

Using Ignition Gazebo to Train RL Agents for Robotic Grasping

Ignition Community Meeting (June 2021)

June 30, 2021

Andrej Orsula

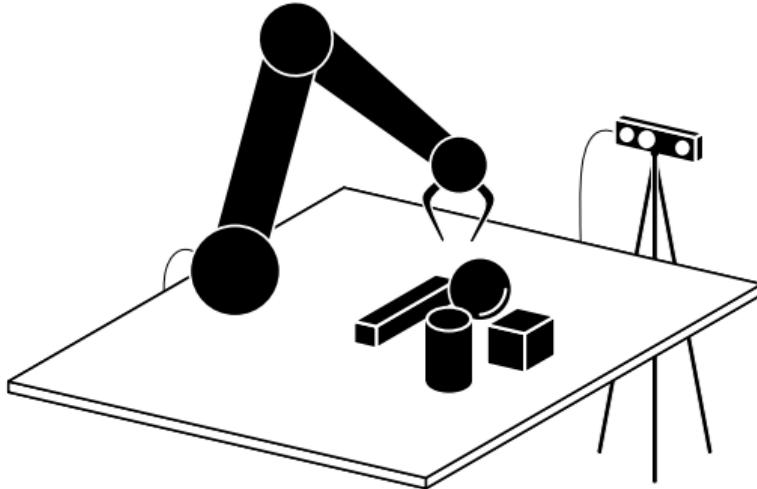
MSc in Robotics
Aalborg University
Denmark



AALBORG UNIVERSITY

Vision-Based Robotic Grasping of Diverse Objects

Objective

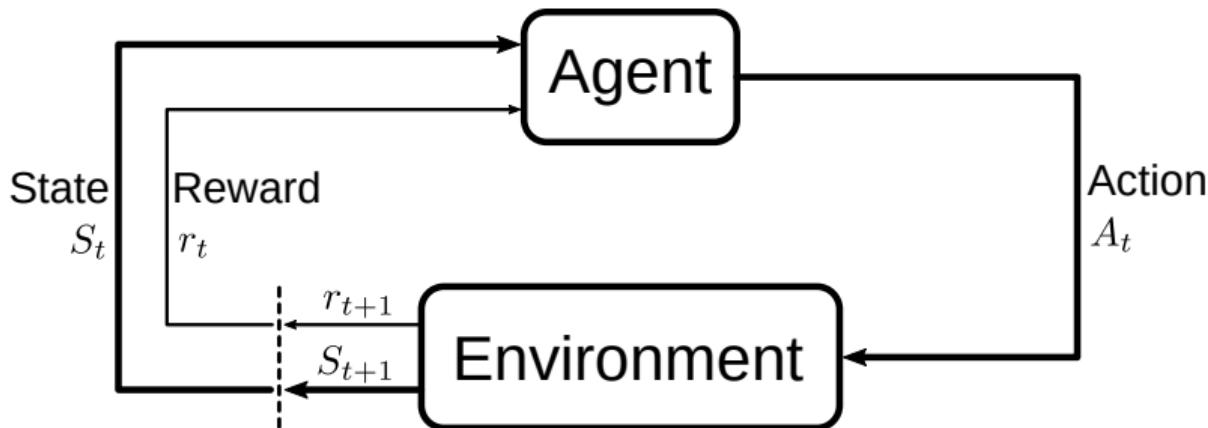


Vision-Based Robotic Grasping of Diverse Objects

Approach



Reinforcement Learning

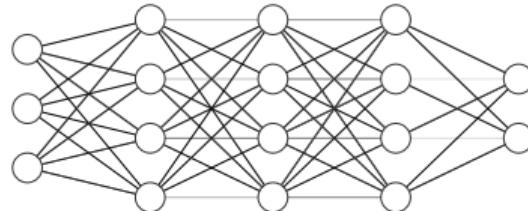
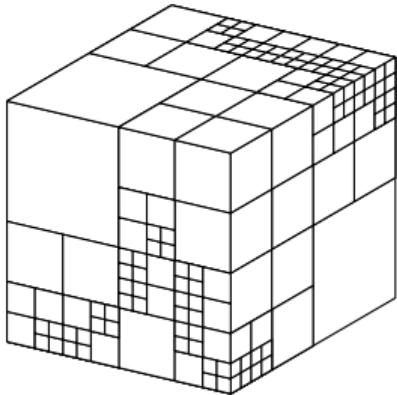


