Erle Robotics

an Acutronic Robotics company

Accelerated Robot Training through Simulation with **ROS** and **Gazebo**

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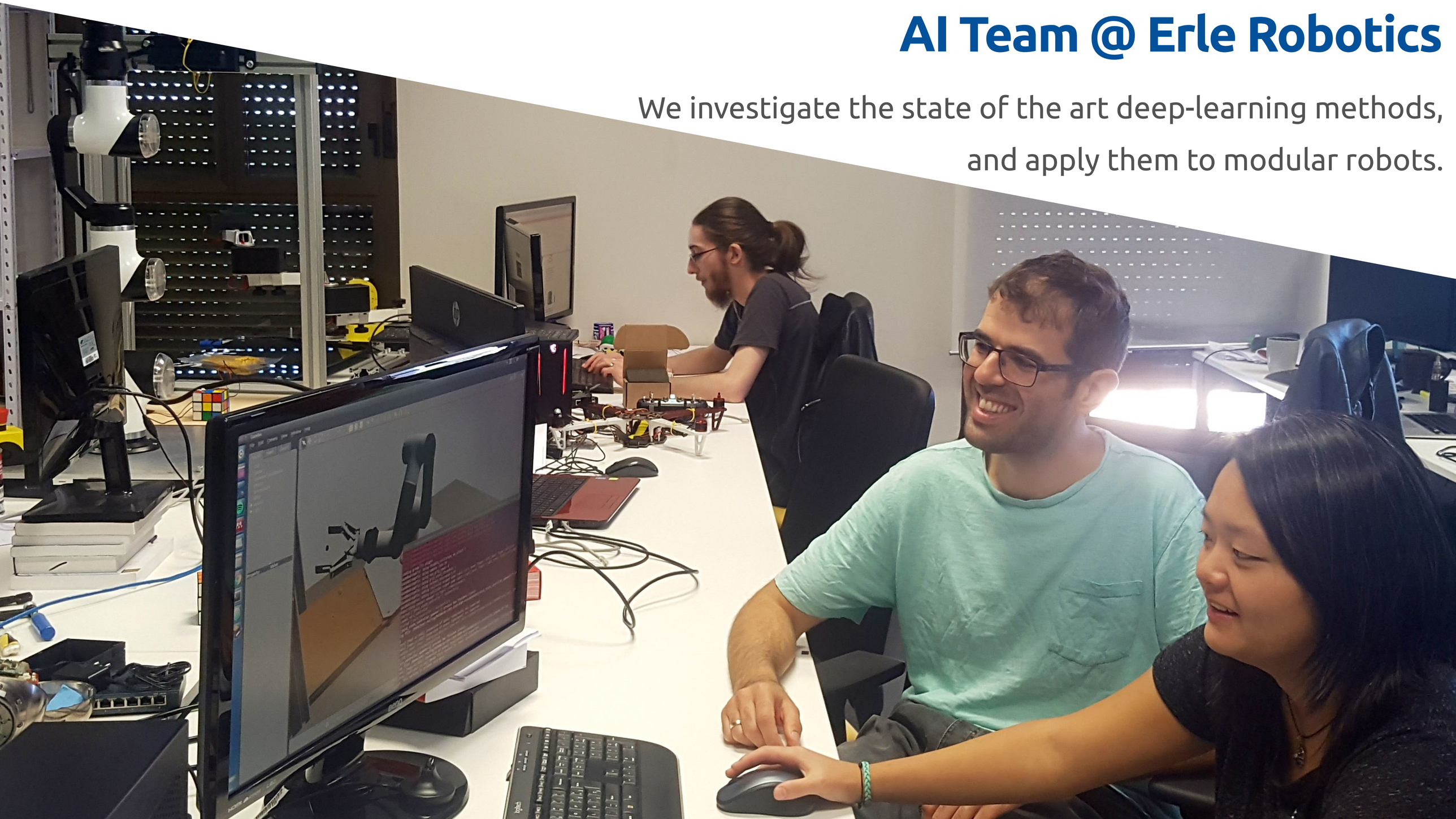
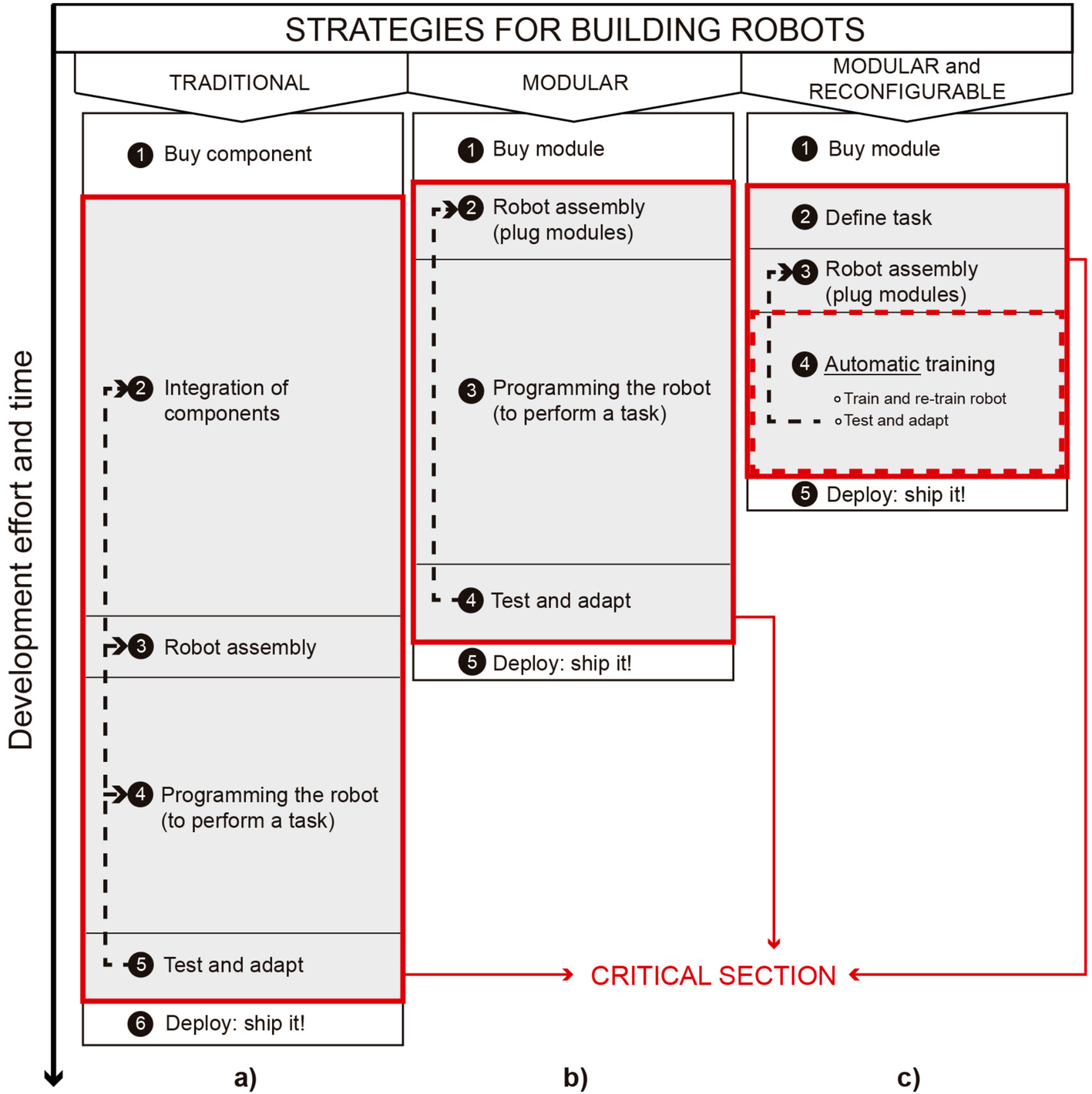
Yue Leire Erro Nuin, Víctor Mayoral Vilches

