Lab 3. Robot ping-pong ball toss competition.

Deliverables: **Each lab group must submit a *short* (~3-page) Lab Report by 5pm Wed., April 20 (in dropbox). All or part of the written report may be replaced or enhanced by a narrated video demonstration, showing both the design process and resulting arm performance: we strongly encourage video documentation!** For fun, we will run a contest, to be defined more precisely by the TA's in lab, to compare accuracy, repeatability, and distance of your robot's toss. The winning team will receive a $25 coupon for amazon.com. If practical, we will allow teams to tune and simulate controller after lab and will run additional "contest" runs again on Thursday, April 21, for teams wishing to improve their system outside the 3-hour lab period.

Overview

The goal of this lab is to control the two-link arm to launch a ping-pong ball into a receptacle.

As always, you are encouraged to explore various solutions, depending on your personal knowledge, interests, curiosity, and persistence.

Credit for the lab includes check-off by TA (40%), and a brief lab report (60%). You are strongly encouraged to use a short video in documenting your results. As in Lab 2, you report must explain your approach and must verify you have completed the tasks listed below. **We are creative/flexible about how you approach particular problems.** For full credit, you must include appropriate documentation of your process in obtaining each result (e.g., a diagram, sketch, or explanation of how you modified your simulink model, any needed paper calculations, a print-out of resulting data, and/or data needed to perform calculations, etc.). *Please be concise and efficient in your presentation; well-labeled plots are always appreciated – and often can be much more effective in communicating details than excessive text.*

Your tasks in this lab include:

1. **Design a trajectory for the end effector.** On the lab website, we have included an m-file function called `trajectory_draw.m` that may be helpful as a starting point. The function shows the approximate workspace for the end effector and allows you to click points, which are then connected via a spline. (x,y) points are returned, as well as joint angles (a1, a2). The website also includes an "appendix" that gives data for a human (TA Brian Satzinger) tossing a ball; we suggest a similar trajectory may be a good starting point in your design process.

2. Calculate inverse kinematics, to obtain trajectories for the joint angles. There are two m-files you may download from the lab website to aid in calculating kinematics and IK. You may need to modify these files to increase the accuracy of calculations, as joint lengths and angle offsets are currently only approximate guesses. These files are: `ang2xy.m, xy2ang.m`

3. Set controller as desired. Your controller design from Lab 2 may be good enough. Otherwise, improve your controller and state estimation as desired.

4. Modify a simulink model so that the arm follows the desired trajectory and tosses the ball as desired. This step will require iteration and experimentation! Good luck.