Vision-Based Robotic Grasping of Diverse Objects

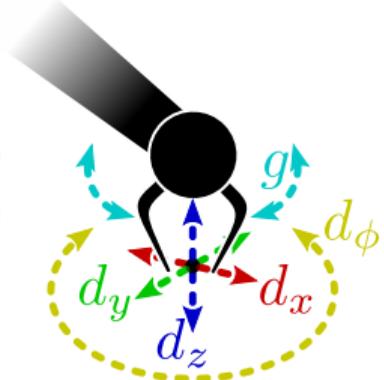
End-to-End Policy



Octree
Observations

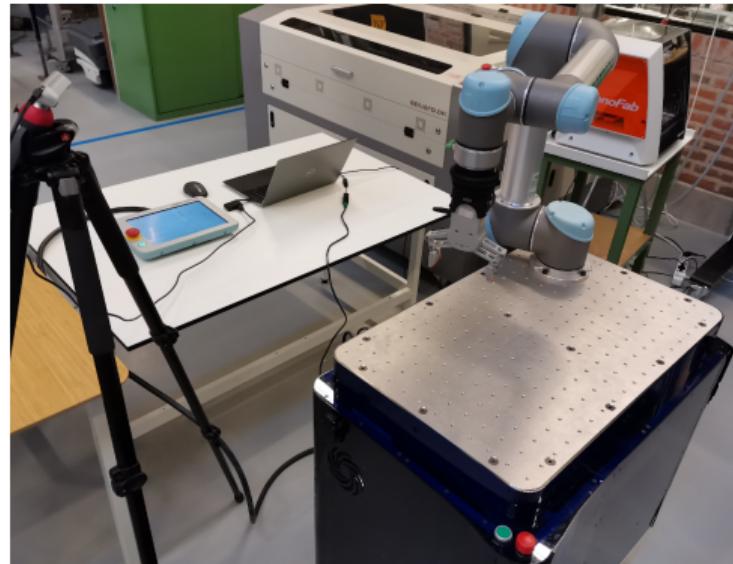


Continuous
Actions



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



Where to Find Models?

Ignition Fuel

Fuel Collection Info

Search

Scanned Objects

Search in collection

Google Scanned Objects By GoogleResearch

Scanned Objects by Google Research is a dataset of common household objects that have been 3D scanned for use in robotic simulation and synthetic perception research. The dataset is licensed under the CC-BY 4.0 License, which gives you freedom in using these assets within your own projects.

Have you published or done something cool with this dataset? Let us know at scanned-objects@google.com.

Models (1932) Worlds (0)

Welsch_Great_White_Shark_GoogleResearch	Vtech_Stack_Sing_Rings_GoogleResearch	Vtech_Ball_Learn_Turtle_GoogleResearch	Vtech_Cruise_Learn_Car_2_GoogleResearch	Victor_Reversible_Bookend_GoogleResearch	VEGETABLE_GARDEN_GoogleResearch
Utensil_5_Porcelain_Bowl_GoogleResearch	Ubisoft_RockGraffiti_Reusable_Tote_GoogleResearch	TriStar_Products_PVC_Powder_GoogleResearch	ToySmith_Windup_Up_Flip_Flop_GoogleResearch	Toys_R_Us_Treat_Dispenser_GoogleResearch	Top_Paw_Dog_Bowl_Blue_GoogleResearch

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No Inertial Properties?

- ▶ Estimate

Too Much Geometry?