AI Team @ Erle Robotics

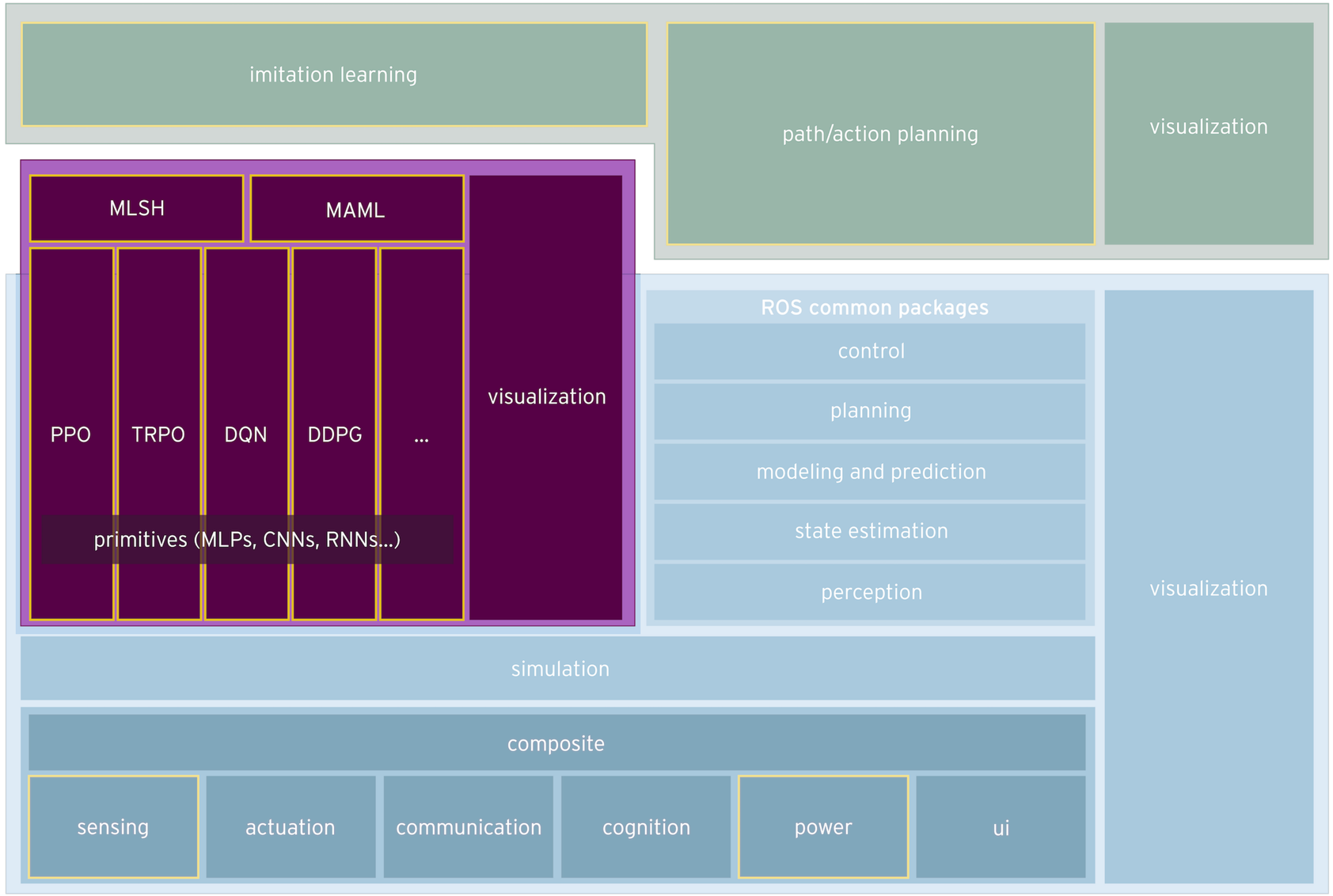
We investigate the state of the art deep-learning methods,
and apply them to modular robots.





