ELEC 442 – A5

Jacob Morrison

All the requested plots were developed and can be found in the folder "resultant plots" which is in the same folder as this document. The Simulink files used to create these plots are titled "A5Q1a", "A5Q1b", "A5Q1c", "A5Q2a_PDG", and "A5Q2b_stiff". Also note that the functions used in these Simulink files can be seen in the files "Jacobiani.m", "PDG_controller.m", "Robot.m", Robot_Friction.m", "Stiffness_controller.m", and "XY.m". All of the above listed files can also be found in the same folder as this document.

Discussion of results:

Part1_i : In this scenario with torque on both motors set to 0 N*m and no friction, the two joint angles sort of go a bit crazy, fluctuating up and down as a result of the angular acceleration caused by the net 0 motor torque. If there was no gravity 0 torque would result in no movement, but because of gravity, there has to be an angular acceleration even with net 0 motor torque.

Part1_ii : In this scenario the second motor has a torque of 5 N*m, while the first has a torque of 0 N*m. This unsurprisingly caused the second joint angle to diverge towards infinity, while the first joint angle diverged towards negative infinity at a slower rate. In this case the 5 N*m torque led to drastically different results than in the previous case.

Part1_iii : This scenario is the same as the first except there is friction on the motors. As a result the two joint angles remain much calmer than in the first scenario. This makes sense because the friction will create a torque in the opposite direction of the angular motion of the joints, preventing any huge jumps in the angular position.

Part2_PDG : In this scenario, thanks to the PD + Gravity set point controller the joint angles converge towards their desired position fairly quickly. There is some overshoot, and the two joint angles don't quite reach the desired position within the 15 seconds, but overall the controller is clearly working.

Part2_stiff_i : In this case where the Kp matrix equally penalized error in the X and Y position, the position of the end effector quickly converged to the desired position.

Part2_stiff_ii : In this case, where the penalty for error in the X position of the end effector was weakened, it can be seen that y position still converged to the desired position fairly quickly, but the x position was yet to converge after the 15 second simulation.

Part2_stiff _iii : In this case the opposite penalty was applied compared to the last scenario, with a lesser penalty applied for error in the Y position of the end effector compared to the error in the X position. As was expected, this resulted in the X position of the end effector converging to the desired position quite fast, whereas the Y position of the end effector moved in the right direction but had not converged by the end of the 15 second simulation.