ROBOTIC ARM ERROR ANALYSIS AND REDUCTION

2020 BRIGHT MACHINES ENGINE CAPSTONE

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Introduction

In industrial robotic arms, calibration can be a time-consuming and expensive process. Our project aims to simplify this process by investigating error reduction methods for small-scale robotic arms that can then be expanded to larger industrial robotics.

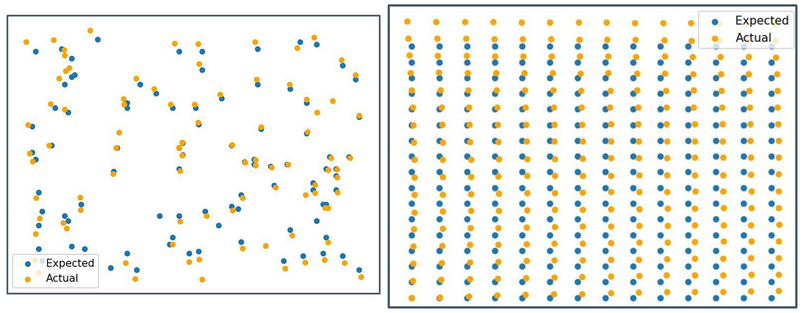
Experimental Setup

In order to measure inaccuracy in a robotic arm, we set up a uArm Swift Pro consumer robot in front of an iPad and used a stylus to touch points on the screen. We performed the following test patterns in our experiment:

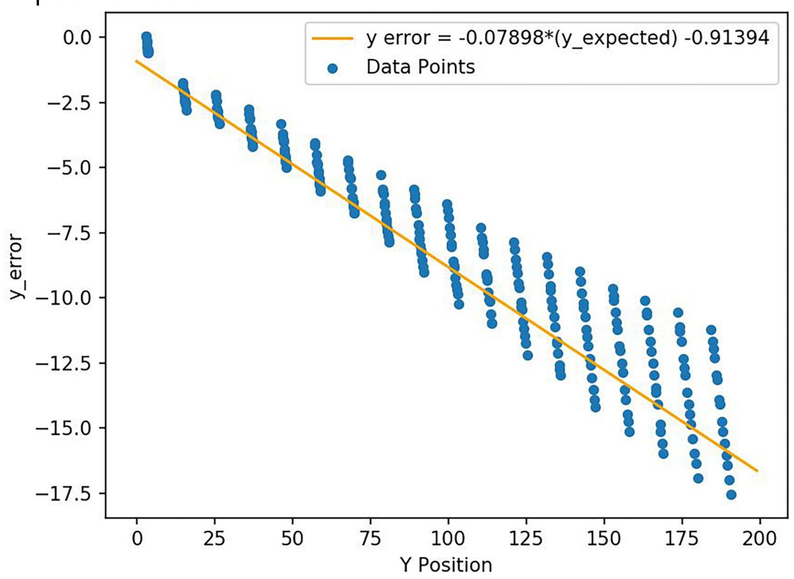
- Grid
- Random
- SIngle point

By comparing the data from our iOS app and the robot's internal positional logic, we were able to calculate the two-dimensional positional error.

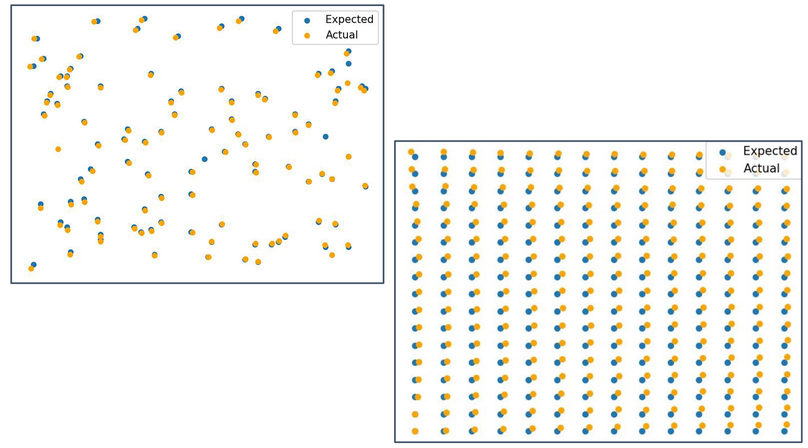
Initial Data



- We discovered that our arm had a similar trend in error regardless of the test pattern performed.
- This error increases in a roughly linear fashion as the x and y coordinates of a point increase.
- By plotting this error as a function of x or y position we can fit a curve to this error. This is shown for y error vs y position below:



Results



- The average error function was inverted and was applied to the movements of the uArm robot.
- By using this first order corrective algorithm, we were able to reduce arm error by an average of 57.5% for grid patterns and 60% for random patterns.

Future Work

- Perform tests in a three-dimensional system that includes height.
- Apply this procedure to larger industrial robots and compare the data to our small scale tests.
- Construct a physical cage/box and automate this process to run without human intervention.
- Explore other algorithms and higher order curve fits to further reduce error.

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