Source: Erle Robotics

AI Infrastructure: Algorithms

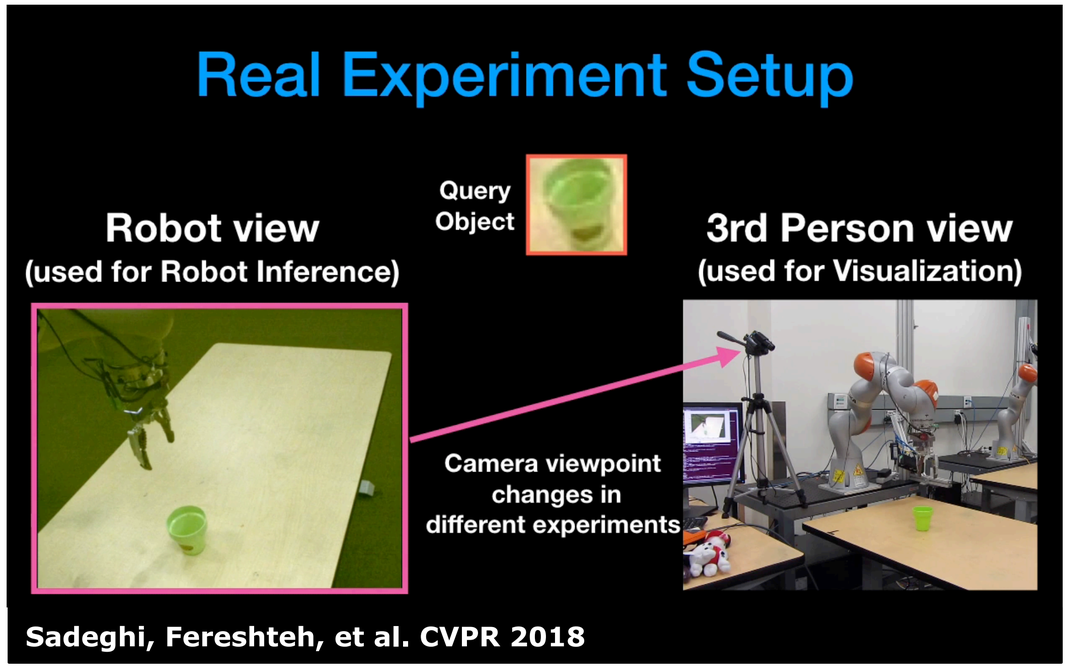


powered by HRIM

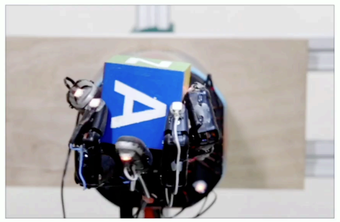
powered by AI

also powered by

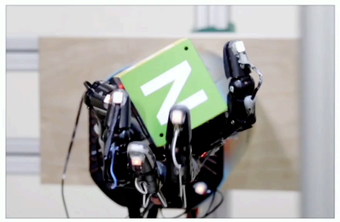
Two unlinked worlds



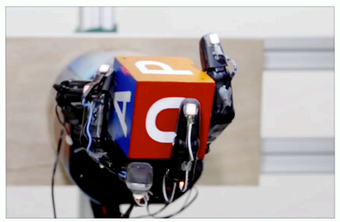
OpenAI



FINGER PIVOTING



SLIDING

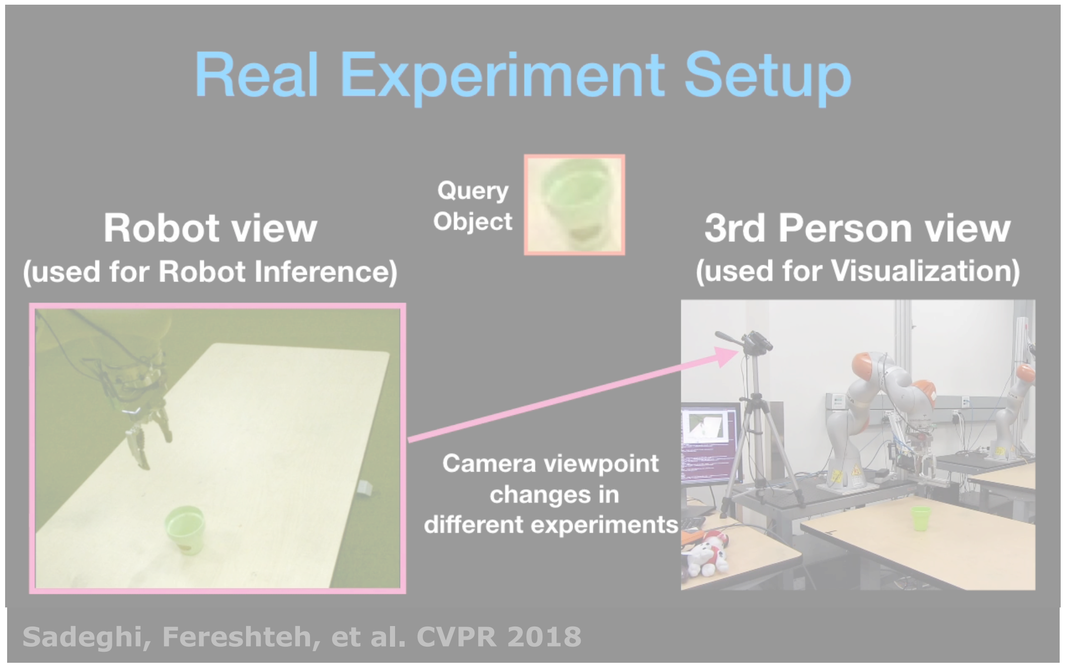


FINGER GAITING

ROS 2

GAZEBO

Two unlinked worlds

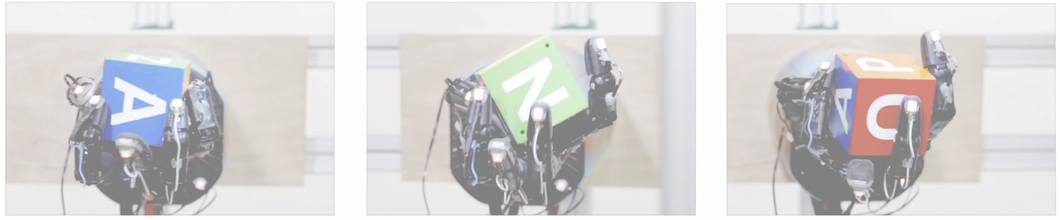


gym_gazebo

ROS 2

GAZEBO

OpenAI

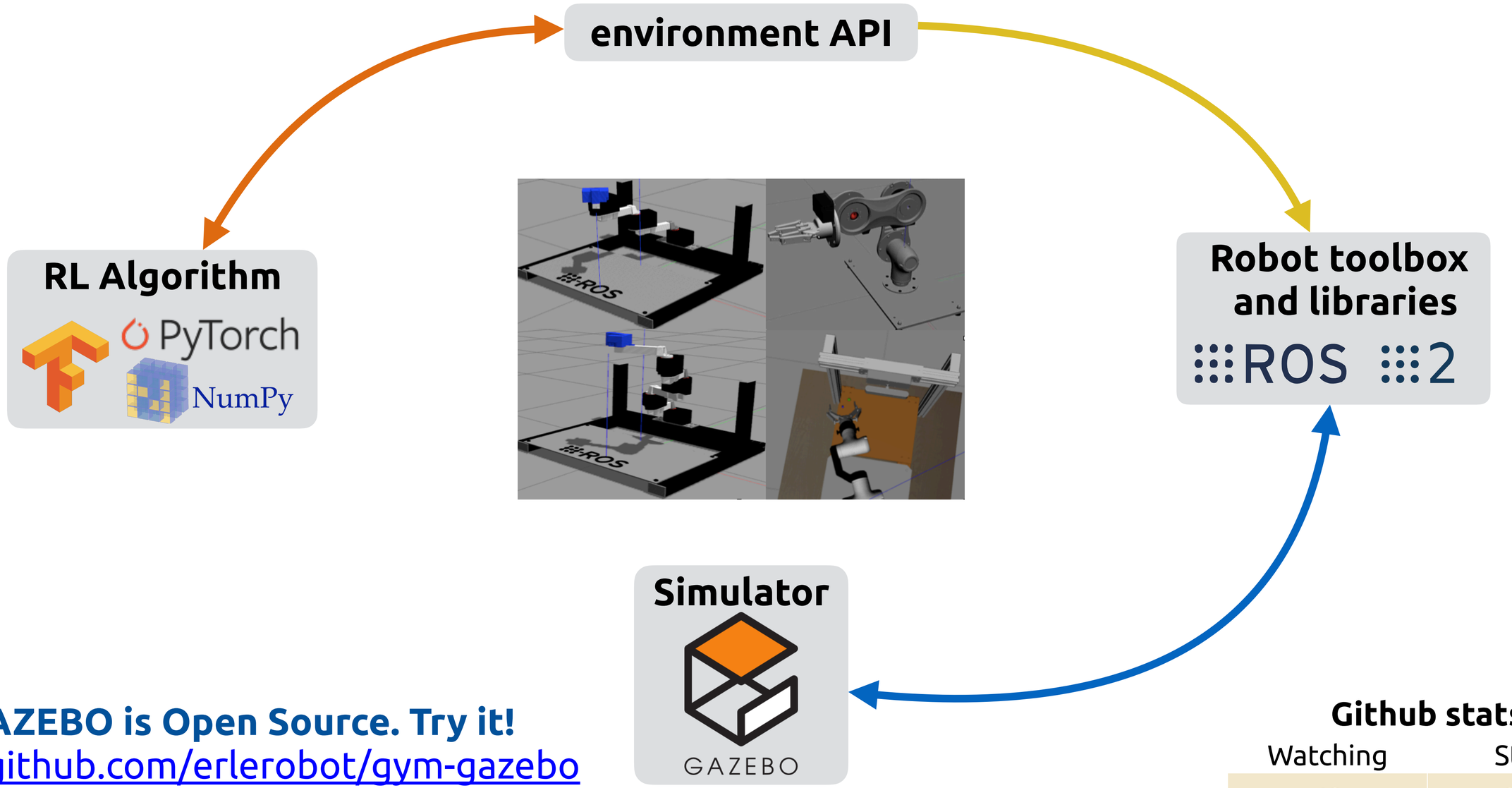


FINGER PIVOTING

SLIDING

FINGER GAITING

GYM_GAZEBO: a Link between *AI* and *Robotic Methods*

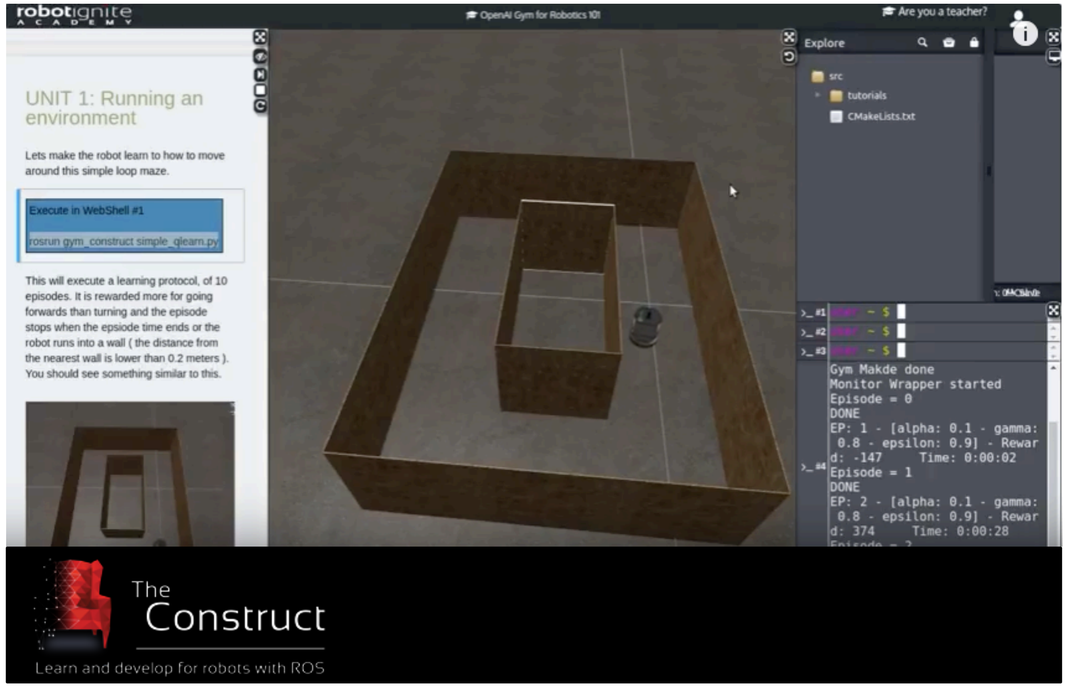


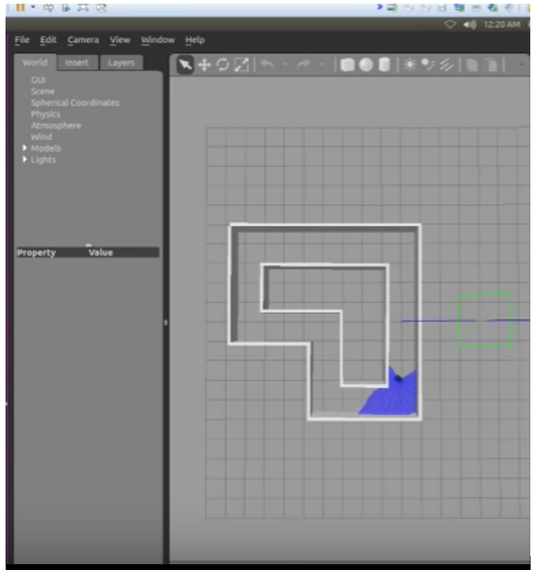
GYM_GAZEBO is Open Source. Try it!
https://github.com/erlerobot/gym-gazebo

