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ME454 Final Project Report
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Three Link Acrobot

The final project I decided to choose was a 3-link acrobot, a three-link pendulum system where the 1st link is passive and the 2nd and 3rd links are actively controlled. For this project, the goal was to have the acrobot start in the hanging position, and eventually maneuver all three links to a standing up right position. The plots for my solution can be found below and the animation attached in the folder.

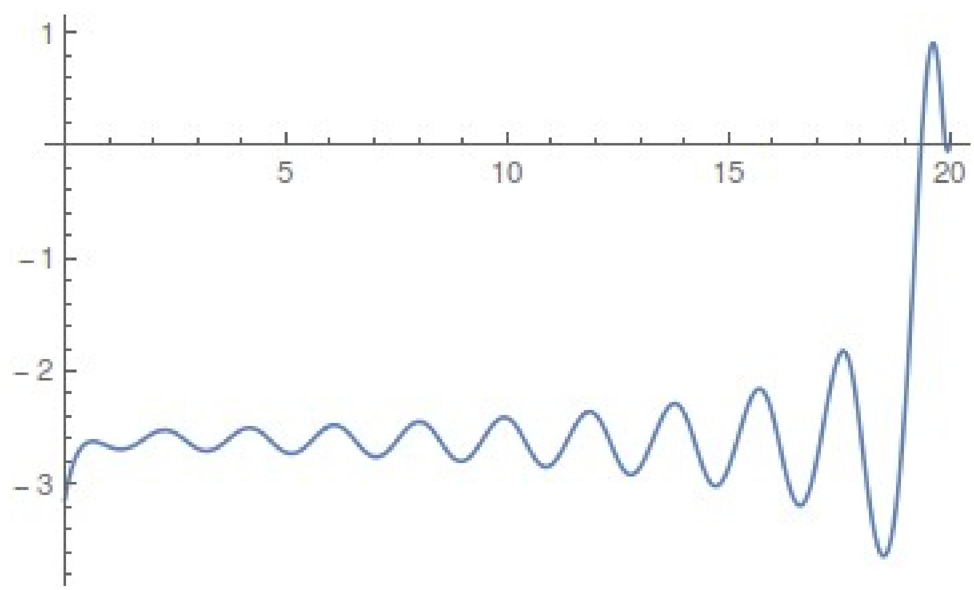
The dynamics of the system were found using the Lagrange equation and the equations describe a three-link acrobot with rotational inertia also accounted for. The length and width of each link is .5 and .1 respectively, and each with a mass of .2.

The parameters of the optimal control algorithm include Q (the weights how much you want to track the system), R (the weights for how much control is allowed), and P (the weights for how important it is to reach the desired endpoint). The values of Q, R, and P for my solution is .1, .0005, and .1, which means that being able to track the state of the system and getting to the desired endpoint is of high importance, while the amount of control we can use is not important.

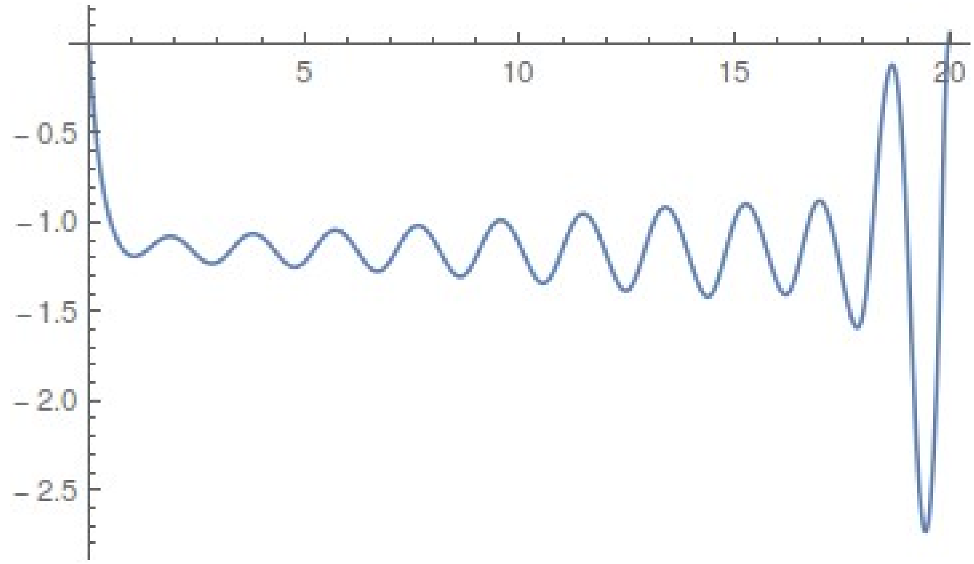
Some problems that I encountered during the project include trying to find ideal end time values and pairing them with Q, P, and R values that would converge to a solution in a reasonable amount of time. This resulted in a lot of time tuning each parameter until I reached a satisfying solution. The values that I have (T = 20) result in a quick solution and a reasonable solution to my problem.

