Robust Sim-to-Real Transfer for Dynamic Robot Juggling Tasks

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Project overview

This research explores the application of Deep Reinforcement Learning (RL) to train robust, zero-shot control policies for deployment on physical robots. Specifically, it investigates which Sim2Real transfer techniques are most effective for mastering highly dynamic, contact-rich tasks, such as robotic juggling.

Why Reinforcement Learning for Robotic Juggling?

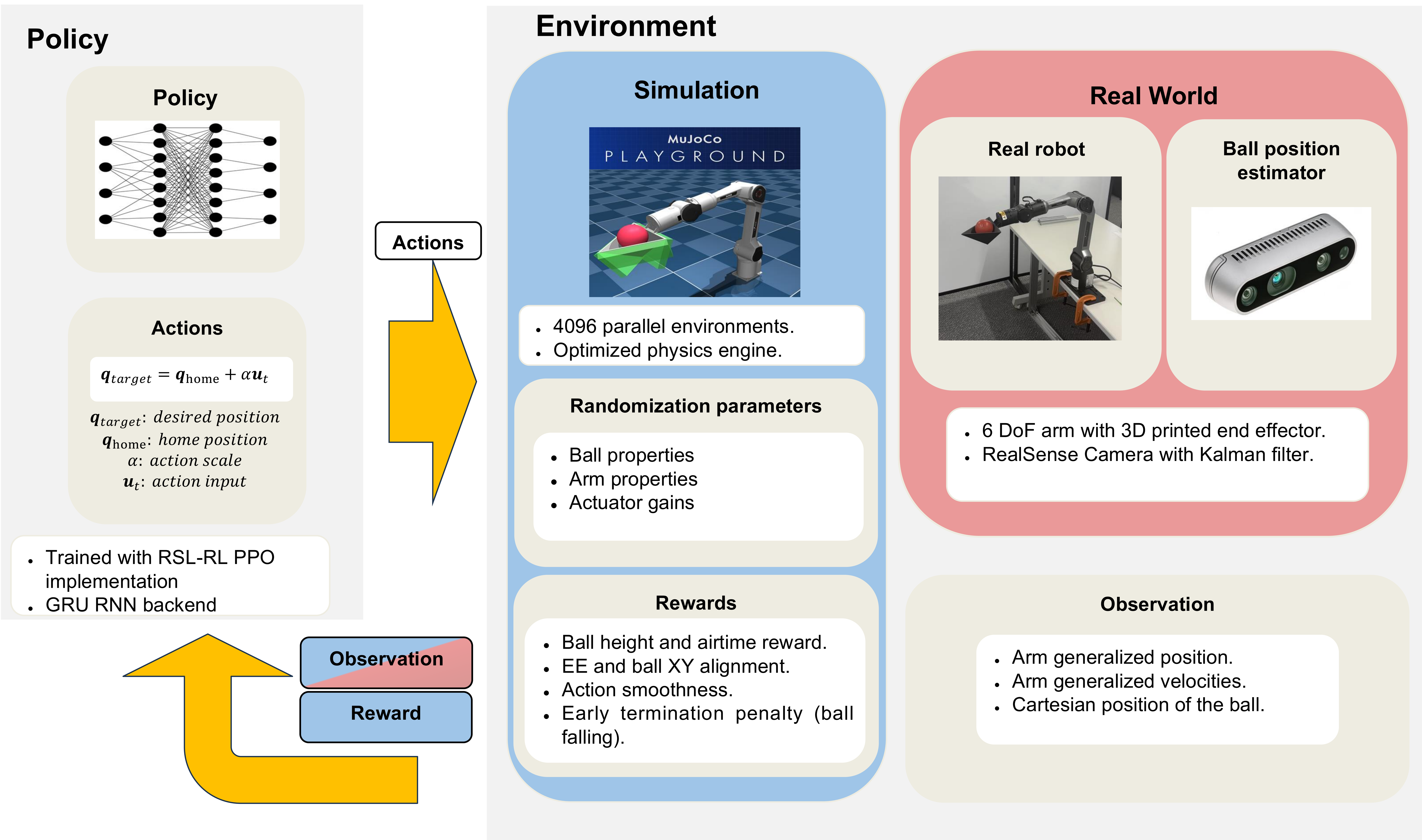
Background

Reinforcement Learning offers a flexible alternative to rigid traditional robotic control, but transferring simulated policies to physical robots remains difficult. This project bridges that "Sim-to-Real gap" using advanced transfer techniques like domain randomization, noise injection, and observation history.

Objective

- **Simulation:** Train a robust RL policy within a simulated environment to successfully achieve the dynamic juggling task.
- **Deployment:** Deploy the trained policy zero-shot onto a physical robotic arm, ensuring performance parity between simulation and reality.

How did we bridge the Sim-to-Real gap to achieve dynamic physical control?



Results

- **Simulation Convergence:** The policy successfully converged within the simulated environment.
- **Zero-Shot Deployment:** The model maintained robustness upon transfer to the physical robotic arm, executing the juggling task with performance comparable to the simulation.

Future work

- Improve robustness of deployed policy by increasing simulation fidelity.
- Propose a novel methodology to finetune the deployed policy.

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