Github stats

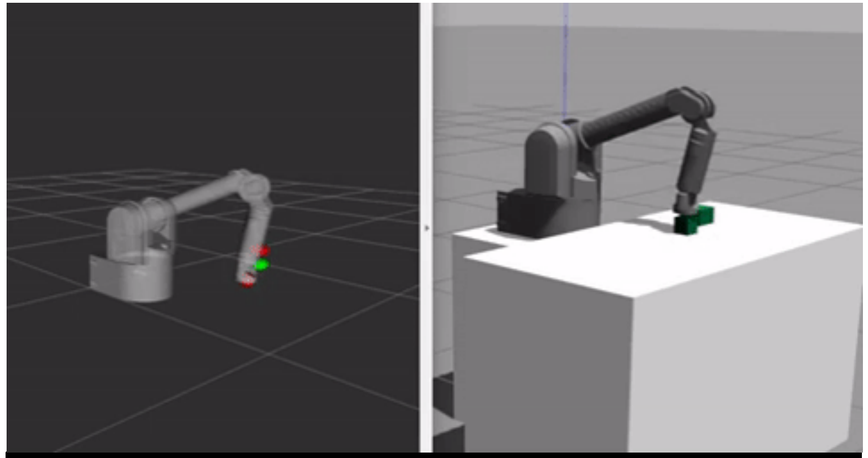
Watching	Stars
42	395

GYM_GAZEBO: Community Projects



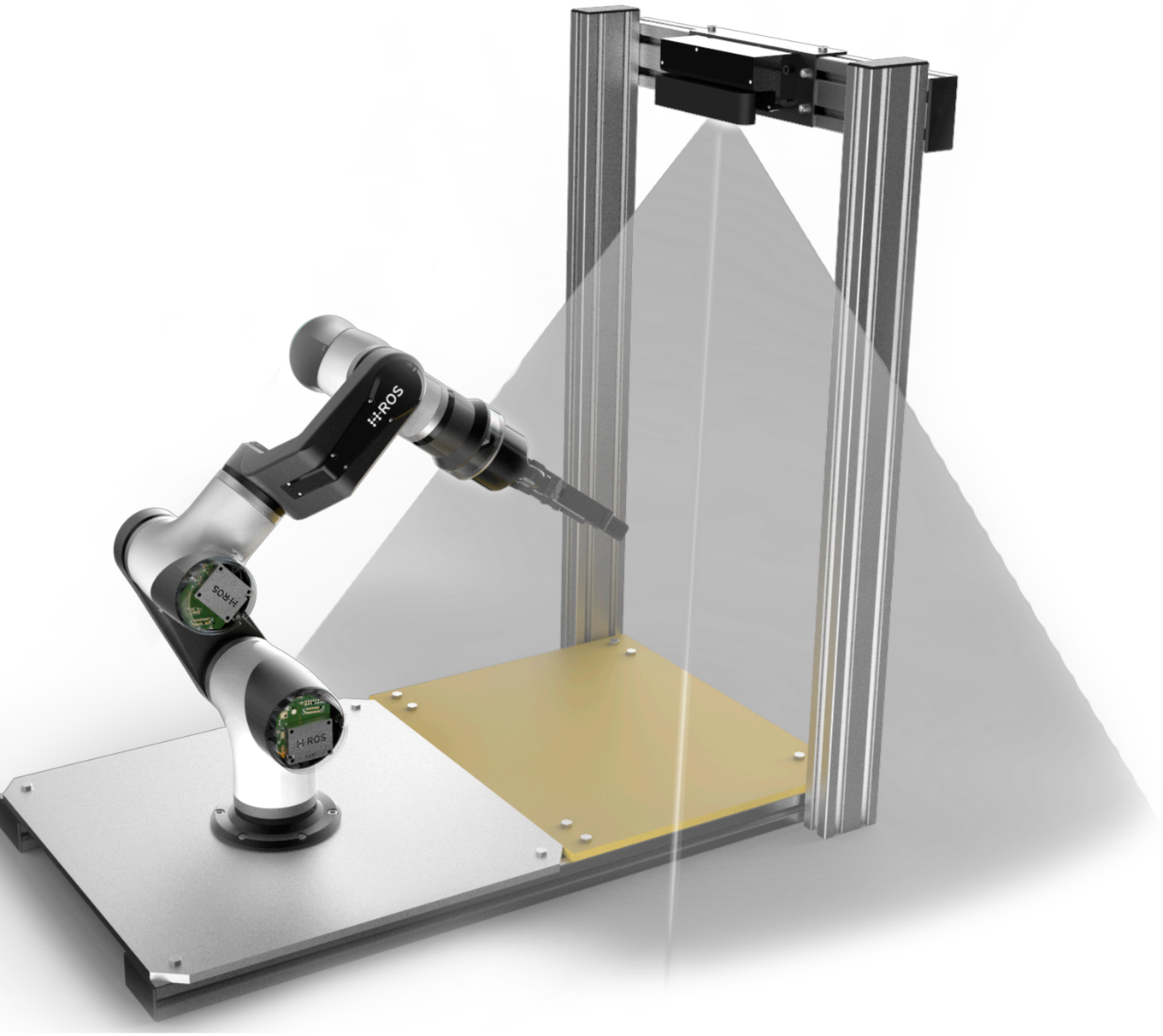


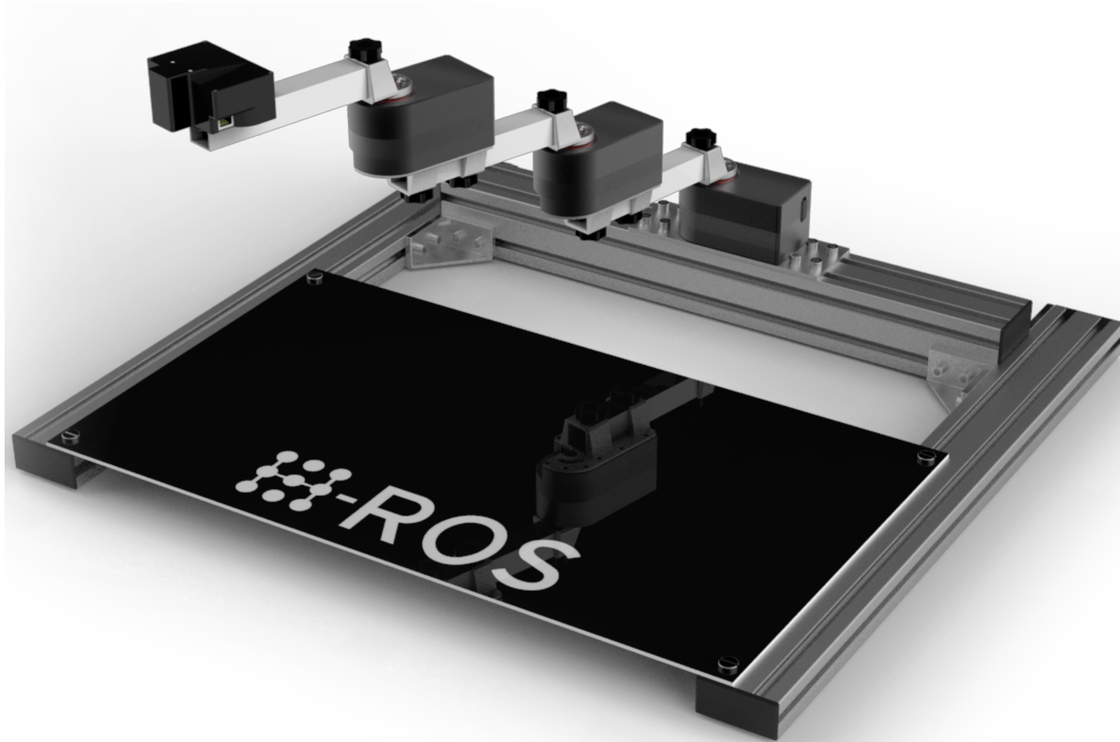
Nicola Ristè
https://youtu.be/h84IkUCze44



