

# Using Ignition Gazebo to Train RL Agents for Robotic Grasping

Ignition Community Meeting (June 2021)

June 30, 2021

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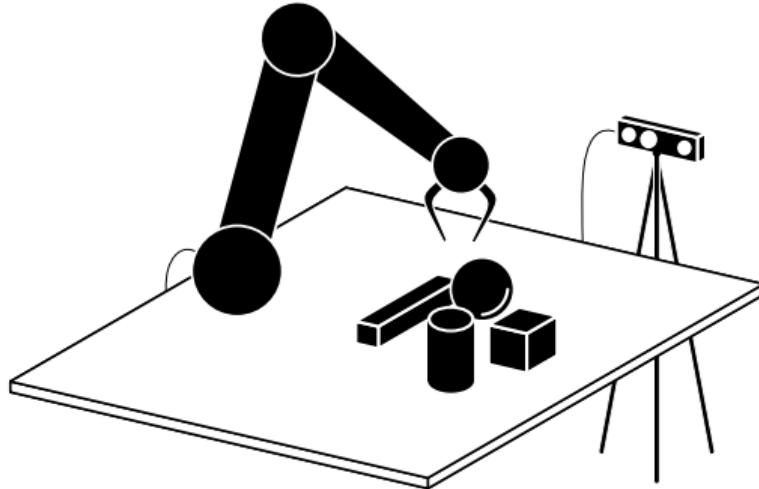
MSc in Robotics  
Aalborg University  
Denmark



AALBORG UNIVERSITY

# Vision-Based Robotic Grasping of Diverse Objects

Objective

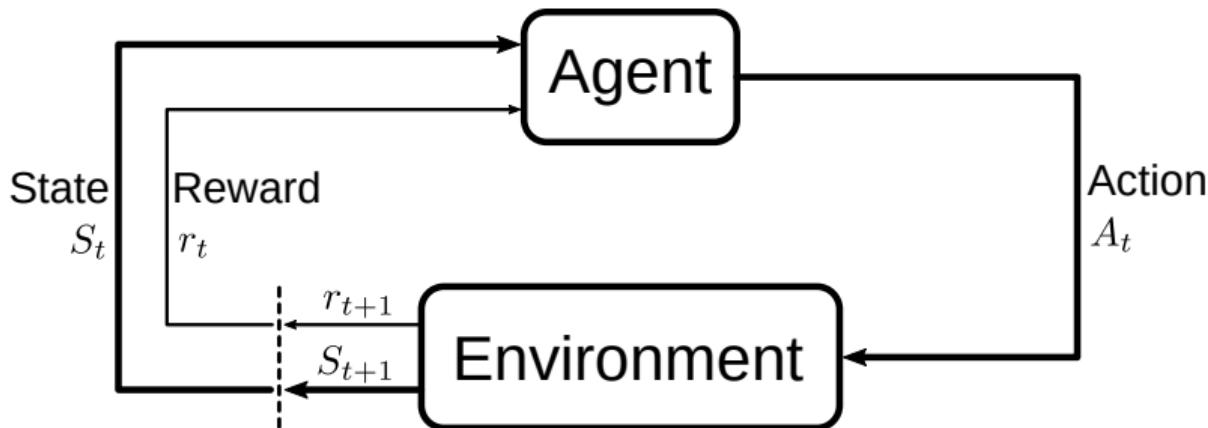


# Vision-Based Robotic Grasping of Diverse Objects

## Approach



### Reinforcement Learning

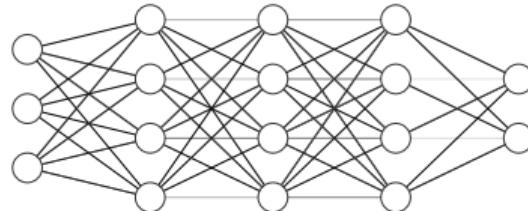
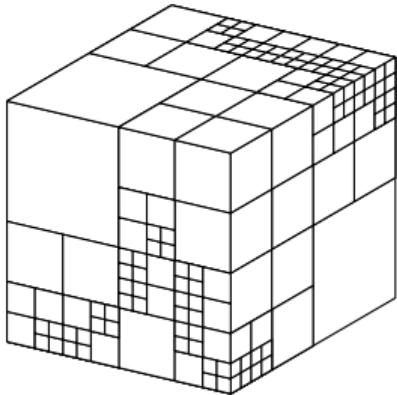


