Using Ignition Gazebo to Train RL Agents for Robotic Grasping

Ignition Community Meeting (June 2021)

June 30, 2021

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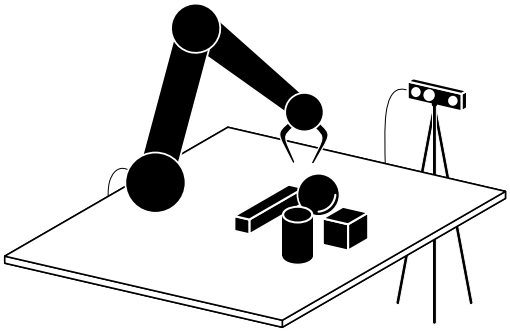
Meeting agenda: https://docs.google.com/document/d/1rJpGluIZtnuKxDHqykwFHfHnjMsQnrvhHOIVtDkyn6s

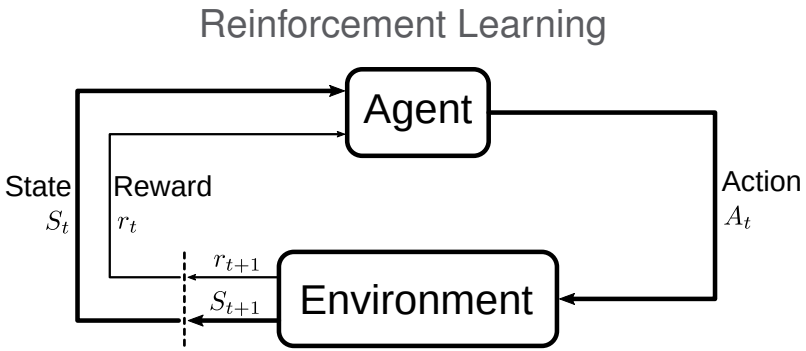
Vision-Based Robotic Grasping of Diverse Objects

Objective



Vision-Based Robotic Grasping of Diverse Objects

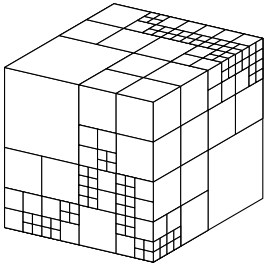
Approach

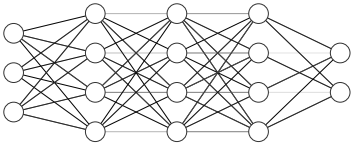


Vision-Based Robotic Grasping of Diverse Objects

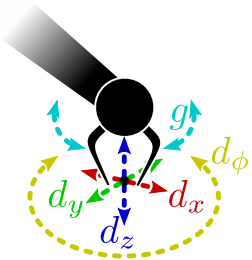
End-to-End Policy

Octree Observations



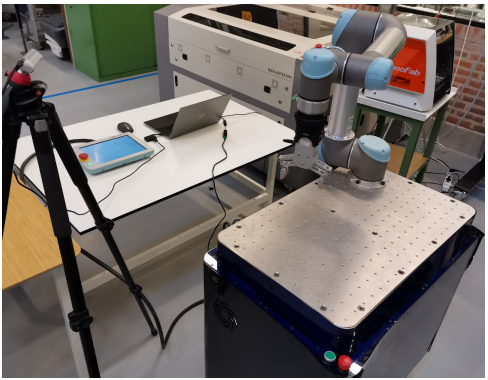


Continuous Actions



Vision-Based Robotic Grasping of Diverse Objects

Sim2Real Transfer



How to Create RL Environments inside Ignition Gazebo?

Gym-Ignition

Gym-Ignition

- Interface for Ignition Gazebo
- Tooling for creation of OpenAI Gym environments
  - Compatibility with RL frameworks (e.g. Stable Baselines3)

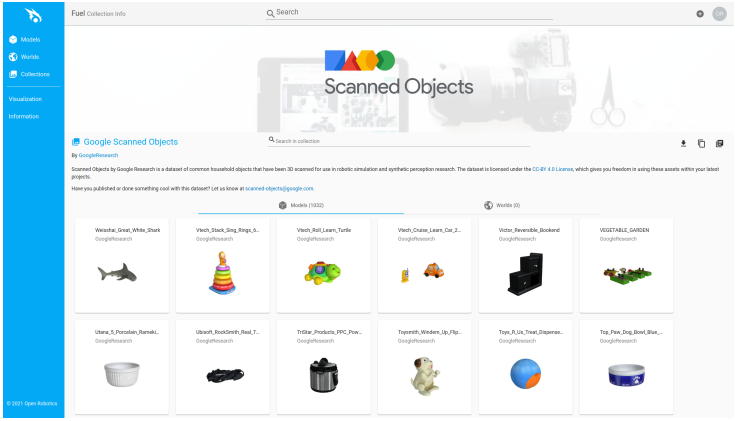
robotology / gym-ignition

Framework for developing OpenAI Gym robotics environments simulated with Ignition Gazebo

Ferigo et al. 2020. Gym-Ignition: Reproducible Robotic Simulations for Reinforcement Learning. In 2020 IEEE/SICE International Symposium on System Integration (SII). 885–890.