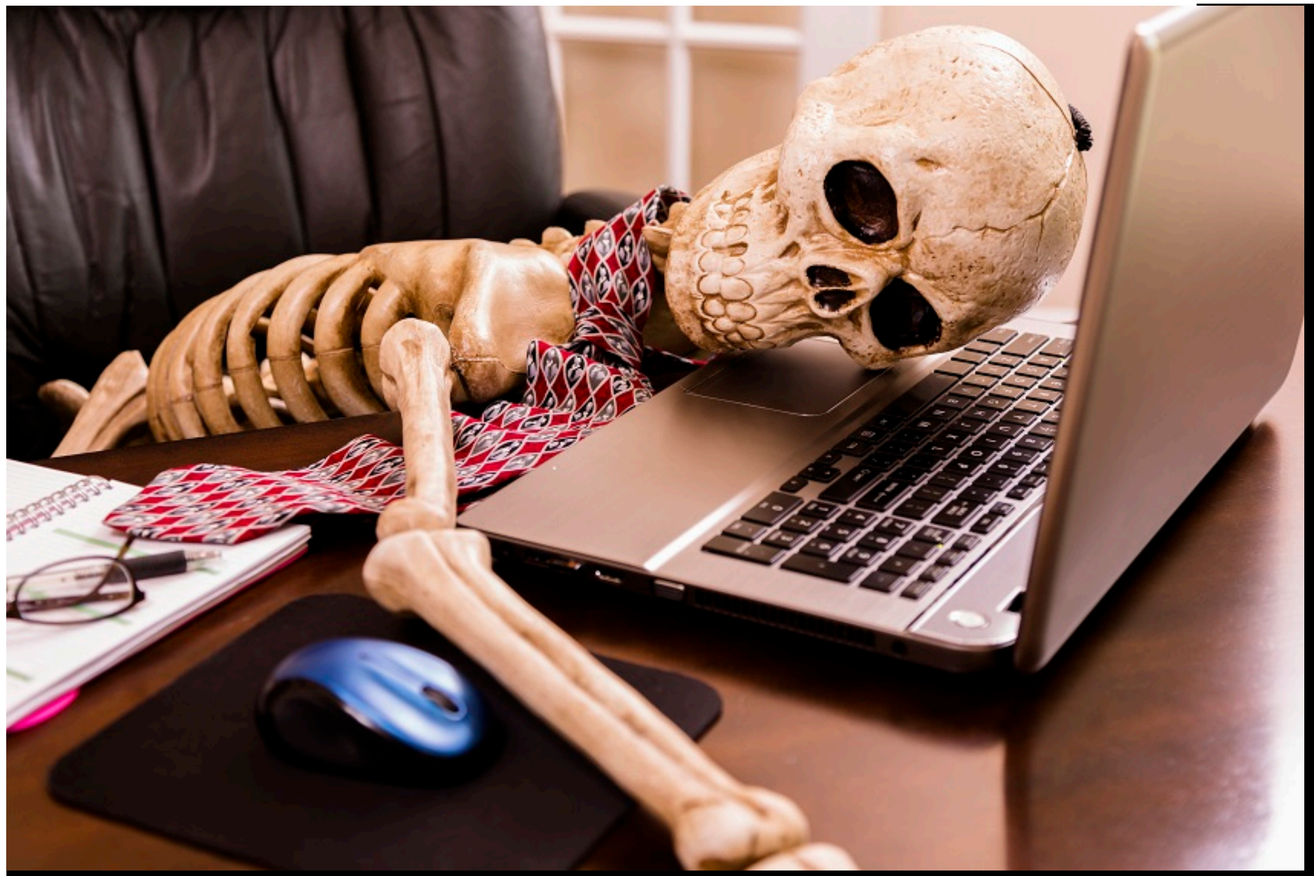
Institut de Robòtica i Informàtica

An **“end to end”** solution for modular robots

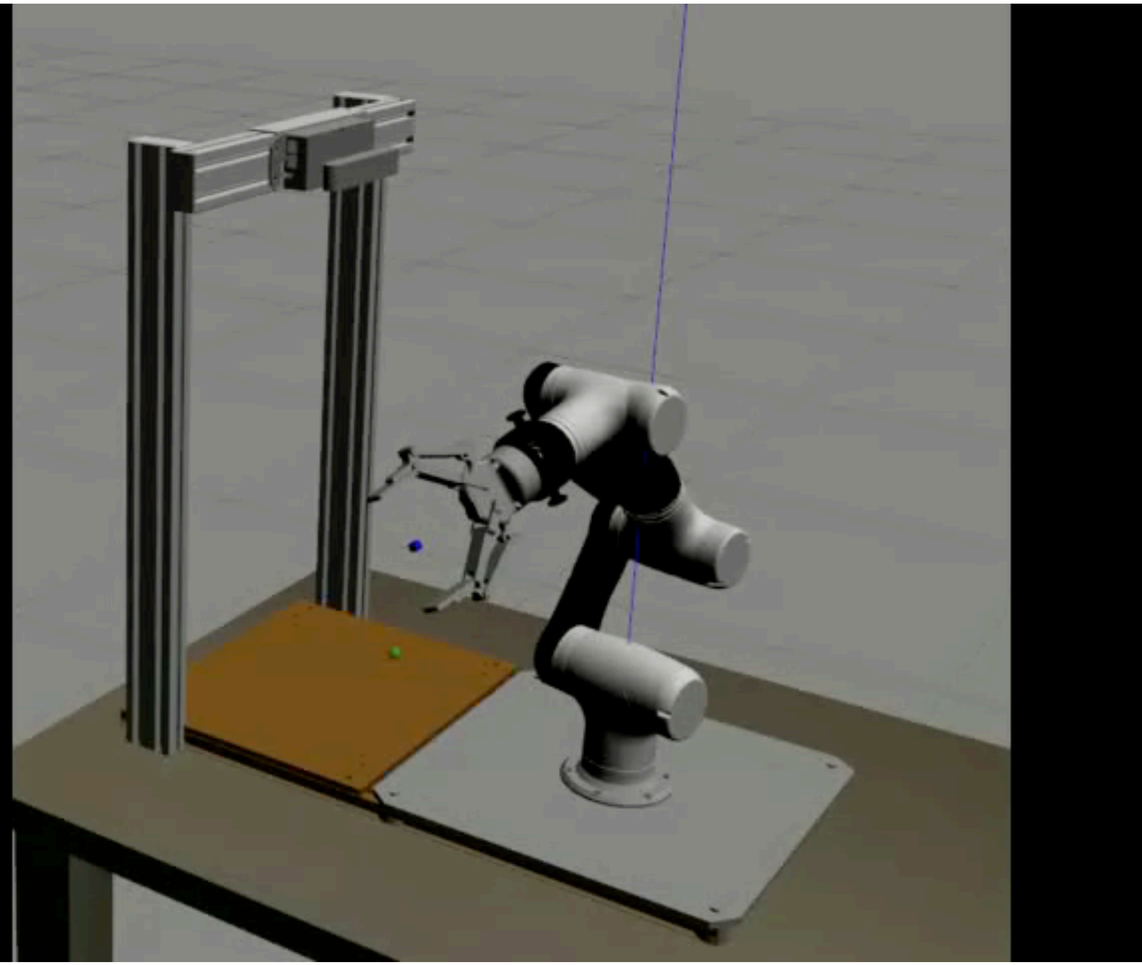




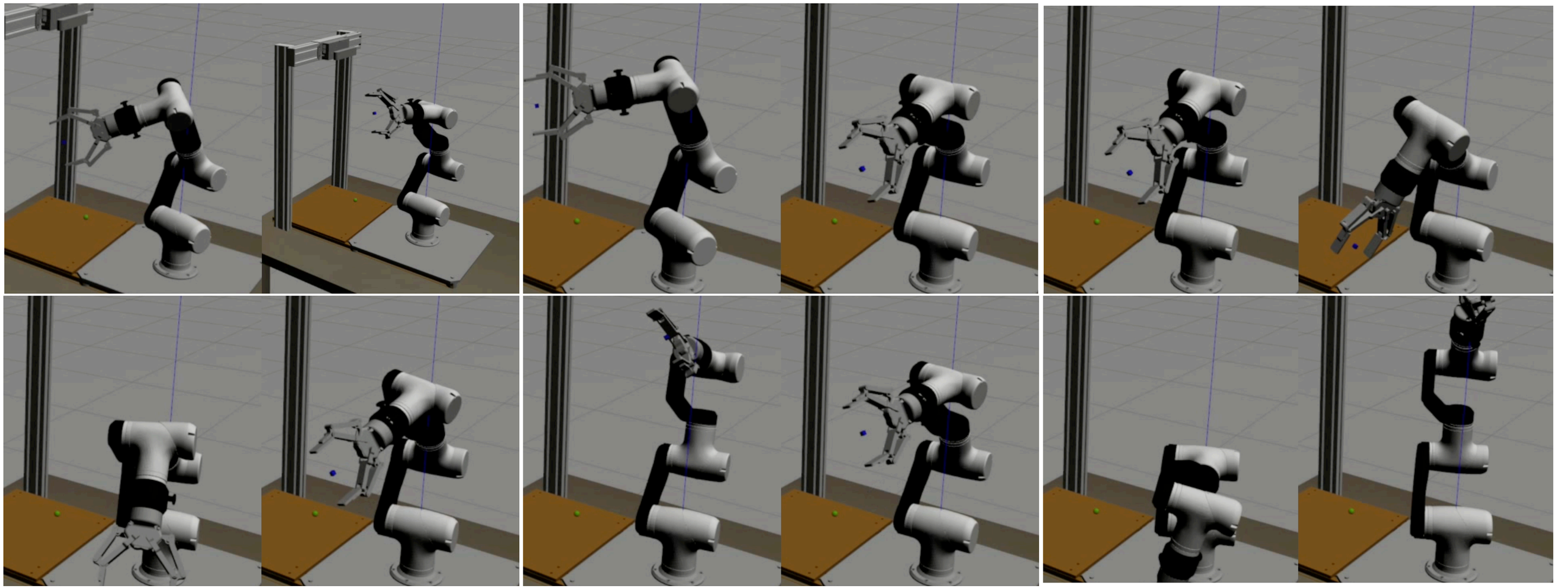
Reinforcement Learning requires long training time…



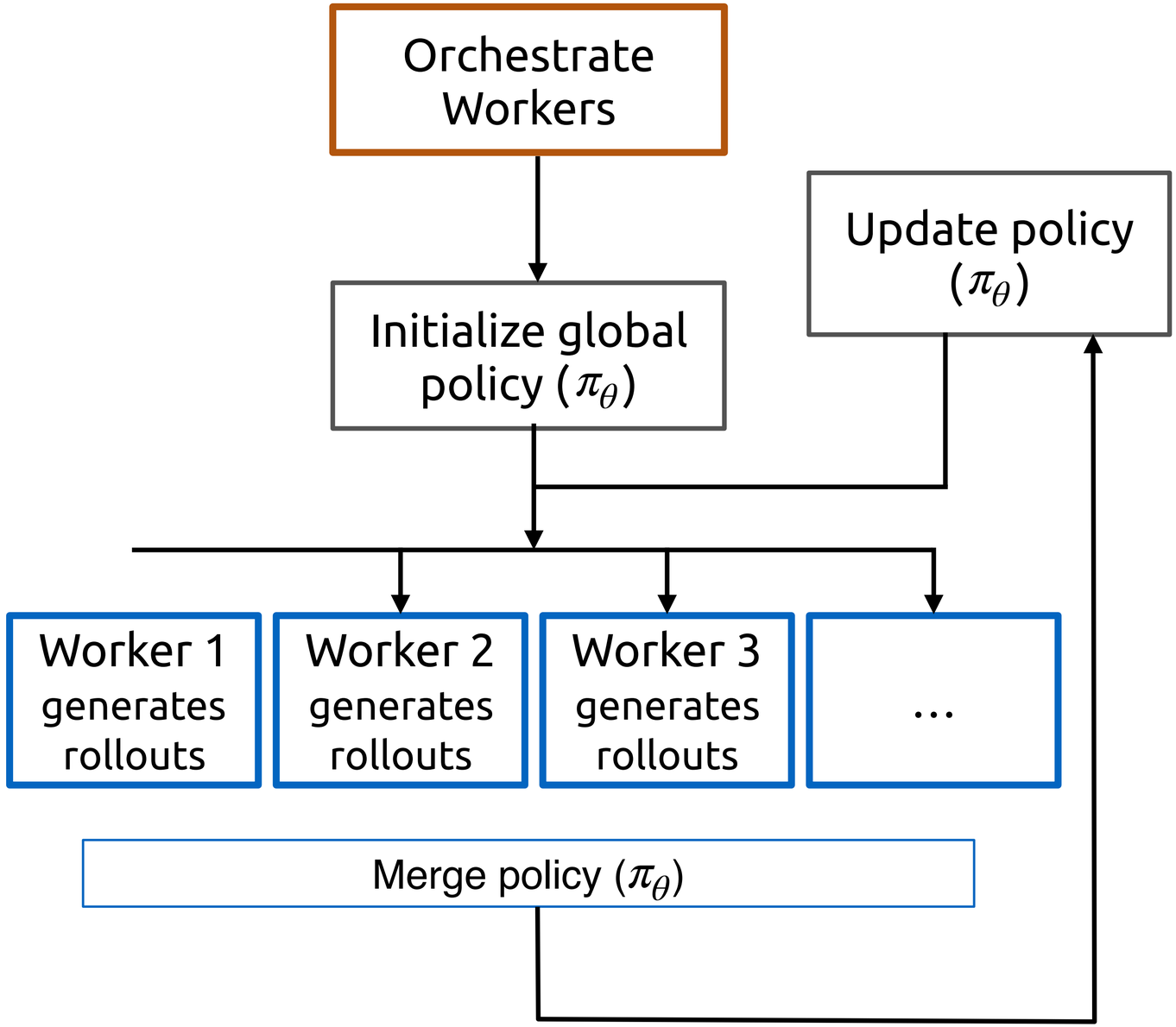
…this is me waiting for results !