# Vision-Based Robotic Grasping of Diverse Objects

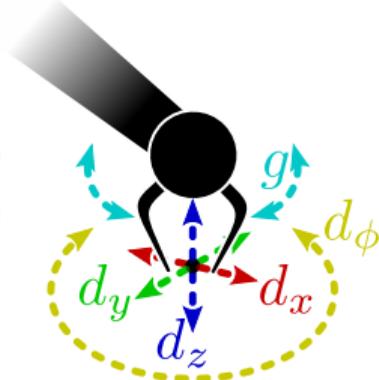
End-to-End Policy



Octree  
Observations

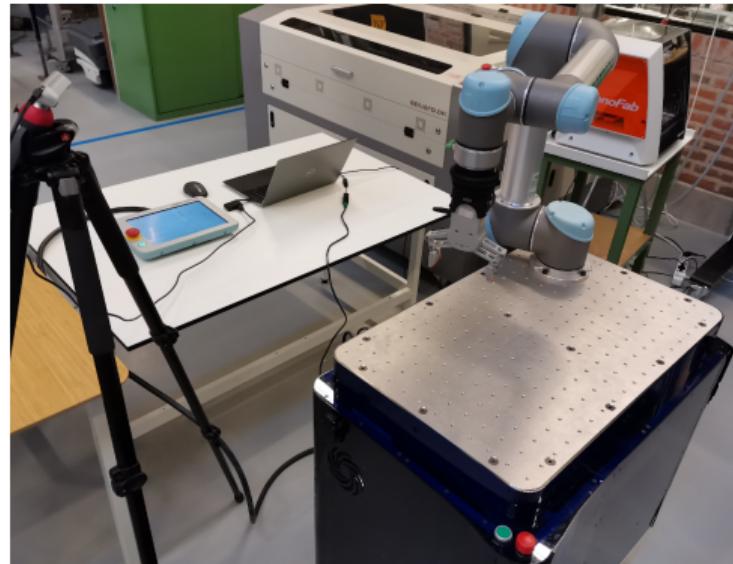


Continuous  
Actions



# 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](mailto: