Real-to-Sim-to-Real for Scaling Robot Learning

Background:

In the field of embodied ai, behavior cloning for skills learning is progressing toward higher generality and robustness, where scaling the data plays a crucial role. Data collection via teleoperation is labor intensive, whereas simulation offers an effective avenue for data expansion. However, simple simulation exhibits domain gaps in both visual appearance and system dynamics, making the generated data inefficient for robot policy learning. An effective simulation environment should closely align with real-world scenes and support multifaceted data augmentation including lighting, background context, and object texture... Recent advances in 3D reconstruction and AIGC can rapidly synthesize photorealistic scenes and objects, thereby facilitating rapid construction of simulation environments.

Description:

In this project, we aim to build a simulation data generation pipeline that can render photorealistic images, support diverse camera and lighting configurations, and flexibly supports different robot embodiments with minimal dynamics domain gap. We will implement automatic generation of grasping poses and automated execution of manipulation skills. We further leverage 3D reconstruction for real-scene reconstruction and AIGC for synthesizing tabletop assets, yielding simulation environments that are consistent with the real settings. In addition, we will train policies (ACT, Diffusion Policy...) and the VLA models (OpenVLA-oft, Pi0.5...), co-training on both sim and real data to validate the effectiveness of the simulated data.

Your Tasks (some of the following):

1. **Constructing an Isaac Sim environment calibrated to the real-world configuration;**
2. **Implementing a pipeline for automatic grasp pose synthesis and their autonomous execution;**
3. **Generating scenes and objects with AIGC and 3D reconstruction;**
4. **Training robot policies with real and simulated data to quantify the contribution of simulated data.**

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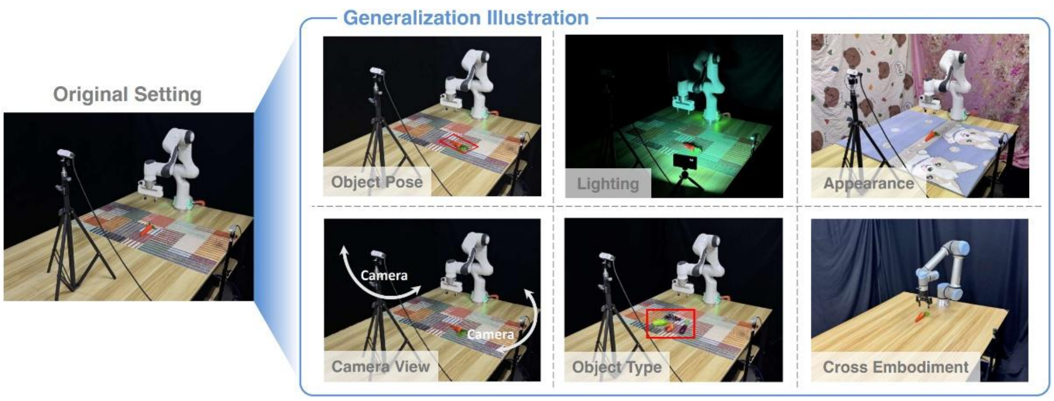

Fig.1: Robosplat [1]

[1] Sizhe Yang, Wenye Yu, Jia Zeng, Jun Lv, Kerui Ren, Cewu Lu, Dahua Lin, and Jiangmiao Pang. Novel demonstration generation with gaussian splatting enables robust one-shot manipulation. RSS 2025.