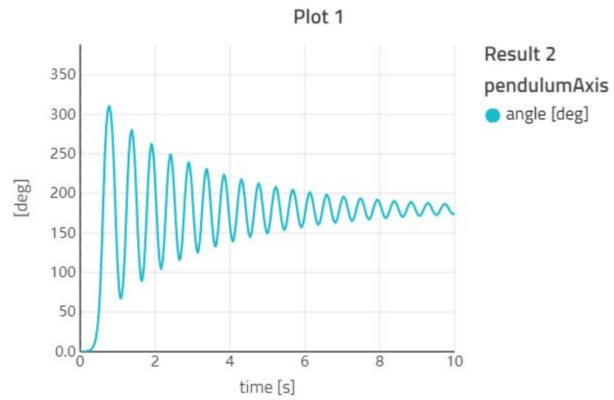
Task 1 Hands-on parameter tuning

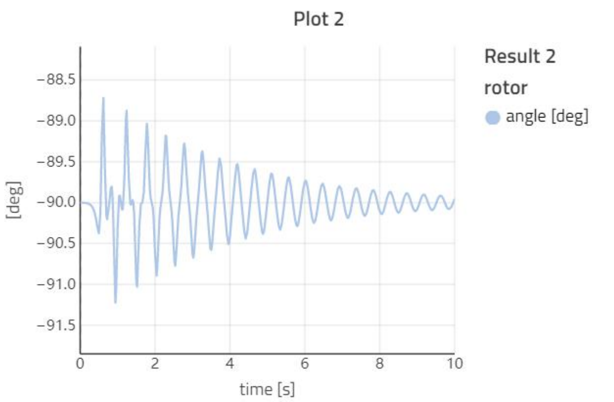
For task 1.1, I just try to set two dampening constants to different values and try to match the results with the two plots in the notebook. Finally, I determine that the two constants are:

Pendulum dampening: 0.000005

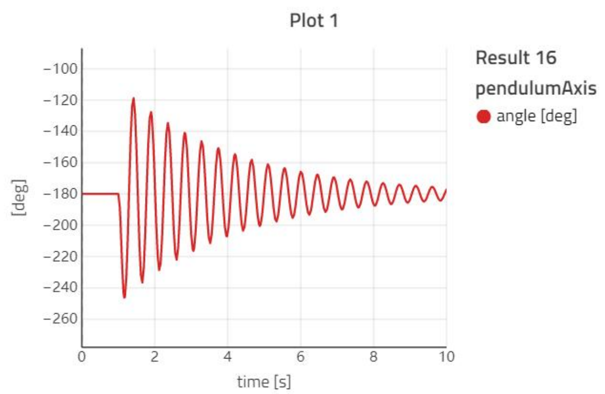
Rotor dampening: 0.01

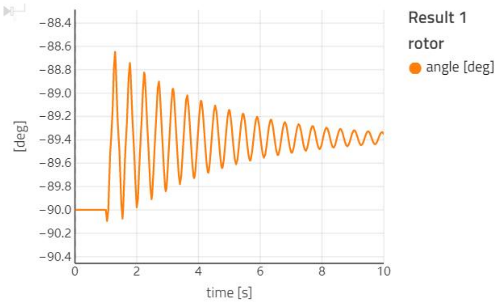
The plot of pendulum angle is quite similar. However, there are too many noises in the given plot of rotor angle, the results are quite similar without considering the noise.



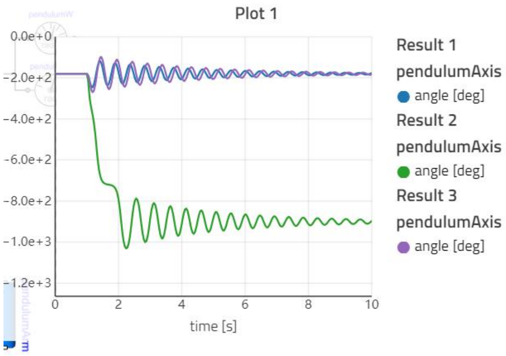


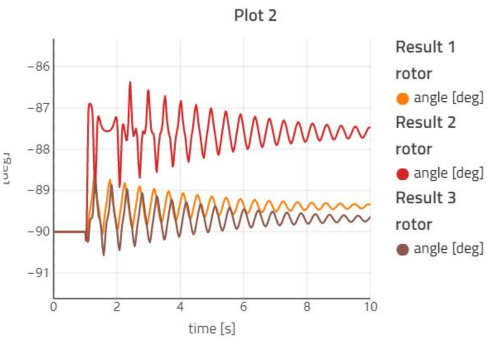
Disturbance with amplitude {0.025, 0, 0}



