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PS7

1.



2. Using the controller gains described by Professor Newman, I was able to maintain stable control up to a ke of 44. However, the oscillations don't die out until after the end of the 10 second simulation.

This controller is less aggressive (slower) than the one I designed in problem 1, which allows it to operate in a stiffer environment.

I should note that anyone having trouble stabilizing this controller probably had their control law wrong. Since the main script already negates the force sensor, it is unnecessary to negate it in the control law itself (contrary to the equation in the assignment document).



3. Using the controller described in problem 1, I was able to maintain stable control for kpt down to . When the stiffness was brought below 10, the system did not go unstable in the sense that it blew up, but instead would not reach steady state before the end of the simulation, which may have indicated unstable low-frequency oscillation, or just a very slow convergence or high steady state error.



4. I found that this controller was much more sensitive to the environment stiffness than the robot's stiffness. When the environment's stiffness was increased to about 27, my controller would destabilize and oscillate out of control. However, the robot's stiffness could be decreased to about 10 (a factor of 400) before instabilities could be observed, and even at this point, I am not sure the system was unstable. It may have just been very slow.