Where to Find Models?

Ignition Fuel



No Inertial Properties?

- Estimate

Too Much Geometry?

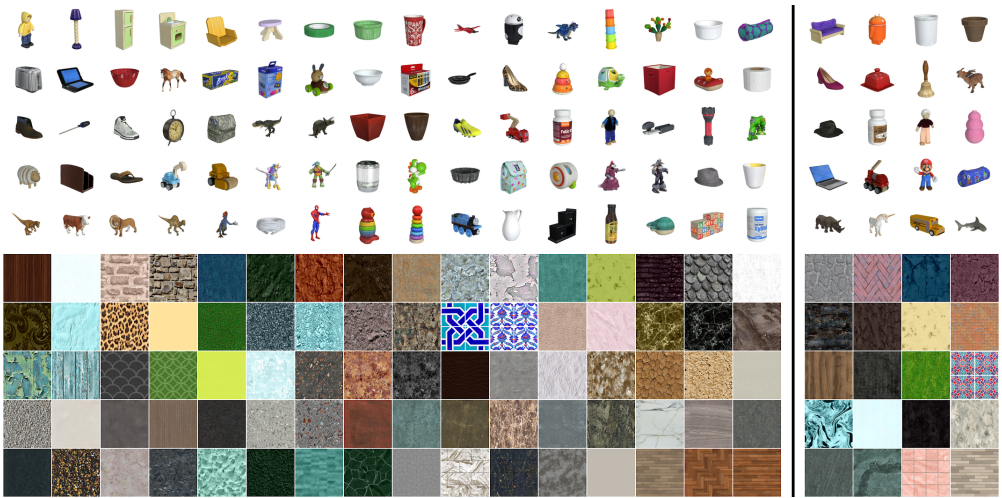
- Decimate

Open-Source Libraries

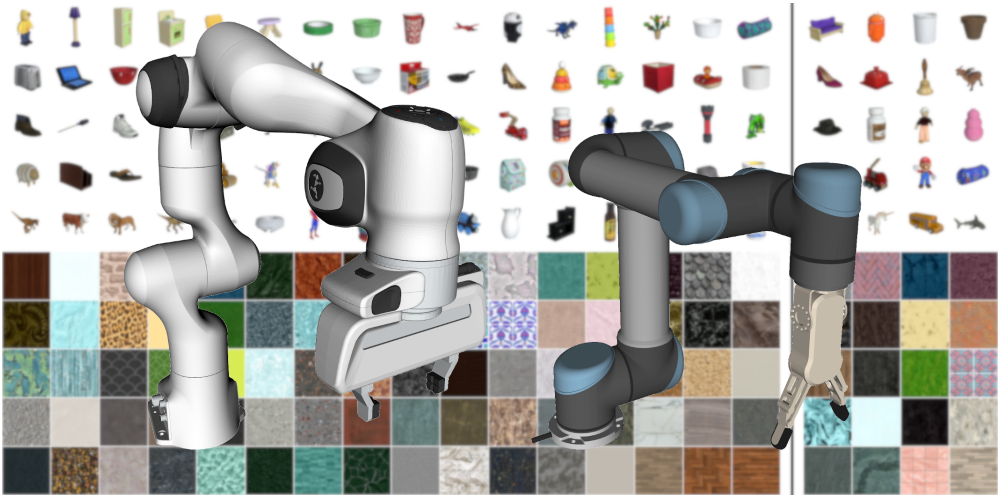
- intel-isl/**Open3D**
- mikedh/**trimesh**
- ...

Models

Object Datasets (Training | Testing)