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

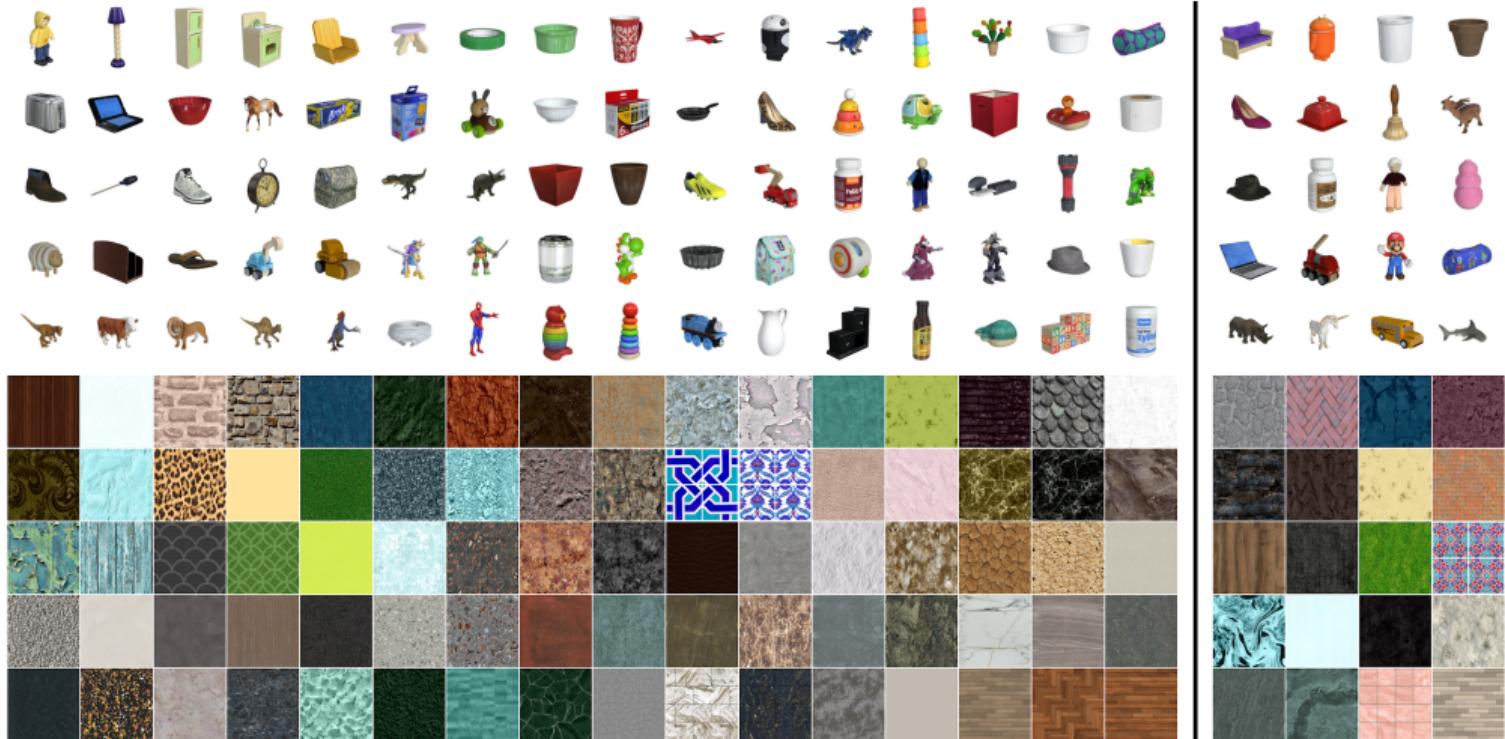
Open-Source Libraries

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



## Models

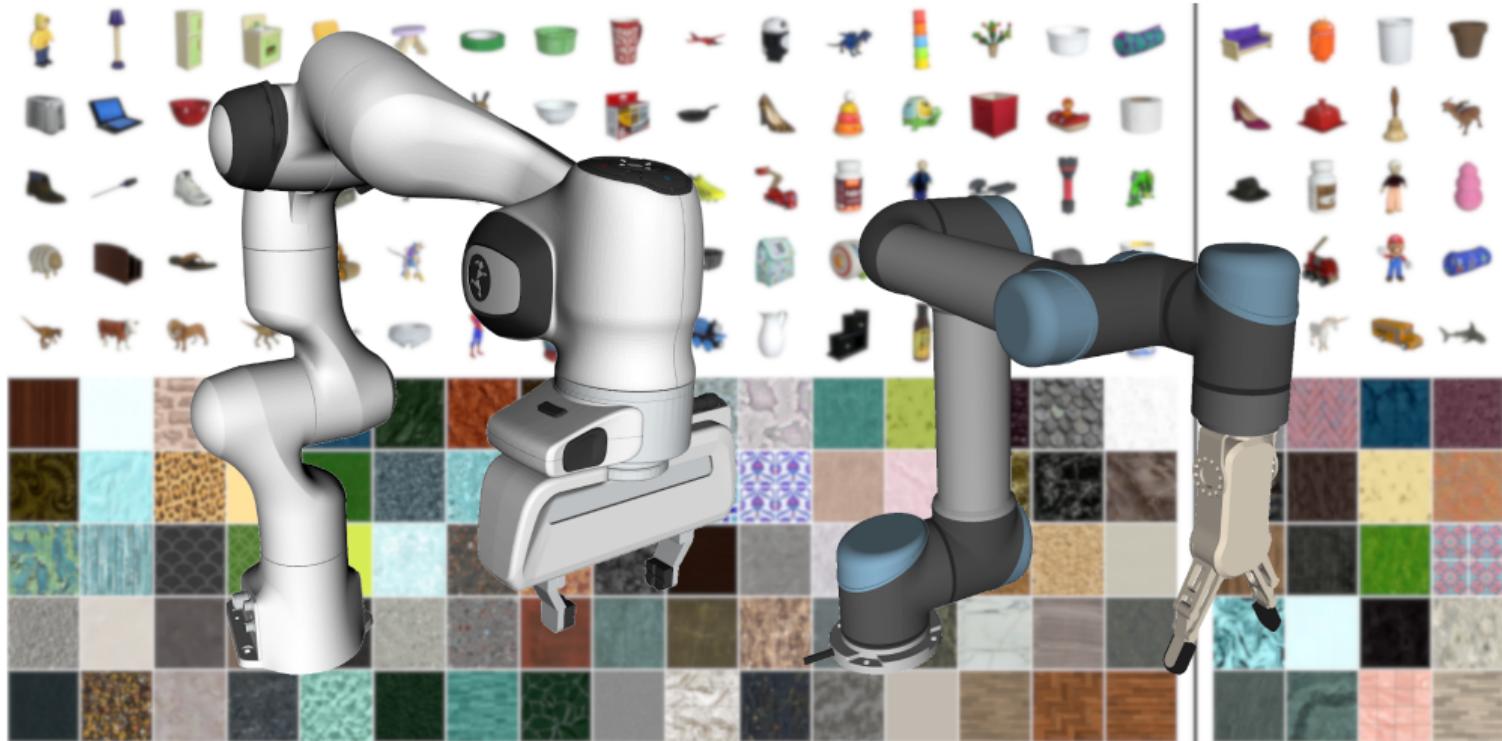
## Object Datasets (Training | Testing)





