Robot Perception and Control
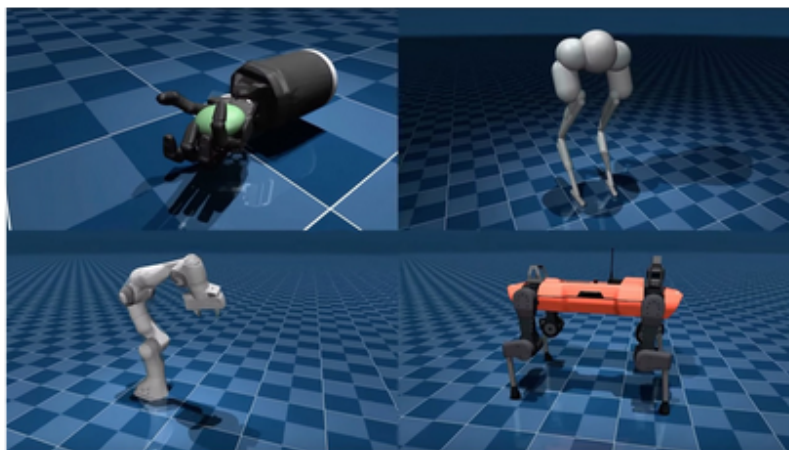
Simulators

Last updated: Jul / 25 /2024
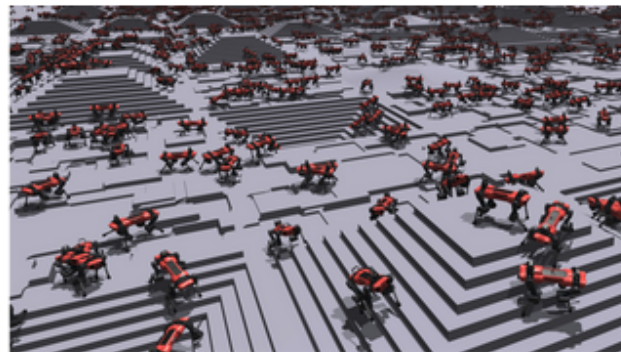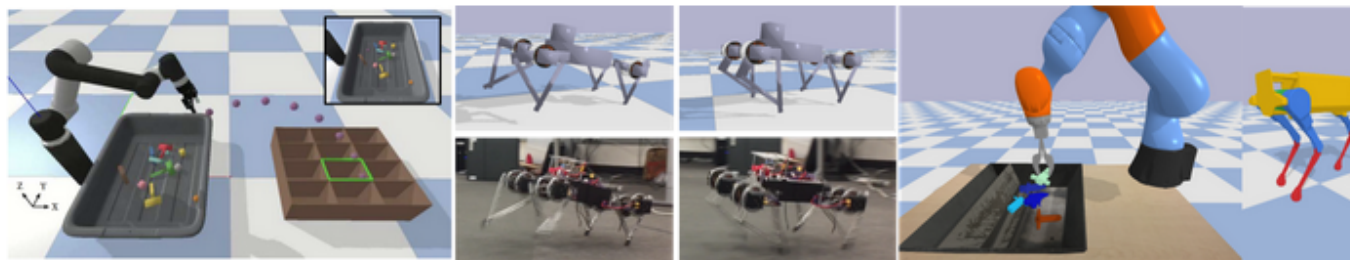
Kashu Yamazaki
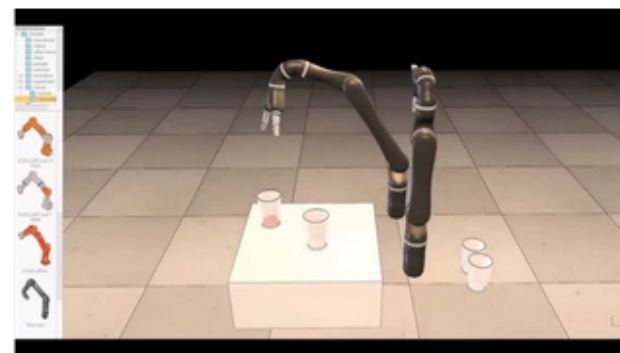
kyamazak@andrew.cmu.edu