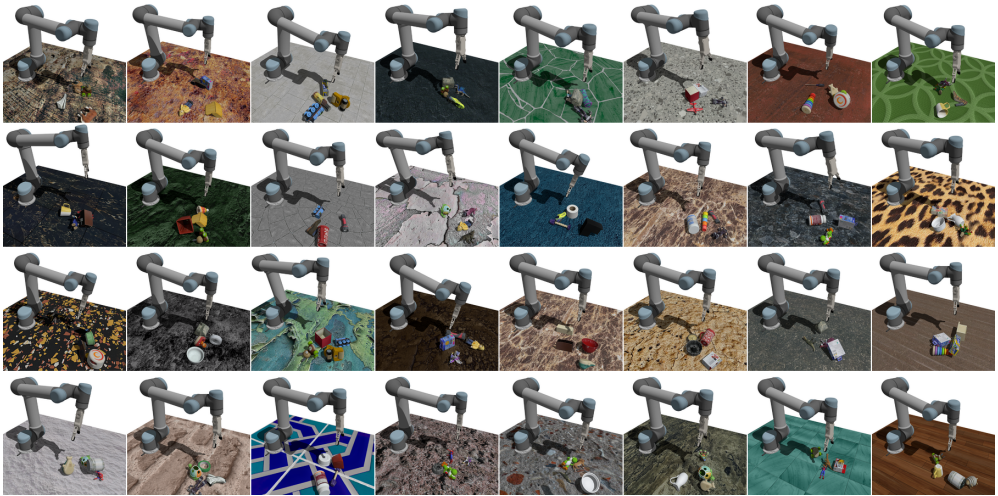


Models
Robots



Domain Randomization

Visual Examples

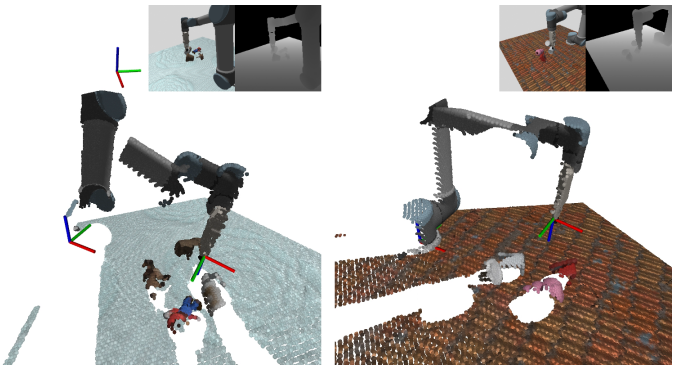


Domain Randomization

Further Randomization

Random

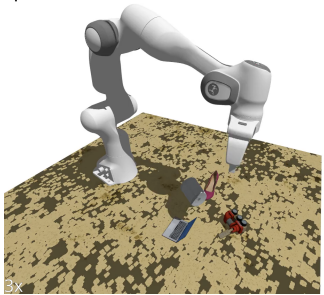
- Objects
  - Model
  - Scale
  - Mass
  - Friction
  - Pose
- Ground plane texture
- Initial robot configuration
- Camera
  - Pose
  - Sensory noise



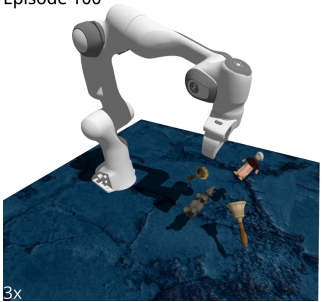
Training

Simulation - Panda (Video Example)