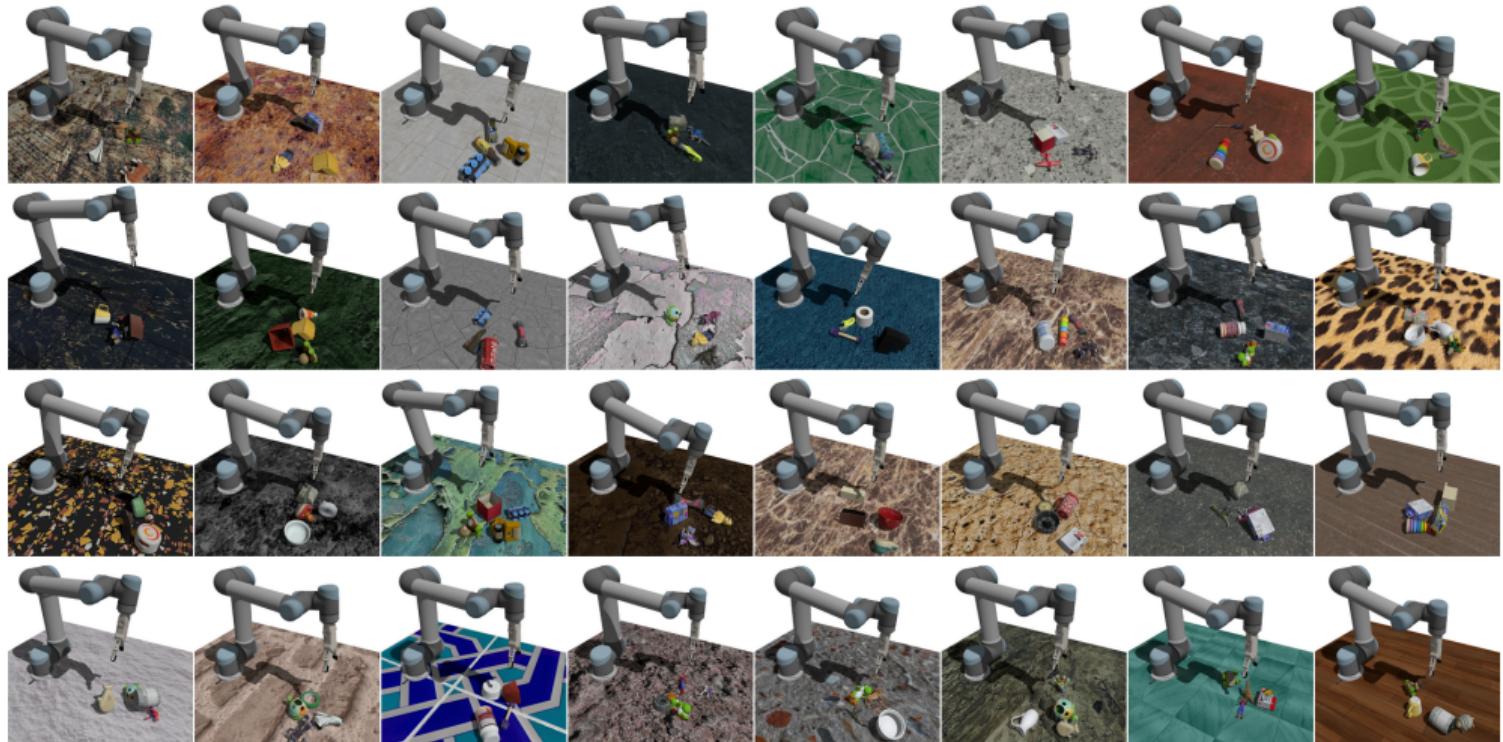
# Models

## Robots



# Domain Randomization

## Visual Examples



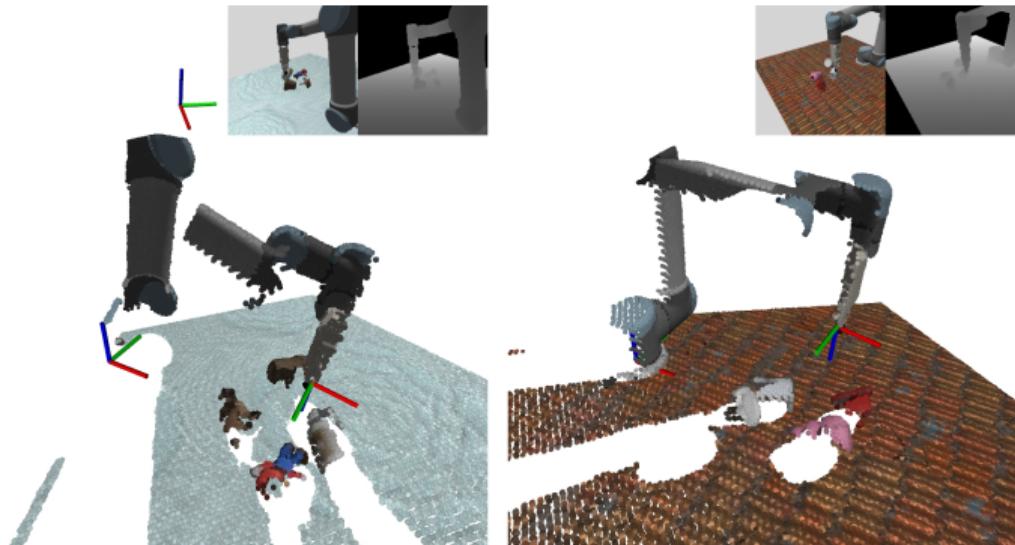


# Domain Randomization

## Further Randomization

