Integration of a Cartesian Robot with ROS

Zhong Zhe, Ankit Bhatia and Matt Mason

**The Manipulation Lab, Robotics Institute**

Introduction

- A Cartesian Robot is an industrial robot whose three principal axes of control are linear and are at right angles to each other. The three sliding joints correspond to moving the wrist up-down, in-out, back-forth.
- A popular application for this type of robot is a computer numerical control machine an 3D printing. Pick and place machines and plotters are also based on the principal of cartesian robot.
- Goals:
  - Set up robot
  - Write driver for the robot
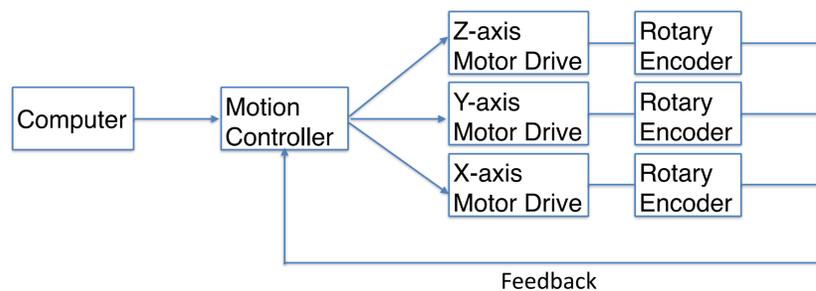 - Measure position errors of x-axis and y-axis

Cartesian Robot
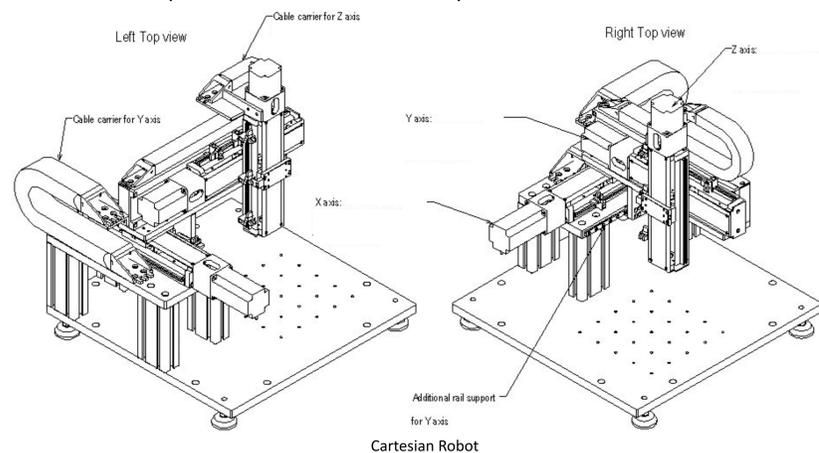
Hardware and Controls

- 6k4 motion Controller
- Linear servo motor driver
- Rotary Encoder
- Brakes
- Limit&Home Sensors
- Couplings

6k4 motion controller
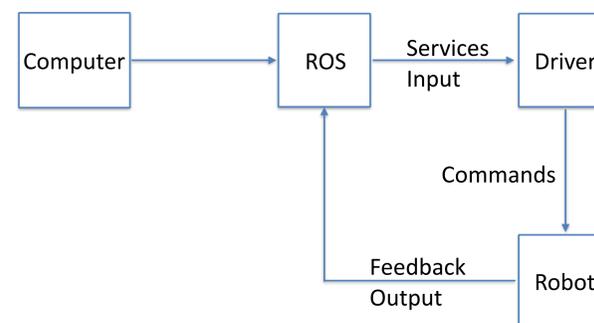
- PC based machine control

Feedback

Interfacing with ROS

- The Robot Operating System (ROS) is a flexible framework for writing robot software. It is a collection of tools, libraries, and conventions that aim to simplify the task of creating complex and robust robot behavior across a wide variety of robotic platforms.

- This flow chart is how the ROS driver works

Operating Principle of ROS Connection with Robot

- Procedure
  - Create ROS environment and create catkin workplace
  - Write ROS services
    - set position, velocity, acceleration, deceleration of robot
    - get position of encoder and status of the robot motion controller
  - Test services on the robot and debug them
  - Actuate robot using ROS services

Results

- Robot Accuracy(position error) is the robot's ability to position its wrist end at a desired target point within the work volume, and it is defined in terms of spatial resolution.

- Procedure
  - collect 5 groups of coordinate data of each axis
  - calculate the mean errors of each axis using

- The following graph is the error bar of each axis:
  x-axis: maximum error is -0.0009 inch
          mean errors is -0.0004 inch
          standard deviation is 0.00024 inch
  y-axis: maximum error of is -0.0008 inch
          mean error is -0.00036 inch
          standard deviation is 0.0003 inch
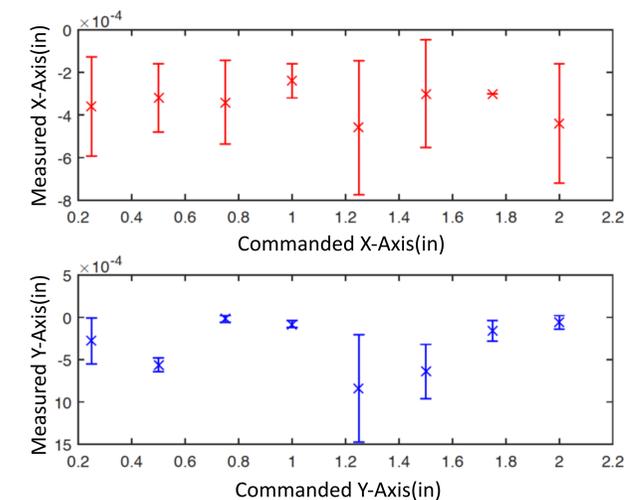
Future Work

Just a part of work has being completed this summer and one simple application is used in drawing machines where a pen translates across an x-y plane while a tool is raised and lowered onto a surface to create a precise design. It can also be used in 3D printer design but it is harder. Another future direction is to use ethernet instead of RS232 to command the robot(TCP/IP). This will allow us to log information faster and command the robot at a higher frequency.