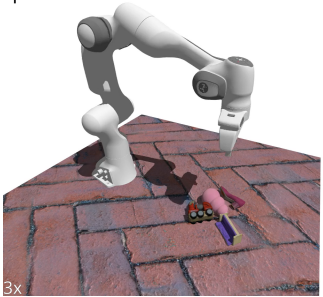
Episode 0



Episode 100

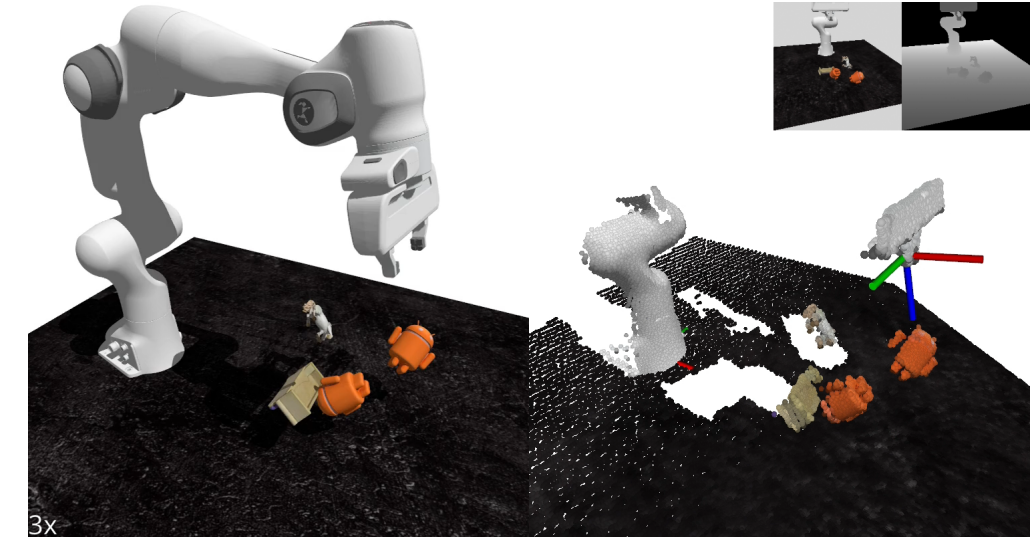


Episode 1000



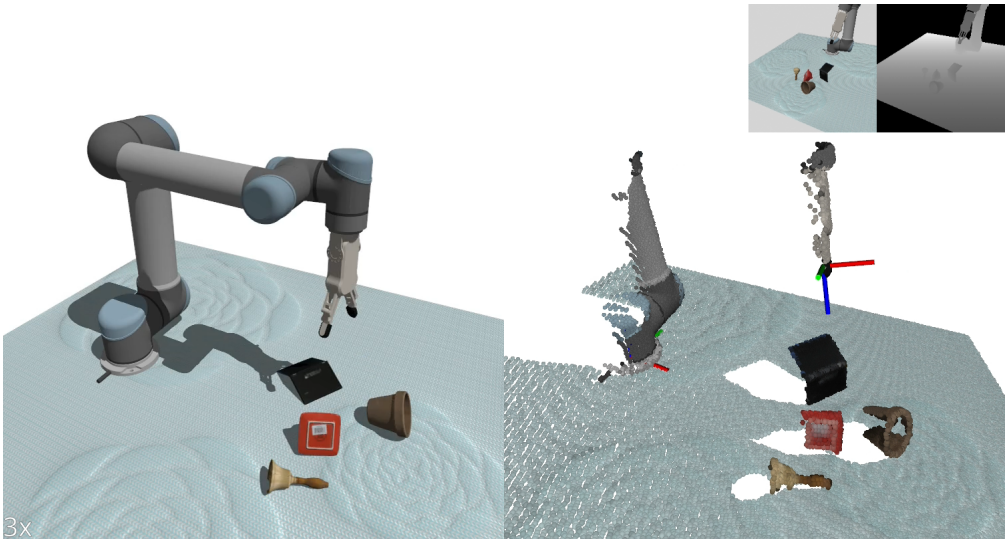
Trained Agent

Simulation - Panda (Video Example)



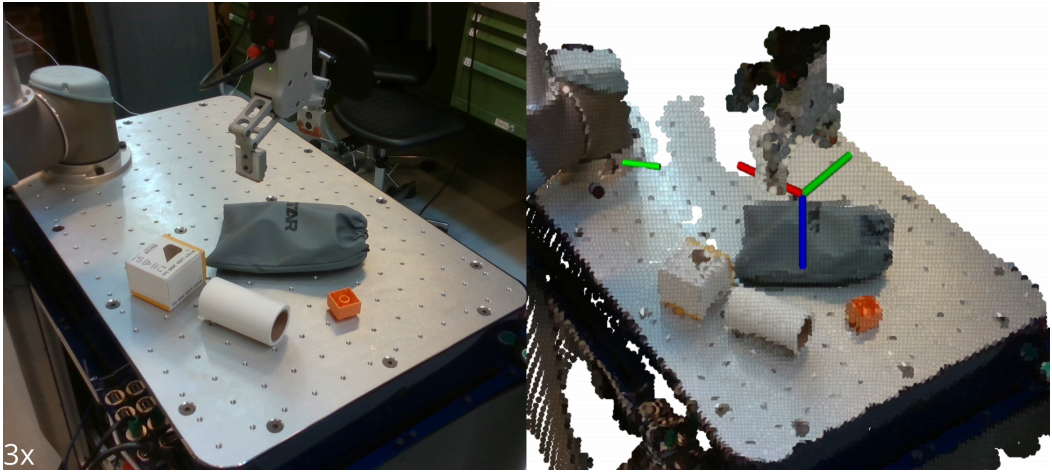
Trained Agent

Simulation - UR 5 (Video Example)



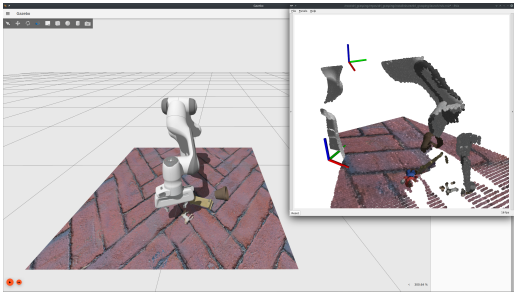
Sim2Real

Real - UR 5 (Video Example)



GitHub Repository and Examples

AndrejOrsula/**drl_grasping**



Pre-Built Docker Image

- ~7.5 GB

```
docker pull andrejorsula/drl_grasping:latest
```

Using Pre-Trained Agents

```
drl_grasping/docker/run.bash andrejorsula/drl_grasping:latest ros2 run drl_grasping ex_enjoy_pretrained_agent.bash
```

Training Your Own Agents

```
drl_grasping/docker/run.bash andrejorsula/drl_grasping:latest ros2 run drl_grasping ex_train_agent.bash
```