### Random

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

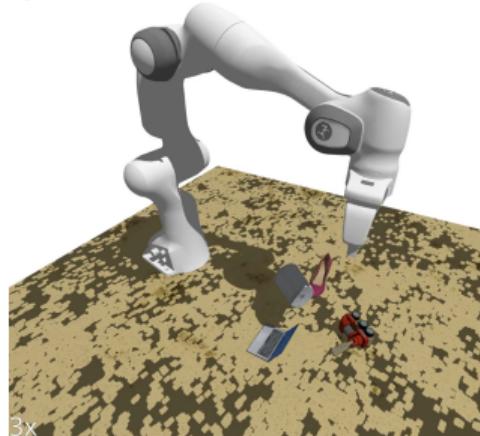




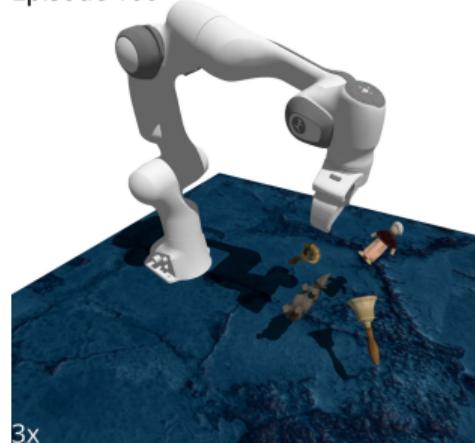
# Training

Simulation - Panda (Video Example)