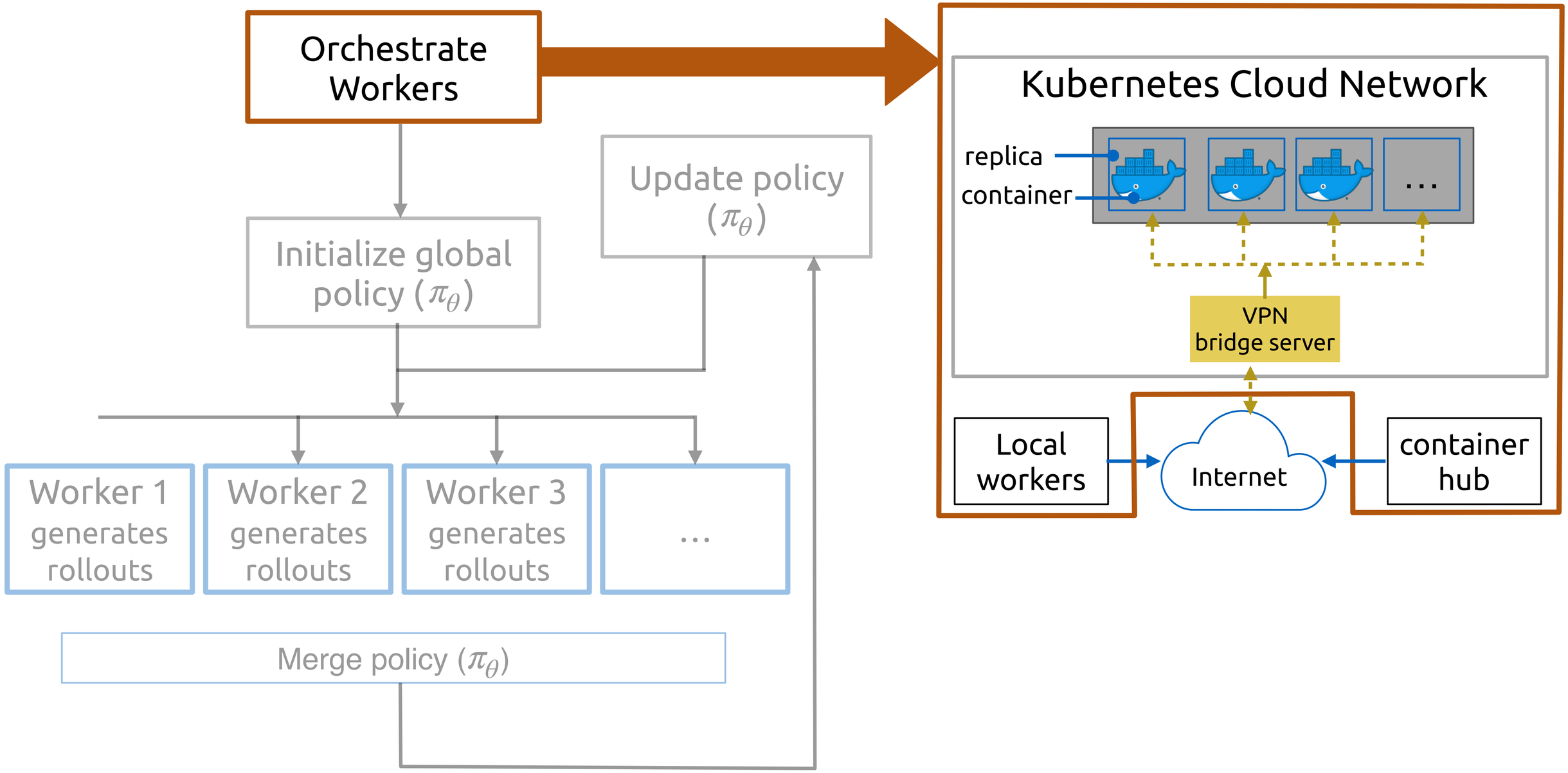
ROBOT_GYM: accelerating training



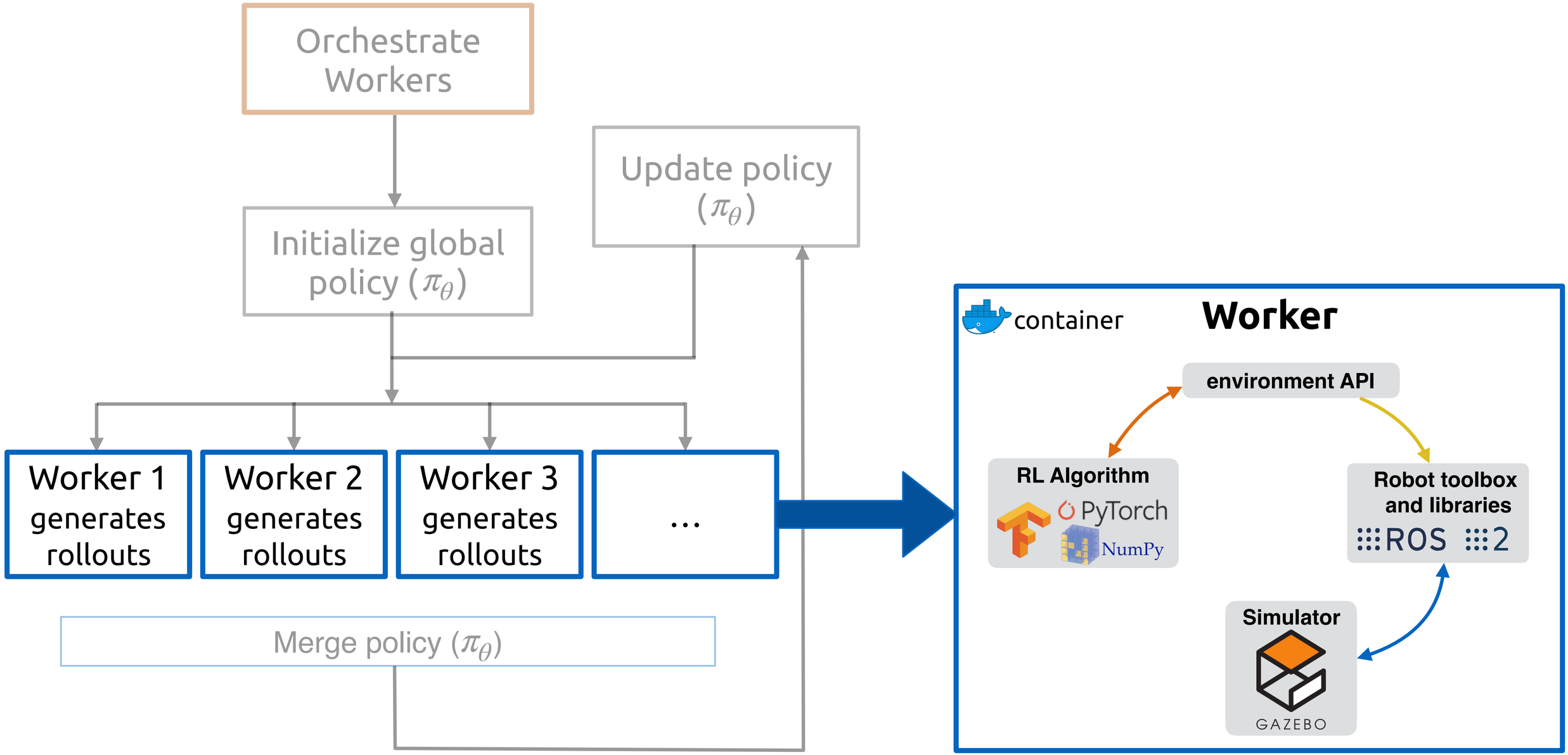
ROBOT_GYM: workflow



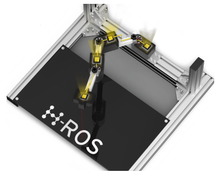
ROBOT_GYM: workflow



ROBOT_GYM: workflow



Results 3DoF: SCARA



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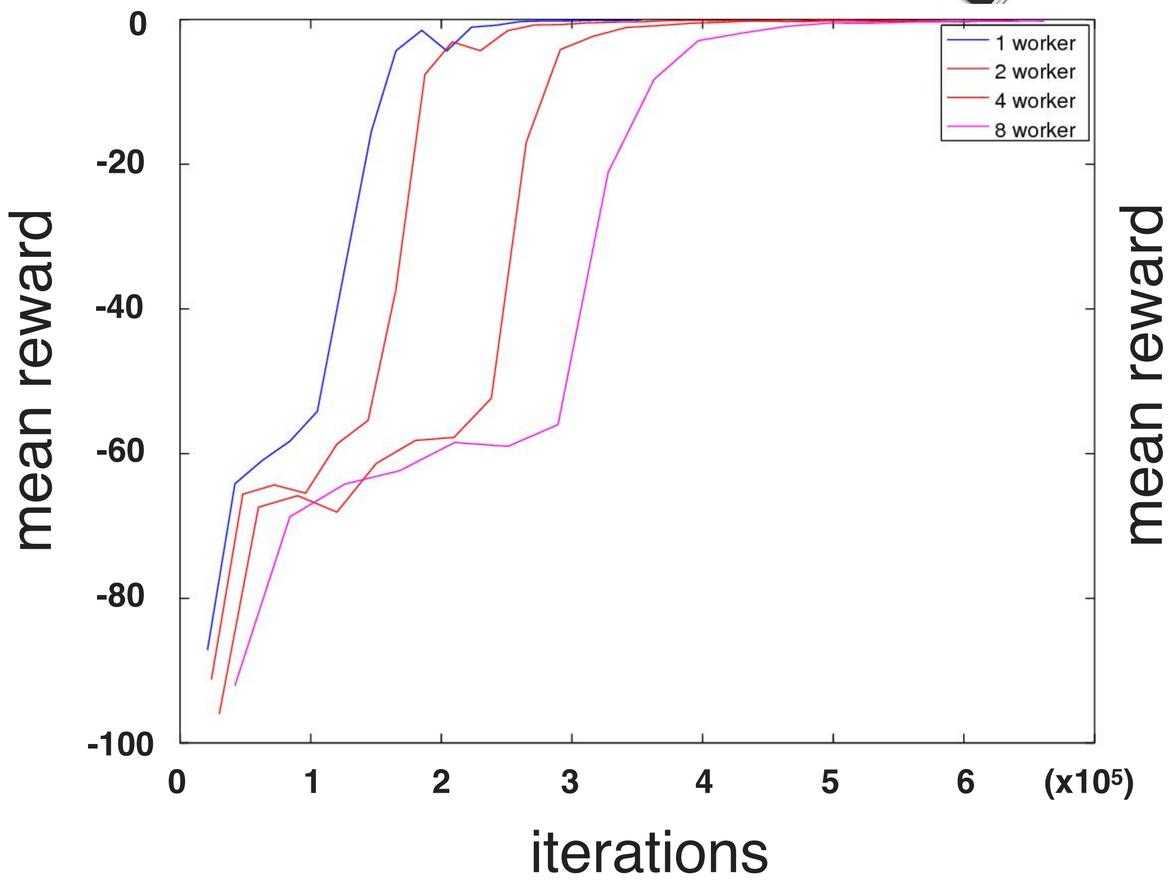
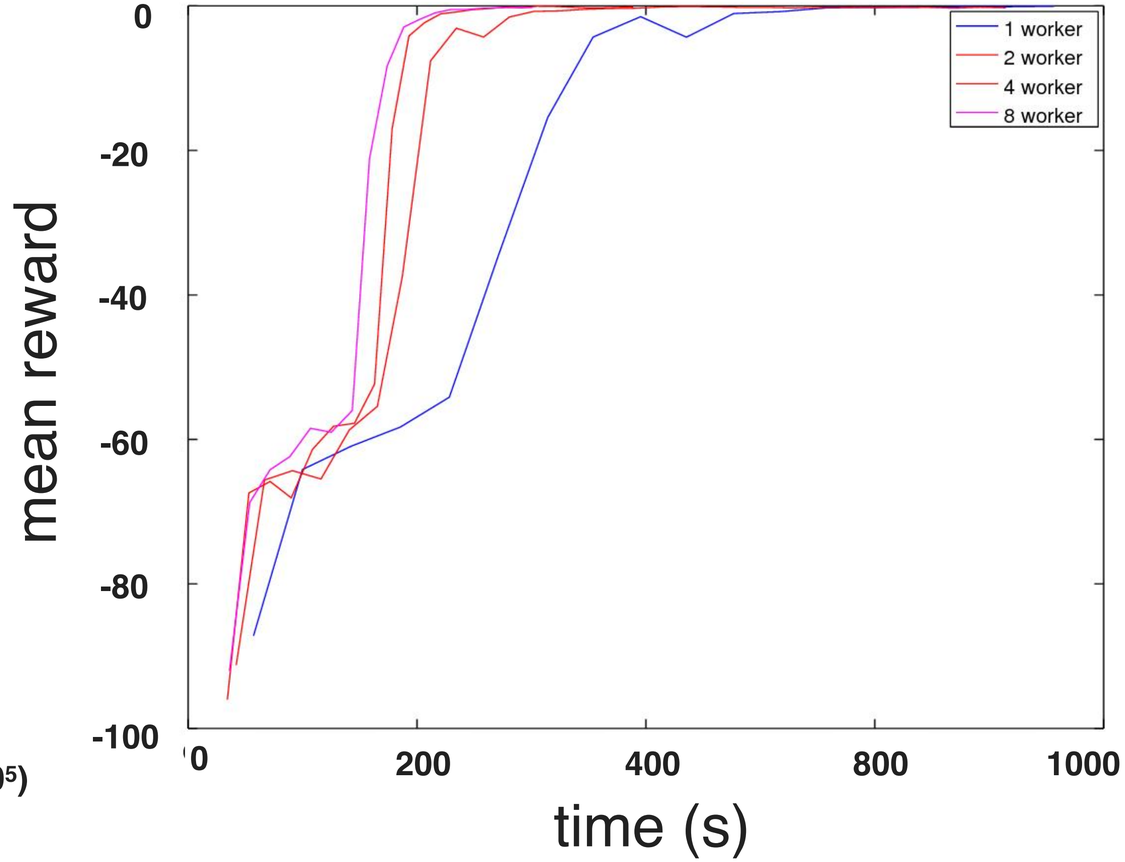