- ▶ Decimate

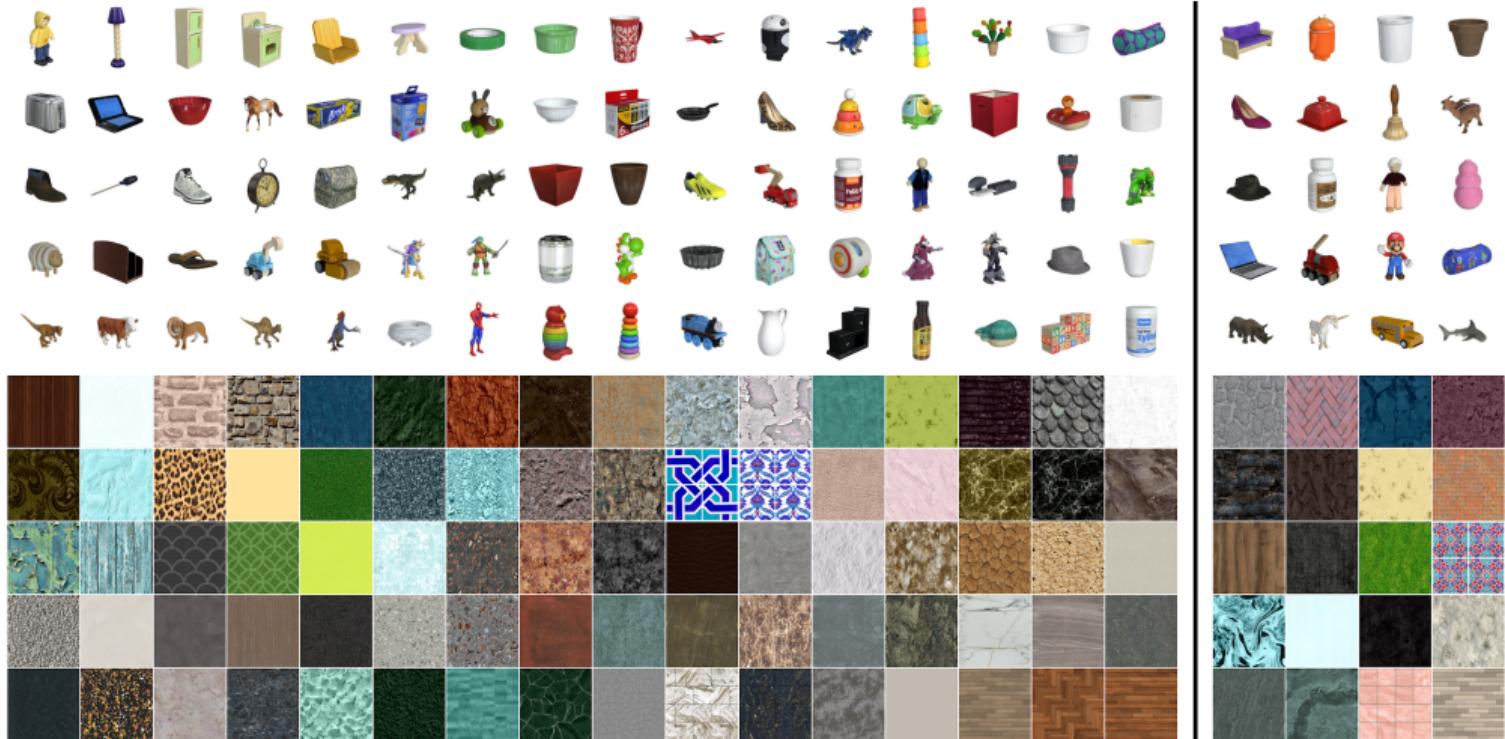
Open-Source Libraries

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