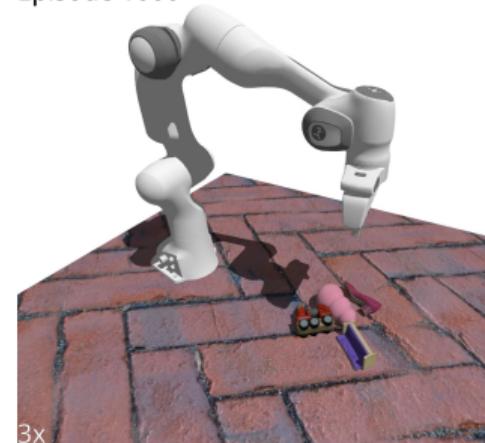
Episode 0



Episode 100



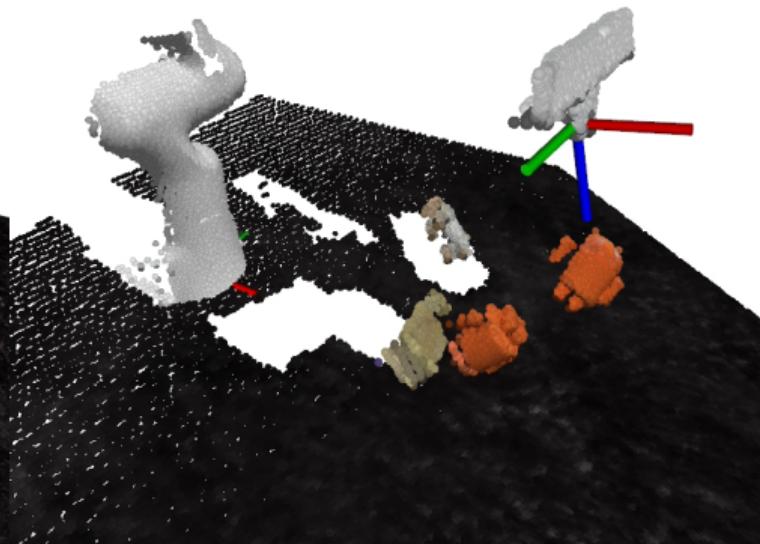
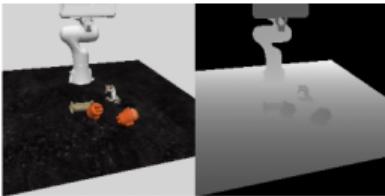
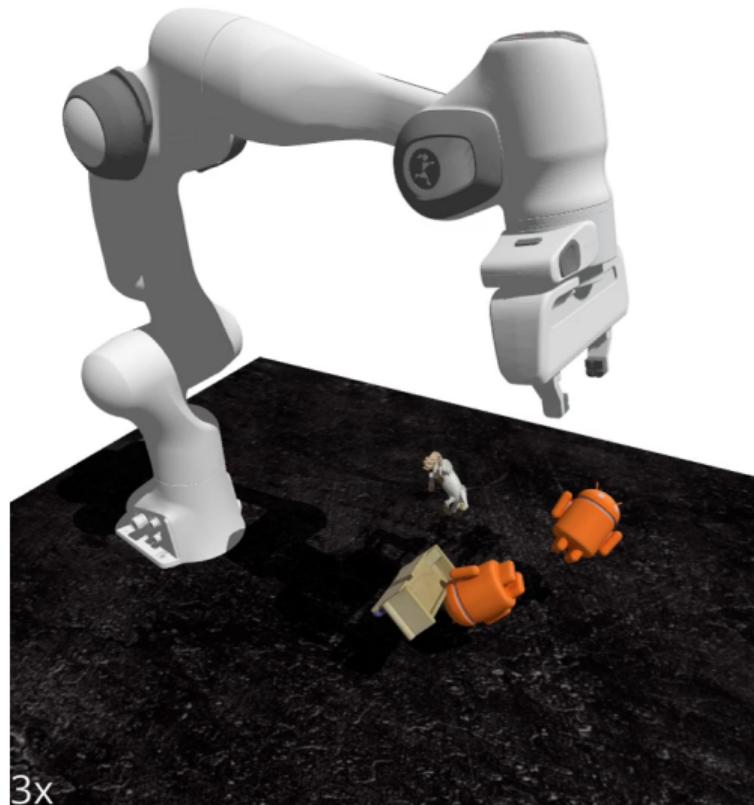
Episode 1000





# Trained Agent

Simulation - Panda (Video Example)