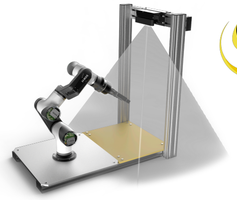




SCARA	Accuracy (mm)		Repeatability (mm)	
	1 Worker	8 Workers	1 Worker	8 Worker
Simulated	2.80	1.37	4.52	3.57
Real	26.14	12.89	28.96	10.83

Results 6DoF: MARA



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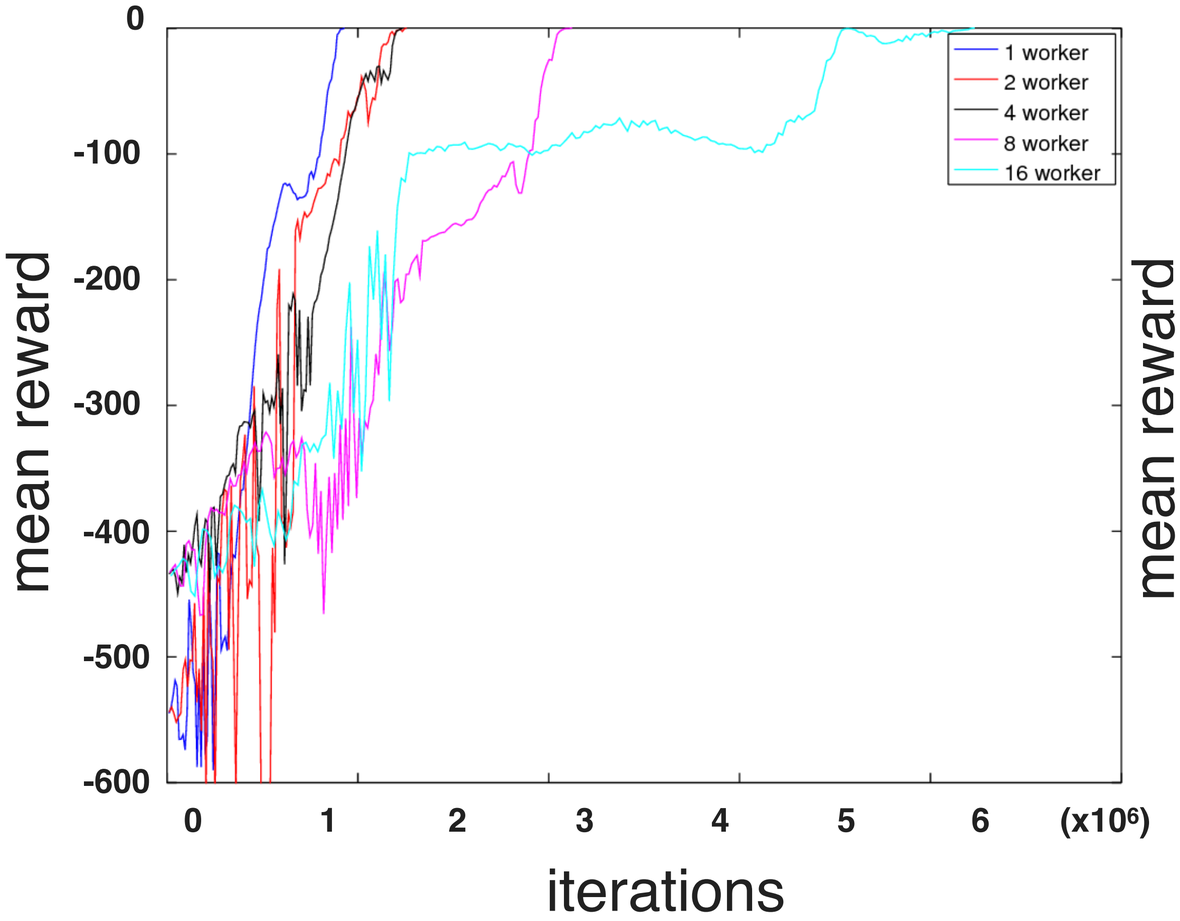
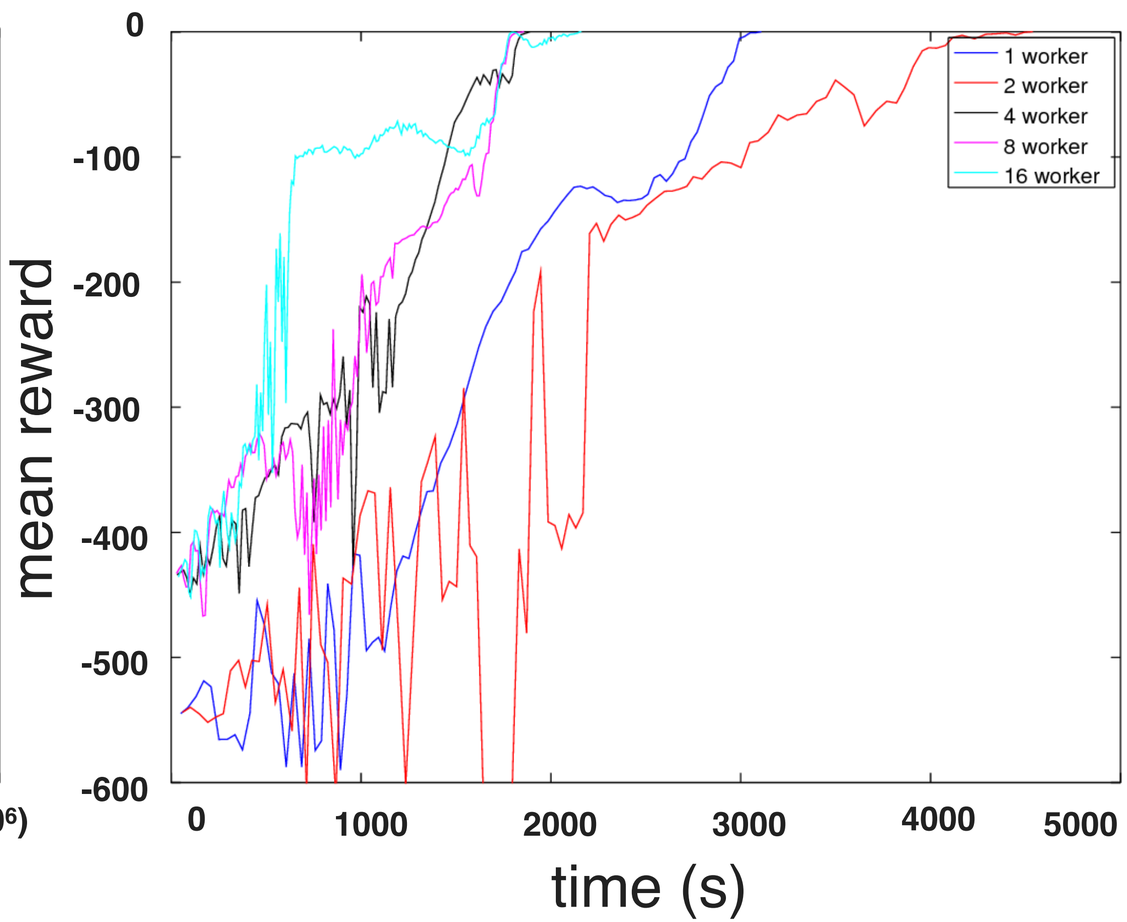
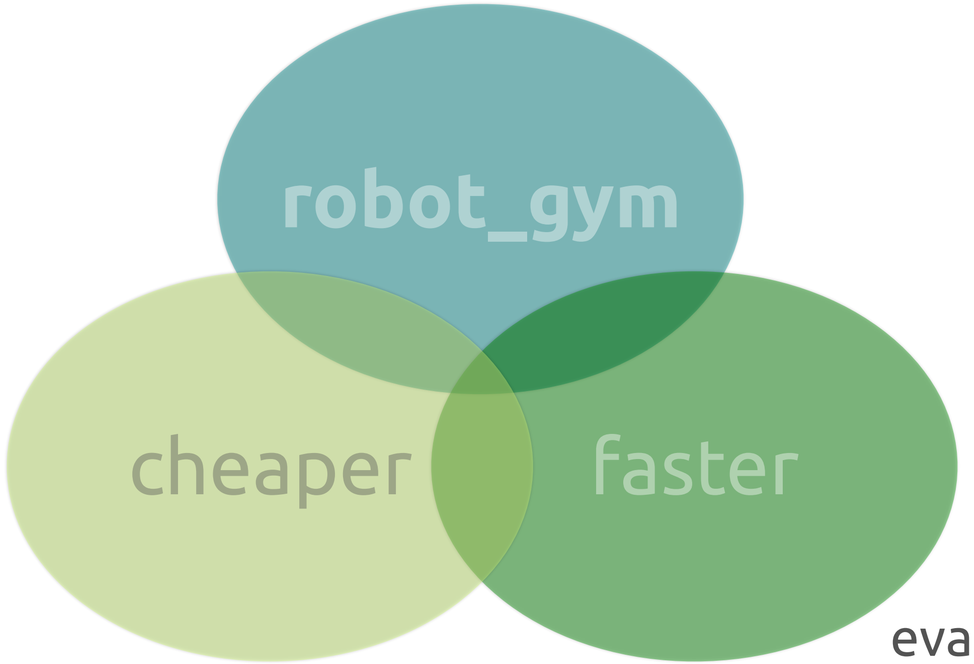




