Real-Time Motion Planning for Industrial Robotics Using cuRobo on Jetson NX

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Making Industrial Robots Smarter and Faster

In modern industrial automation, efficient motion planning remains a critical challenge, particularly for multi-axis robotic systems operating in dynamic environments. Traditional CPU-based motion planners struggle with real-time responsiveness, often leading to suboptimal trajectories and inefficient collision avoidance.

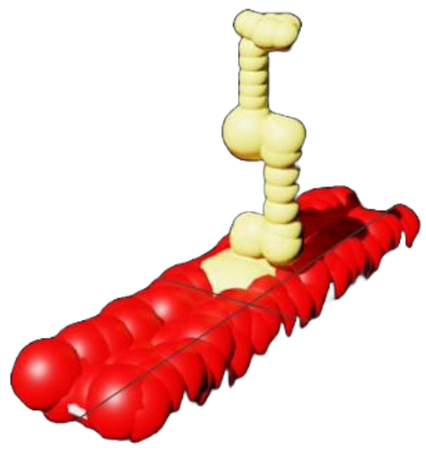
Compact GPU Platform

Our project leverages GPU - accelerated motion planning with NVIDIA's Jetson NX platform. This compact solution delivers exceptional performance gains, ensuring real-time collision avoidance.

Real-Time Planning Pipeline

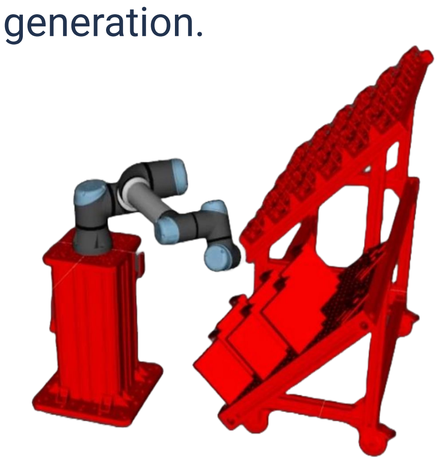
Self-Collision Definition

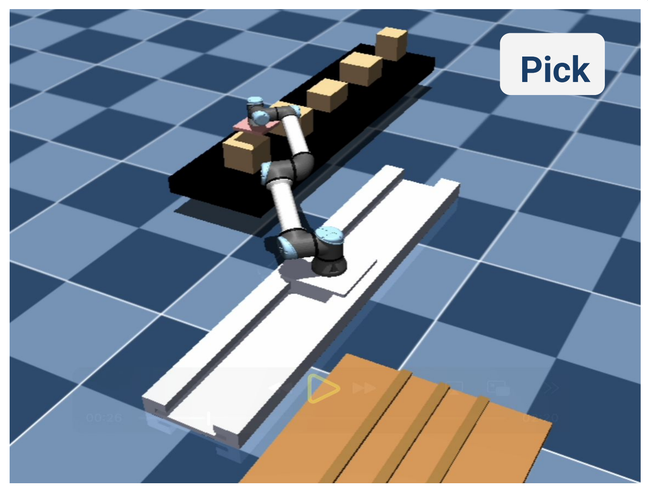
The robot and any additional joints are represented as **spheres** to define **self-collision**. This defines the number of joints in the plan.

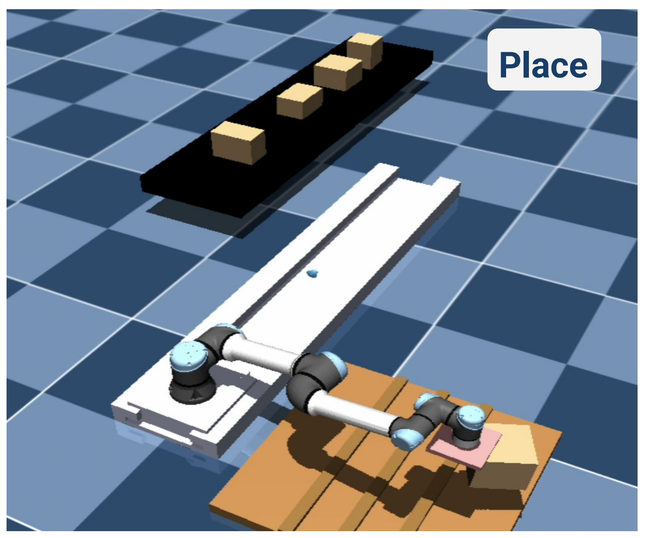


Obstacle Representation

The surrounding obstacles are defined using **simple geometries, meshes, or point cloud data**.
This allows the planner to **efficiently detect and avoid obstacles** during motion generation.