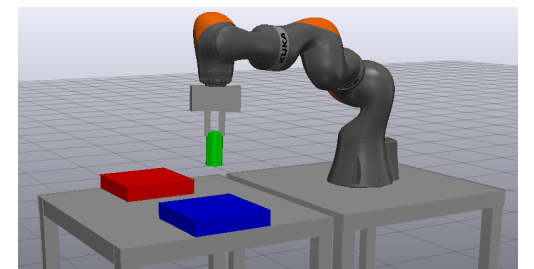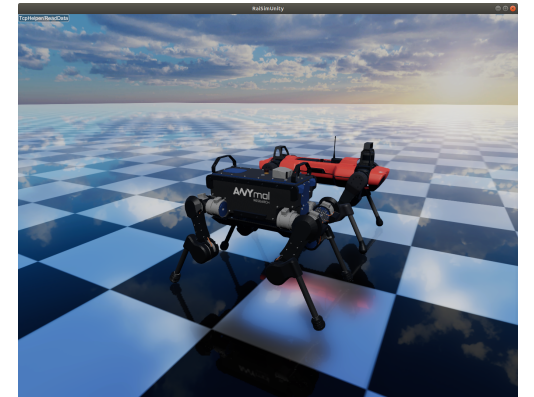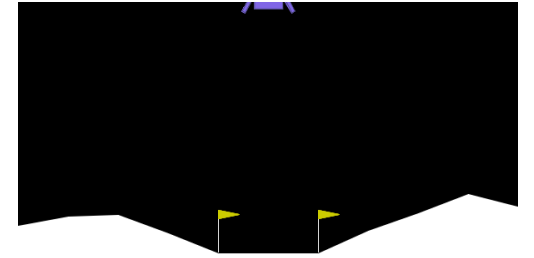# Simulators

Mujoco

Isaac Gym

Omniverse

PyBullet

V-REP

Research oriented simulators

Popularized in robotics as sim2real research

- **Gymnasium** (OpenAI Gym)⤴: An API standard for single-agent reinforcement learning environments.

- **MuJoCo**⤴:

- **NVIDIA Issac**⤴: GPU accelerated simulation: Gym (depricated), Sim, and Orbit.

- **RaiSim**⤴: physics engine for robotics and artificial intelligence research with easy to use C++ library.

- **PyBullet**⤴:

- **Drake** (MIT)⤴: C++ toolbox started by the Robot Locomotion Group at the MIT and Toyota.

- **Gazebo**⤴: part of ROS.

Game engines as simulators

General purpose (physics simulation, rendering, etc.) game engines:

- **Unity3D** (Unity Technologies)⤴: cross-platform game engine developed by Unity Technologies
    - **Barracuda**: neural network interface for Unity
- **Unreal Engine** (Epic Games)⤴: 3D computer graphics and game engines developed by Epic Games
- **CryEngine** (Crytek)⤴:
- **Lumberyard** (Amazon)⤴:
- **Stingray** (Autodesk)⤴:
- **PhysX** (Nvidia)⤴:
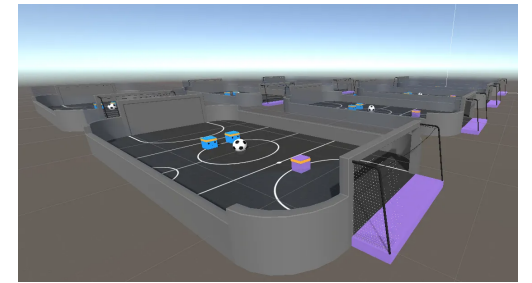
Describing a Robot

URDF

URDF (Unified Robot Description Format) is a standard format based on XML used to describe a robot model in simulators. A URDF models a robot as a tree structure composed of **links** and **joints**. Links represent the robot's physical parts, while joints define how these parts move relative to each other, specifying their spatial relationships.

Language in Simulator

Sim2Real

Domain Randomization