



QArm Mini

Inverse Kinematics

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QArm Mini – Application Guide

Inverse Kinematics

What is Inverse Kinematics?

Inverse kinematics refers to the mathematical process of determining the joint angles of a robotic manipulator required to achieve a specific position and orientation of the end-effector. While forward kinematics calculates the end-effector's position from known joint angles, inverse kinematics works in reverse—starting with a desired location in task space and solving for the corresponding joint positions. This is essential for tasks where precise control of the end-effector's location is required, such as pick-and-place operations or assembly processes.

In this lab, you will explore the practical applications of inverse kinematics through two key activities: using a software-based teach pendant that guides the robot along predefined waypoints; and generating smooth trajectories using cubic splines. These techniques are commonly used in industrial automation for tasks requiring accuracy, repeatability, and controlled motion, such as welding or complex assembly lines.

Background

Prior to starting this lab, please review the following concept reviews (located in Documents/Quanser/4_concept_reviews/),

- Concept Review – Robotics → Position Kinematics
- Concept Review – Robotics → Trajectory Generation

Getting started

In this lab, the teach pendant allows you to record and replay Cartesian positions, while the trajectory generator ensures the manipulator follows a continuous path. Ensure you have completed the following labs

- **Play Lab**
- **Lab 1 – Forward Kinematics**

Before you begin this lab, ensure that the following criteria are met.

- If using a physical QArm Mini, make sure it is securely attached to the base and the manipulator is in the rest position. See the QArm Mini Quick Start Guide for details on this step.
- You are familiar with the basics of Simulink. See the [Simulink Onramp](#) for more help with getting started with Simulink.