

ED5314: Design, Analysis and control

Project Proposal

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September 15, 2017

1 Introduction

A quadrapedal robot in its quadruple stance phase, all the four legs are placed on the ground. In such a scenario the architecture of the robot can be considered parallel as the legs are actuated in-parallel for any position or orientation.

2 Problem Statement

1. Analysis of the quadruped as a parallel manipulator for to find out the workspace and singularities.
2. Given a particular load and a specified trajectory to the robot, finding the possible segment of the trajectory where the robot will slip, by assuming a friction model between the leg and the floor and each leg.

Time Optimal Control:

Given the initial and final position, the problem statement is to come up with control actions that perform this task in minimum time possible.

Energy Optimal Control:

Generating energy optimal trajectory from a rest state of a quadruped to a normal standing state.

3 Possible extensions

1. Balancing a ball on the end-effector at the center point.
2. **MPC:**
To develop a MPC algorithm to control the manipulator from any given start and end position.
3. Assuming one of the leg is lost or defective, study the changes in the workspace and singularities.

4 Literature Survey

1. Jingjun YU, et.al., "Motion capability analysis of a quadruped robot as a parallel manipulator", Front. Mech. Eng., 2014.
2. J.E.Bobrow, et.al., "Optimal Robot Motions for Physical Criteria", Journal of Robotic Systems, 2001.