Initial condition of the system is (Angle 1 = -Pi, Angle2 = 0, Angle3 = 0) and final desired position is (Angle 1 = -Pi, Angle2 = 0, Angle3 = 0). The mathematica code takes less than 1 minute to run and converges to the solution within 1 run.

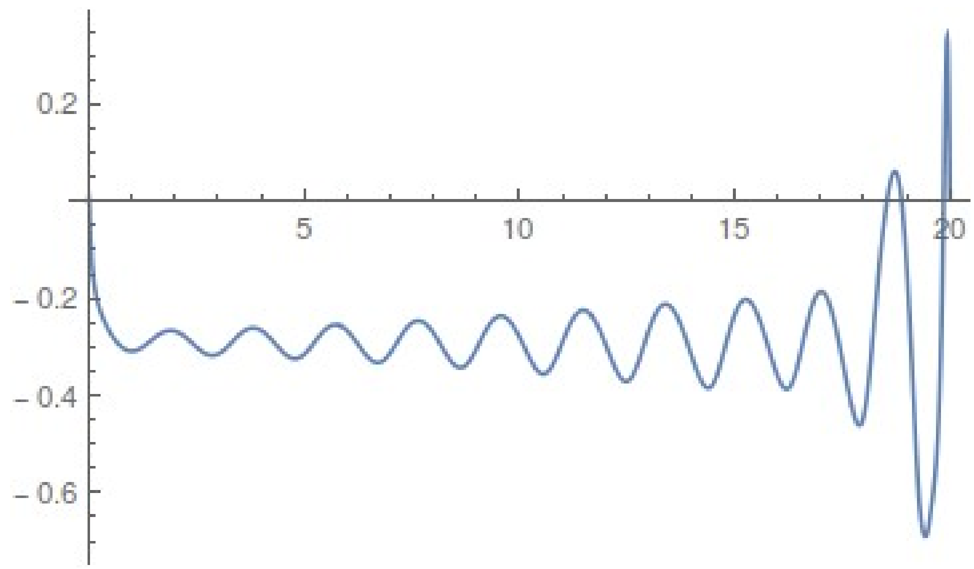
Plot of Angle 1 vs Time



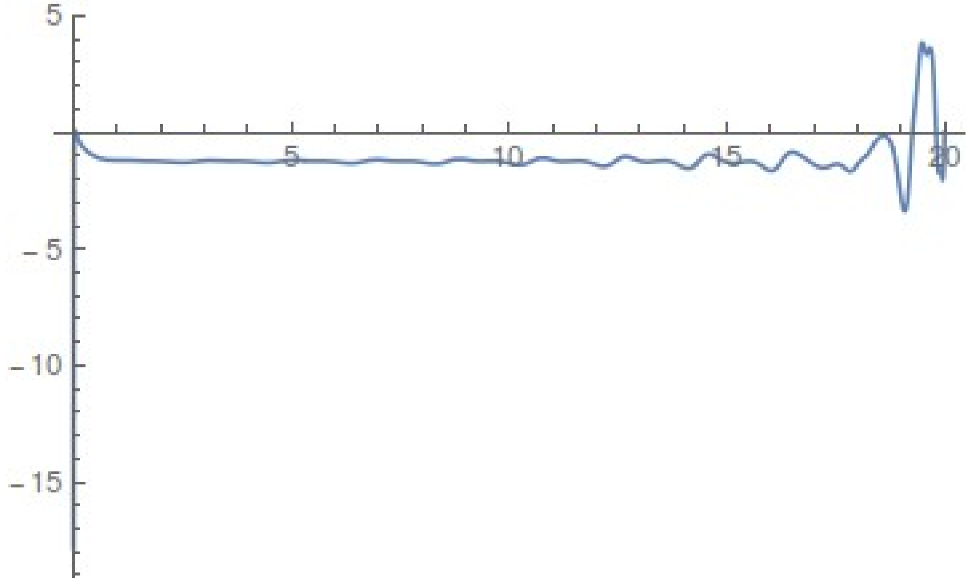
Plot of Angle 2 vs Time



Plot of Angle 3 vs Time



Control of Link 2 vs Time



Control of Link 3 vs Time