 / 20	5 / 20	1 / 20
MVP	2 / 20	0 / 20	3 / 20	1 / 20	7 / 20	2 / 20	4 / 20	2 / 20	1 / 20	1 / 20	3 / 20	2 / 20	8 / 20	4 / 20	10 / 20	6 / 20
Ours	7 / 20	6 / 20	8 / 20	5 / 20	14 / 20	11 / 20	13 / 20	13 / 20	9 / 20	4 / 20	10 / 20	7 / 20	15 / 20	10 / 20	17 / 20	13 / 20

1. Main Comparison on Real Robot. perform evaluations of the models in four levels of real-world scenarios. These levels included: (a) Level 1: In Domain, (b) Level 2: Out of Position, (c) Level 3: Random Light, and (d) Level 4: Out of Position and Random Light.

Key Finding

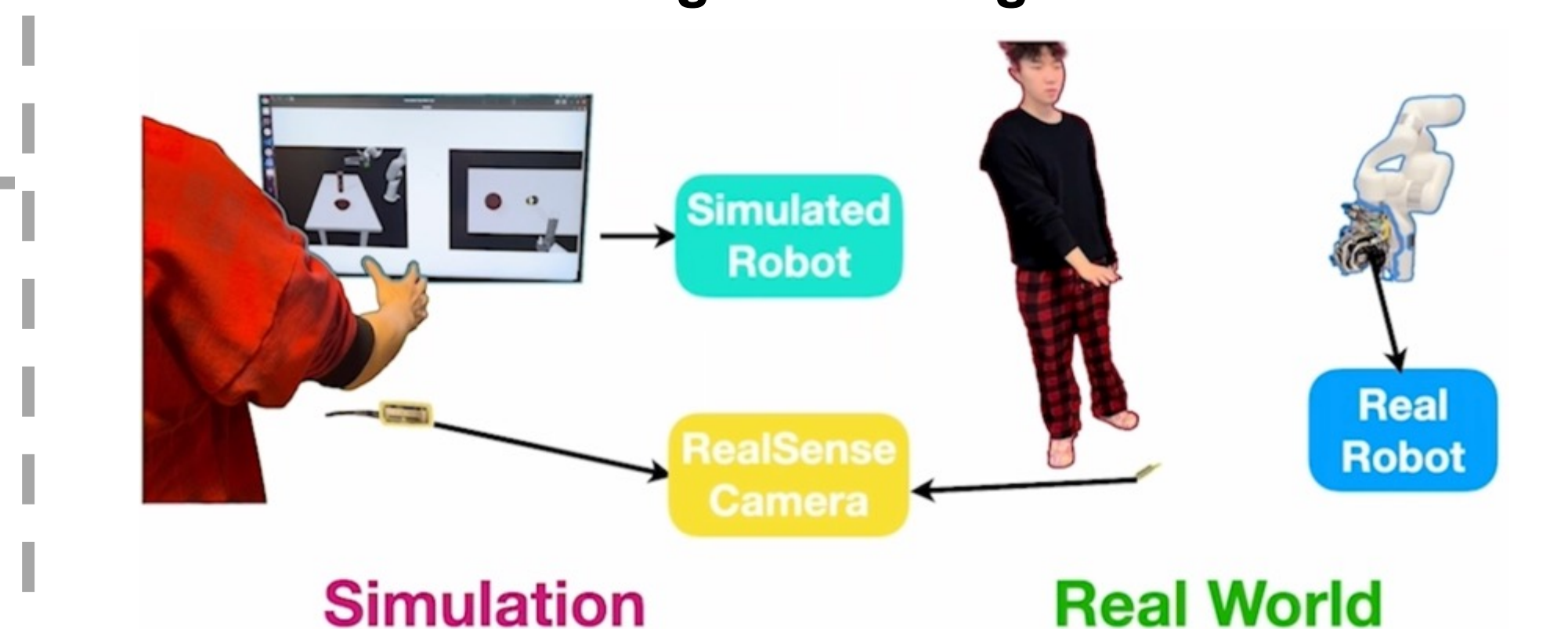


✓ Real learn from Sim: we could extract from sim to get **robust** and **Generalizable** real robot manipulation policy



✓ Auto Curriculum Learning: No need to manually tune params and could better help sim2real transfer

✓ Low Cost Teleop: we could easily collect many Sim demos and do aug with a single realsense cam



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