Apply Trajectory

cuRobo Motion Planner

The motion planner **generates and publishes trajectories**, which are then fed into the simulation.
This ensures **accurate, real-time motion execution**.

Mujoco Physics Simulator

The Mujoco simulation loop continuously updates obstacle positions based on **physical contact** models. Any obstacles affecting motion are updated.

Update Obstacles

Key Contributions

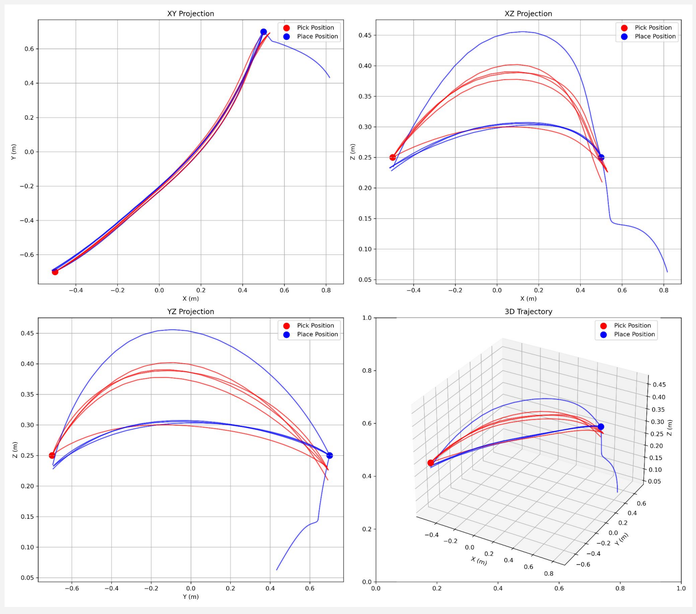
1) Integrated cuRobo with MuJoCo for real-time, collision-aware trajectory planning
2) Deployed on Jetson NX for low-latency, embedded industrial use
3) Benchmarked against OMPL on pick-and-place tasks with obstacle avoidance

Precision at Speed: *3X Faster* Industrial Performance

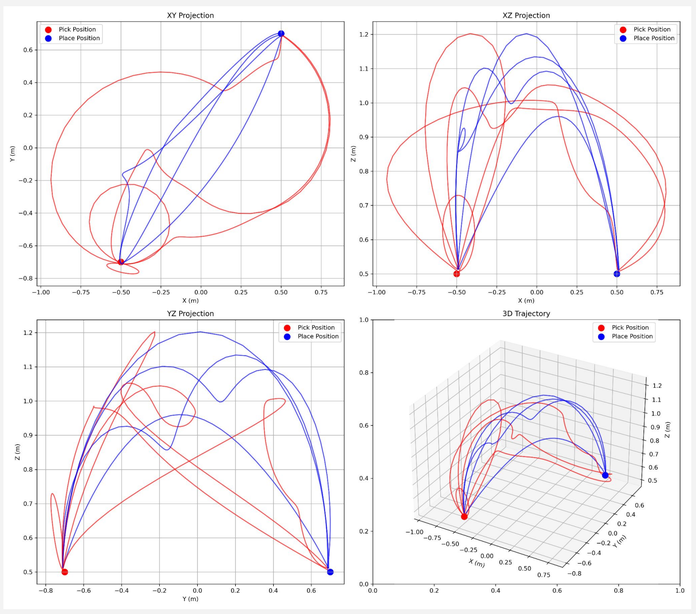
Our GPU-accelerated planner running on Jetson NX achieved a 3× faster average cycle time than traditional CPU-based planners (e.g., OMPL) across 100+ runs of a representative pick-and-place task with collision avoidance around static pillars.

cuRobo generates significantly smoother, more optimal trajectories compared to common industrial MoveIt planners, reducing mechanical wear.

cuRobo



Reference (OMPL)



End-Effector positions(m) during task and planar projections.