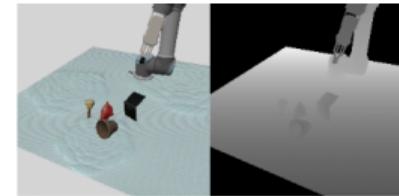
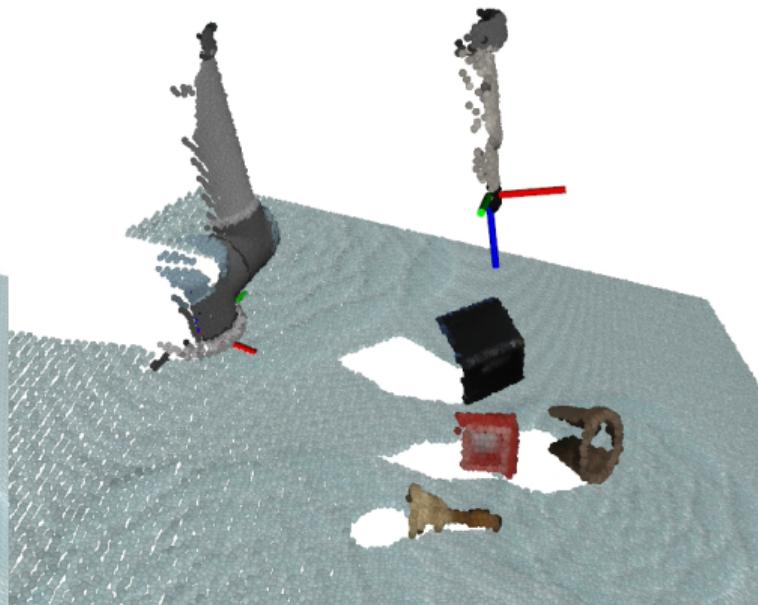


3x



# Trained Agent

Simulation - UR 5 (Video Example)

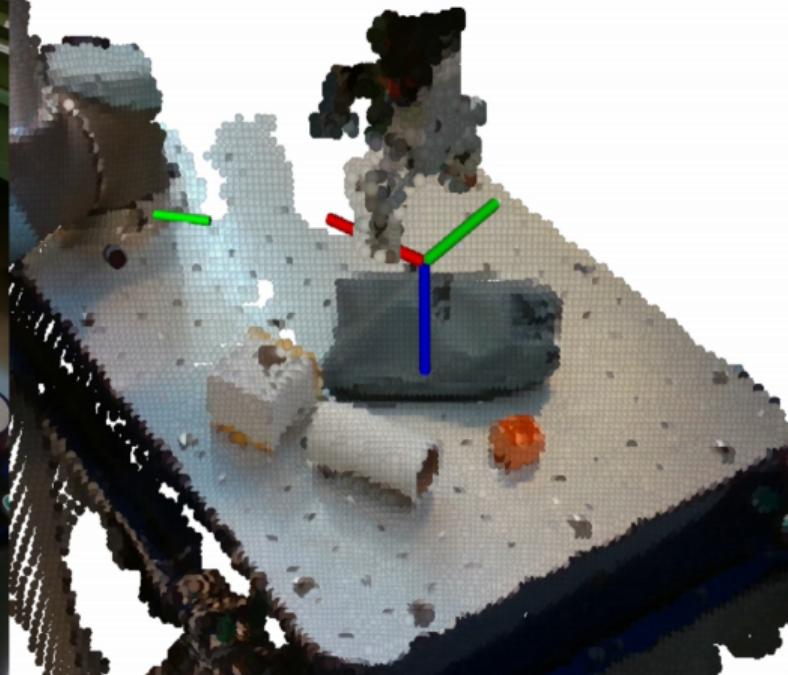


# Sim2Real

## Real - UR 5 (Video Example)



3x





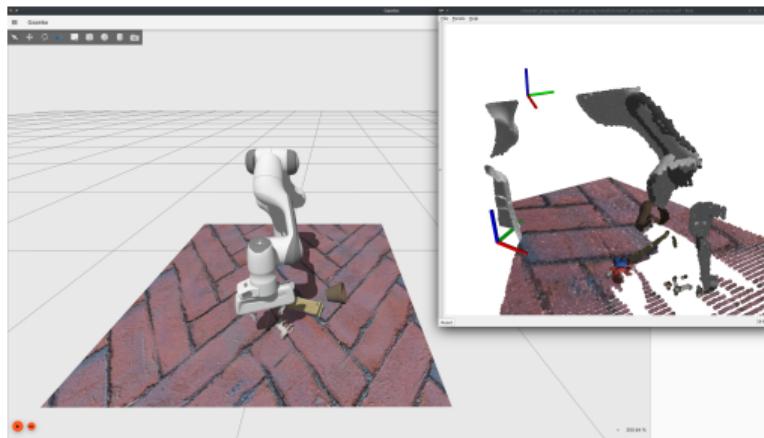
# GitHub Repository and Examples

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
```