Models

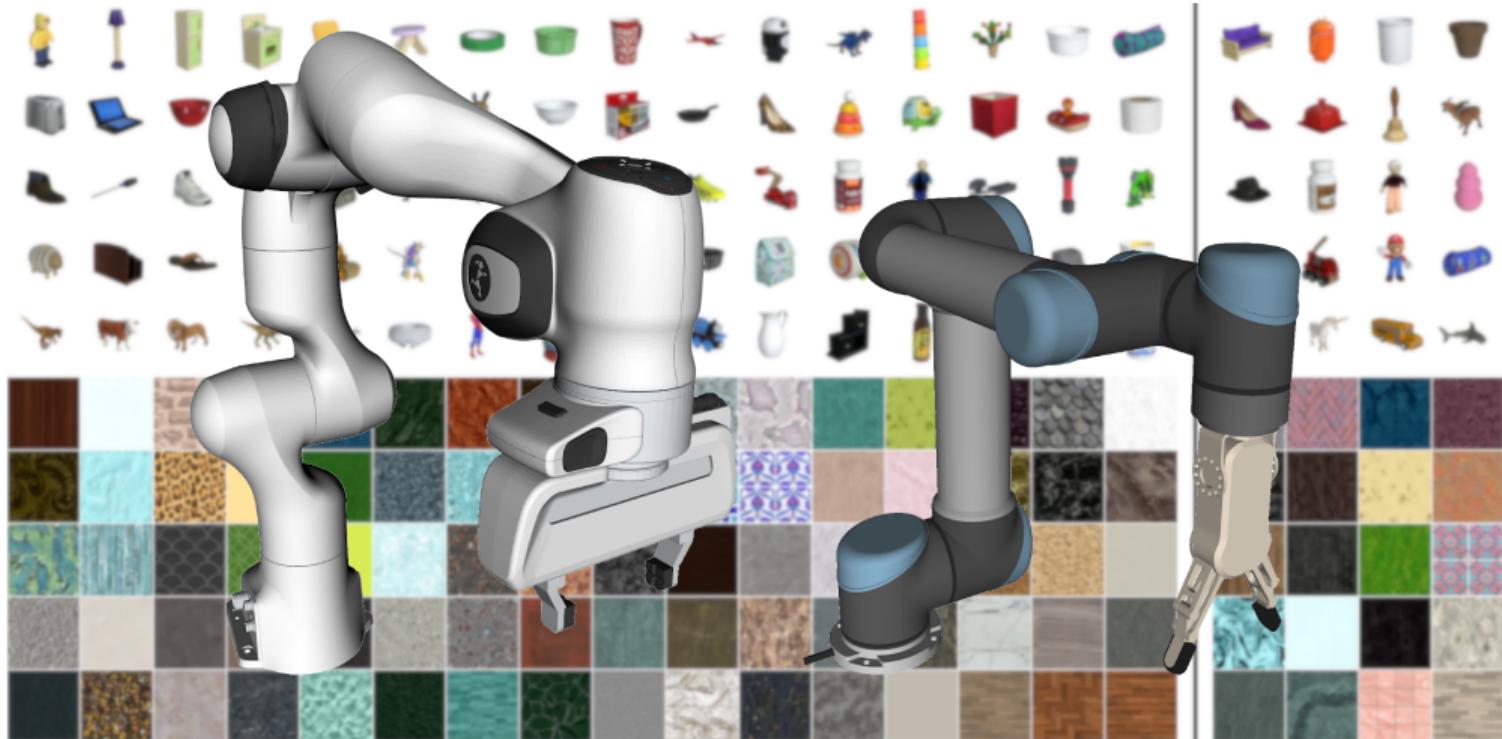
Object Datasets (Training | Testing)