MARA	Accuracy (mm)		Repeatability (mm)	
	1 Worker	8 Workers	1 Worker	8 Worker
Simulated	0.05	0.08	0.02	0.02

a framework to accelerate
robot-training using
Gazebo and ***ROS*** in the cloud



- **12 replicas** in parallel

- **1603 hours** of cloud computing:
0,134 e/hour per instance, or 1,606 e/hour for all the replicas running at the same time

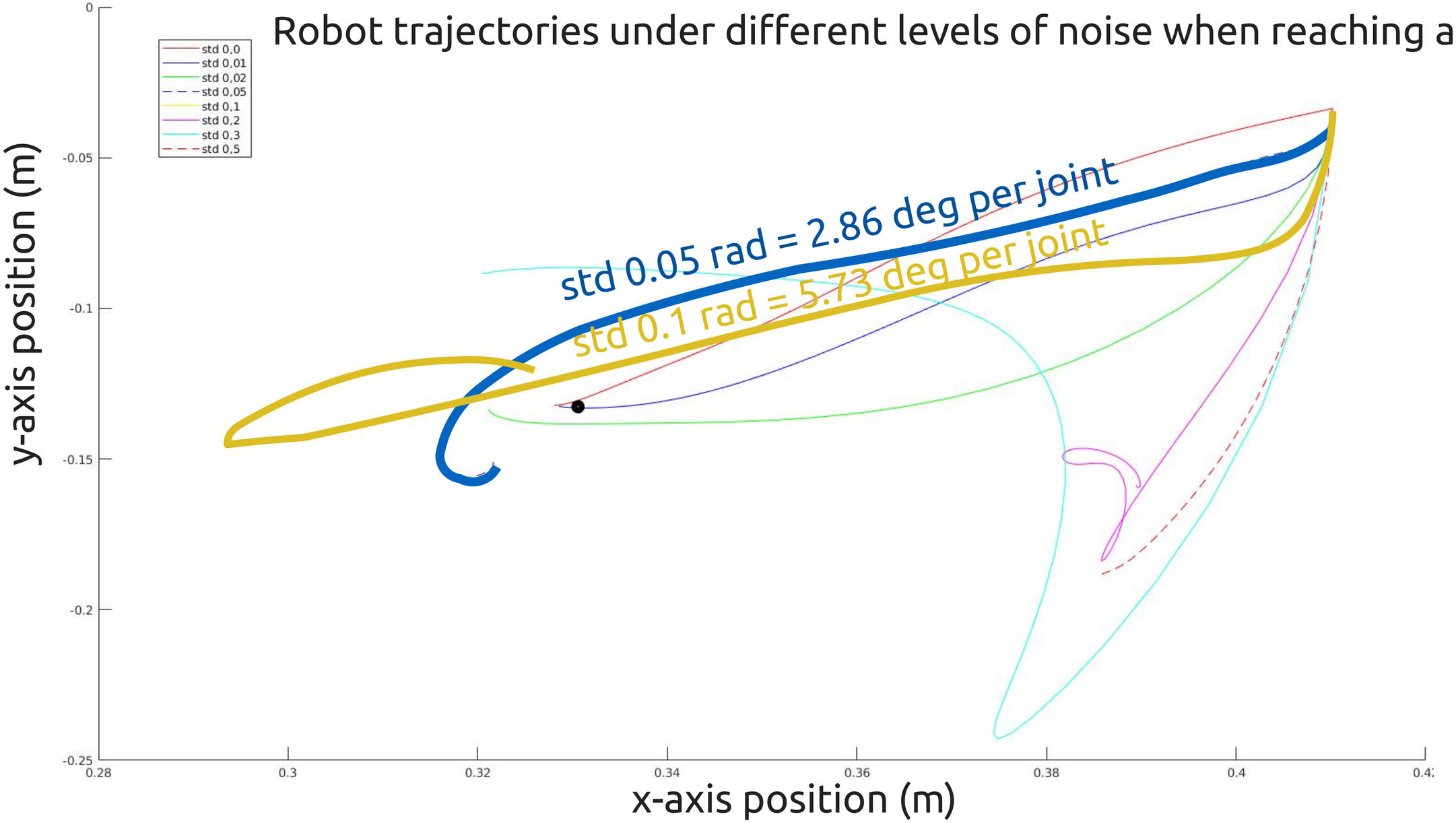
The total costs for all evaluations was **214 Euros**

evaluated 2 different modular robots

training-time can be **reduced by more than 33%**
while maintaining similar levels of accuracy

Perspectives and Future Work

Robot trajectories under different levels of noise when reaching a target



Published Work

- robot_gym: accelerated robot training through simulation in the cloud with ROS and Gazebo

https://arxiv.org/pdf/1808.10369.pdf

- Towards self-adaptable robots: from programming to training machines

https://arxiv.org/pdf/1802.04082.pdf

- Hierarchical Learning for Modular Robots

https://arxiv.org/pdf/1802.04132.pdf

- Evaluation of Deep Reinforcement Learning Methods for Modular Robots

https://arxiv.org/pdf/1802.02395.pdf

- gym_gazebo: a toolkit for reinforcement learning using ROS and Gazebo

https://arxiv.org/pdf/1608.05742.pdf

Check our webpage:

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