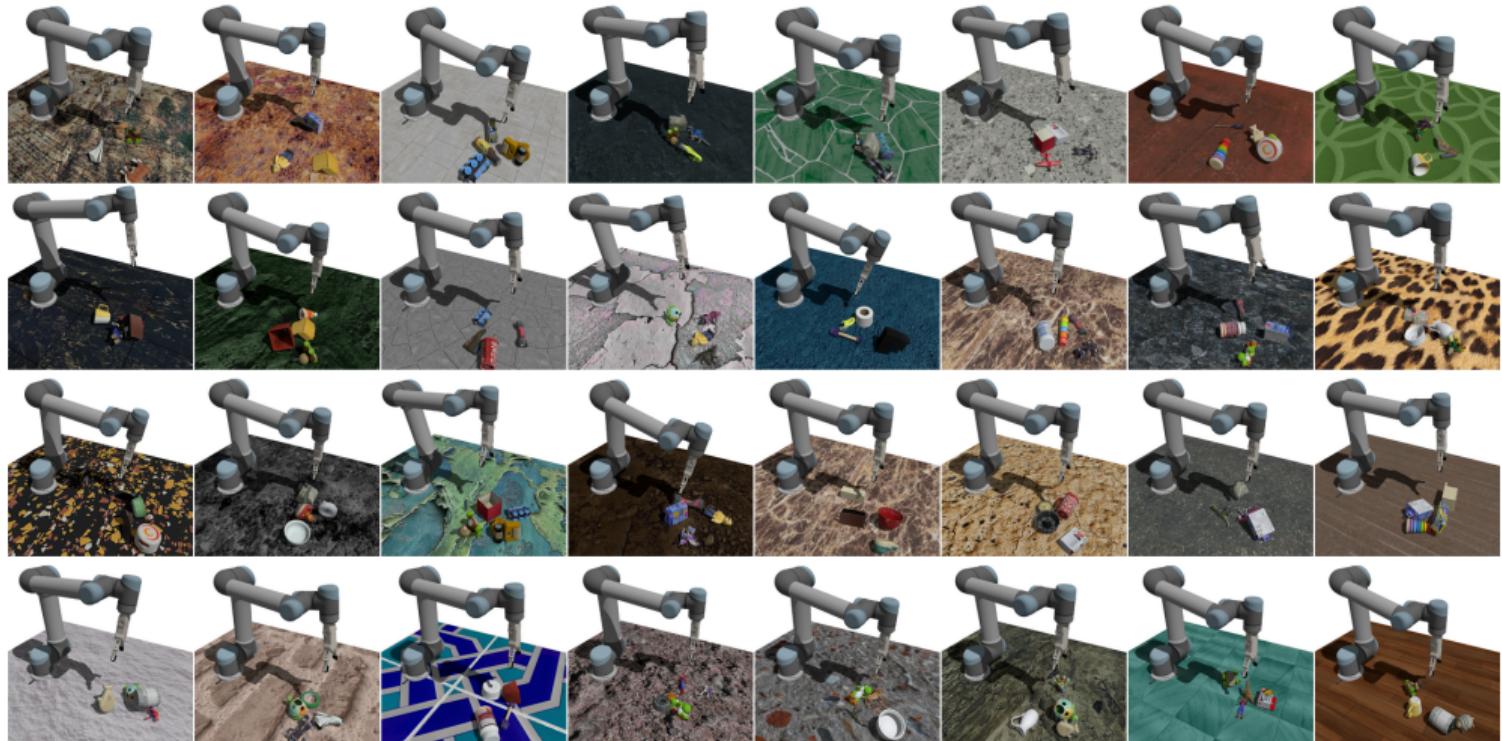
Models

Robots



Domain Randomization

Visual Examples



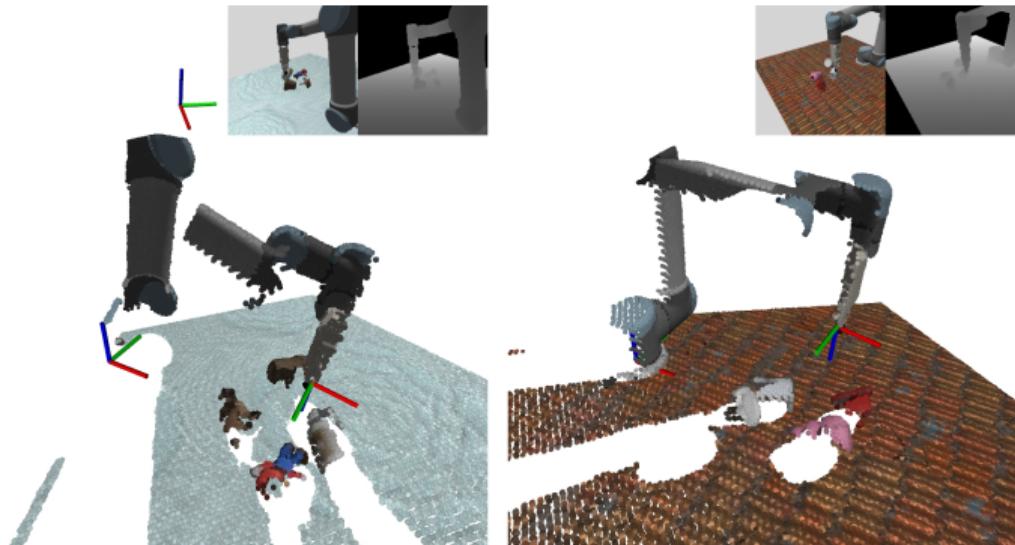


Domain Randomization

Further Randomization

Random

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

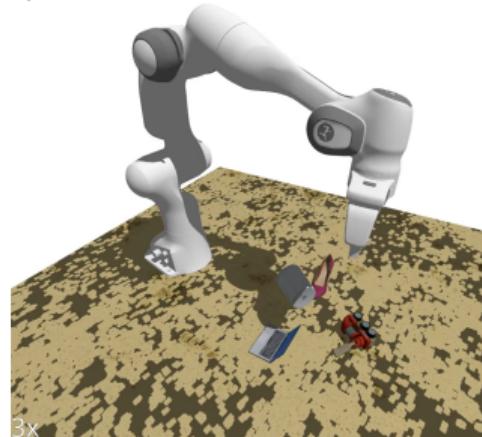




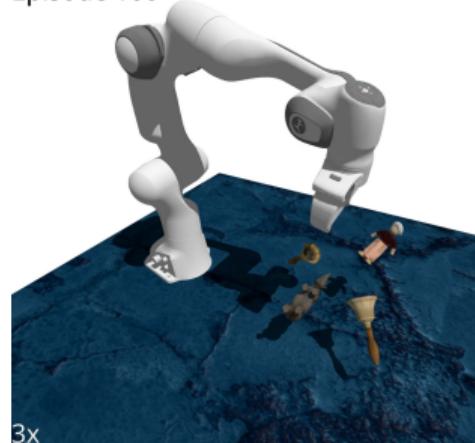
Training

Simulation - Panda (Video Example)

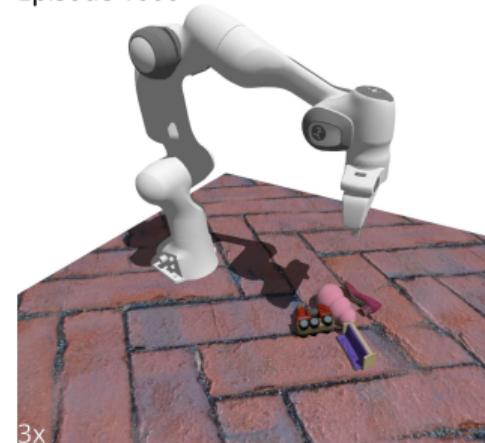
Episode 0



Episode 100



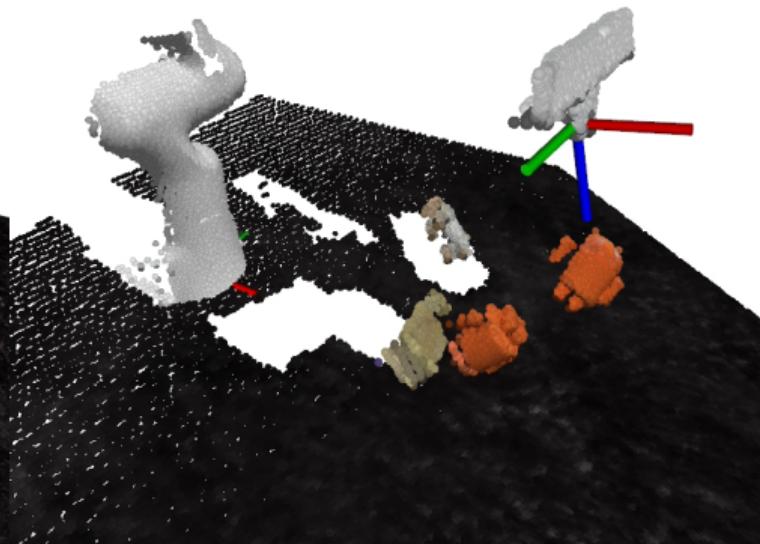
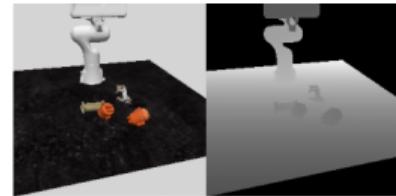
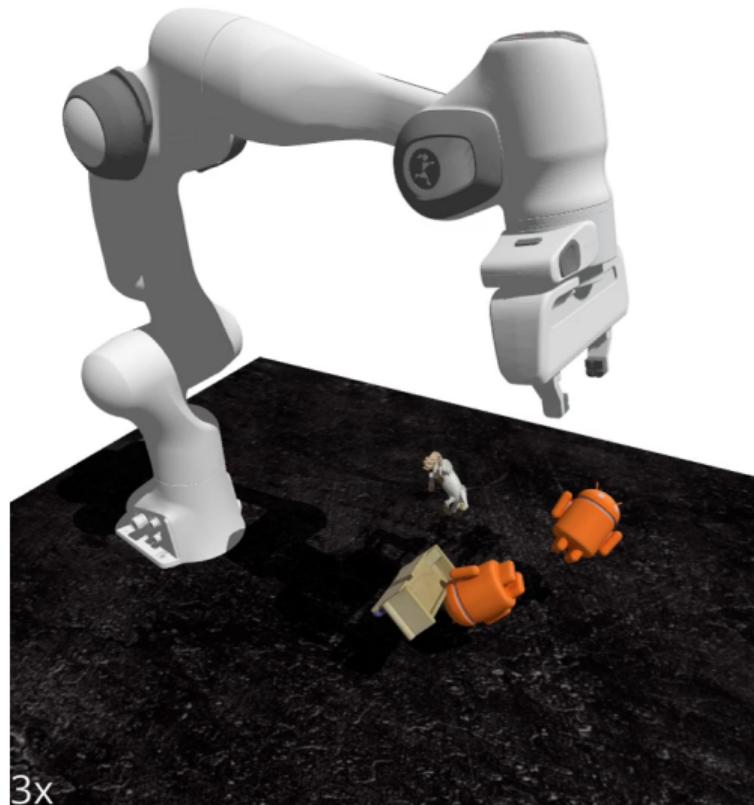
Episode 1000





Trained Agent

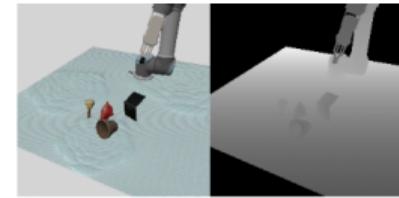
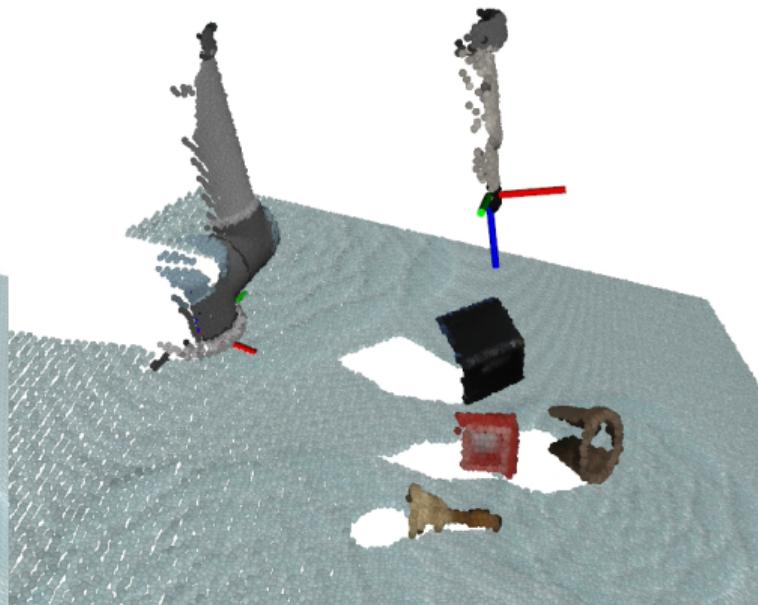
Simulation - Panda (Video Example)





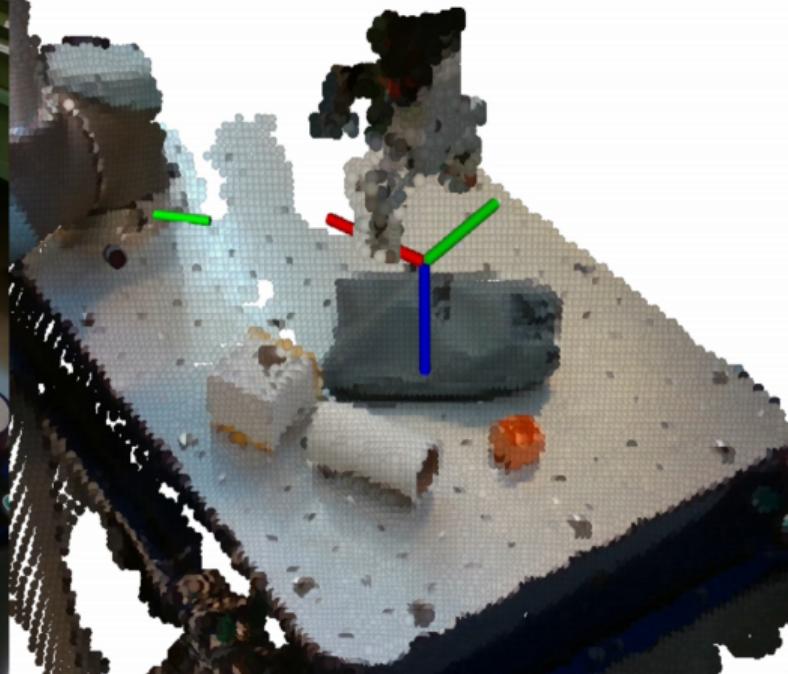
Trained Agent

Simulation - UR 5 (Video Example)



Sim2Real

Real - UR 5 (Video Example)





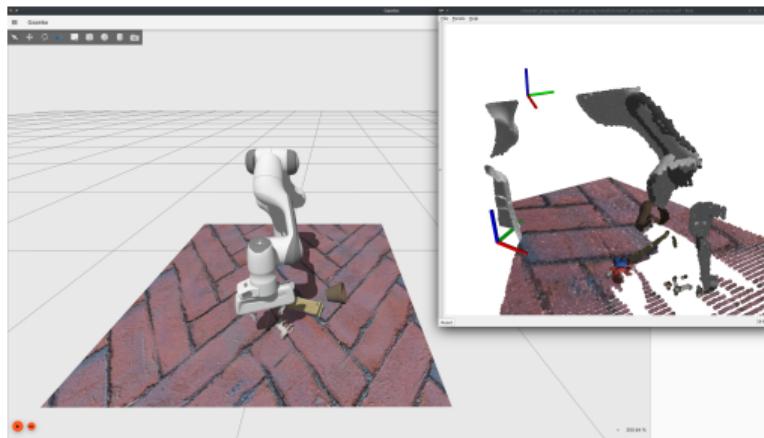
GitHub Repository and Examples

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.bash
```