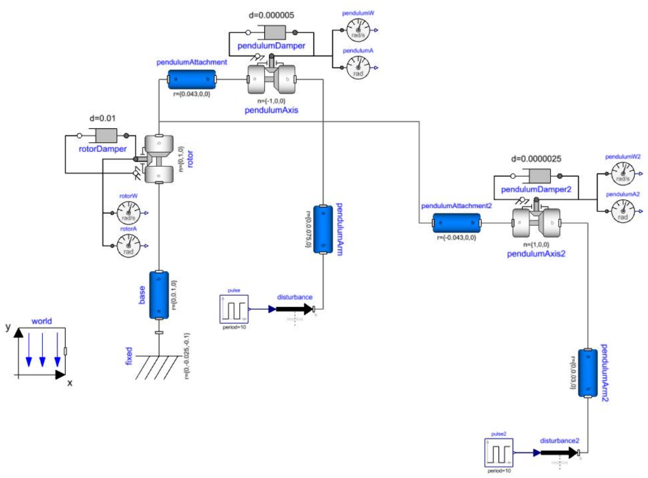


The result looks reasonable as the damped oscillation.
Two more amplitudes: {0.1, 0, 0} and {0.025, 0.025, 0.025}

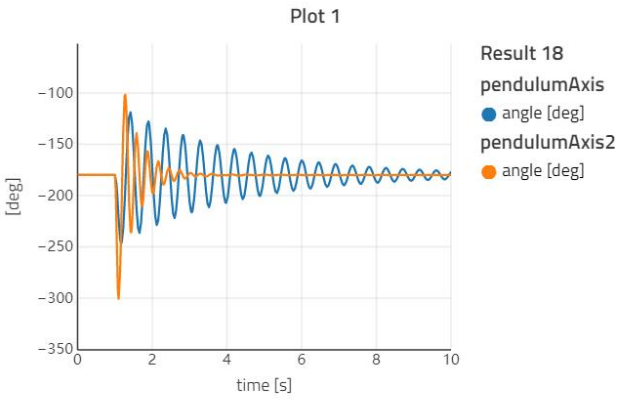


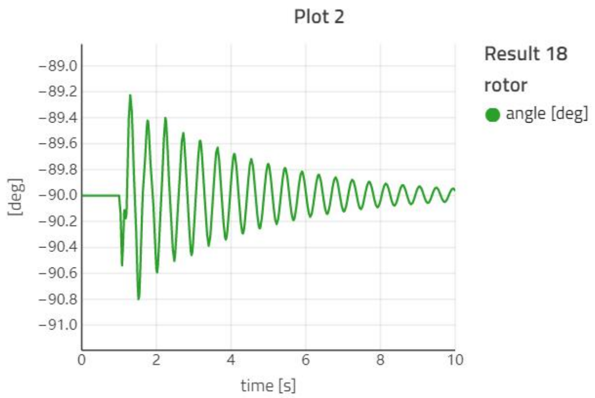


2. Adding an additional pendulum arm



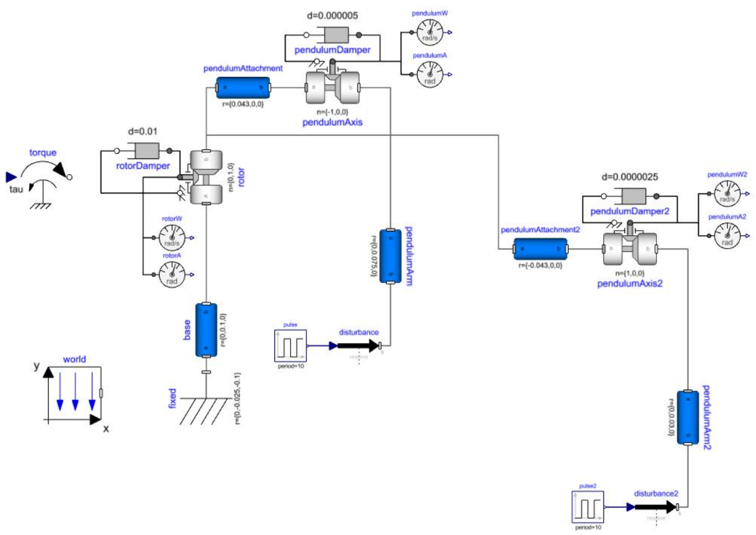
To add an additional pendulum arm, we just need to copy the blocks in the diagram window, and implement those new blocks in the same way.

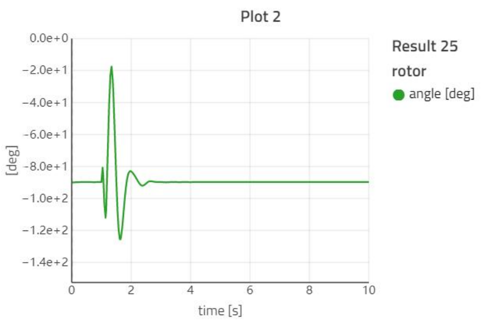


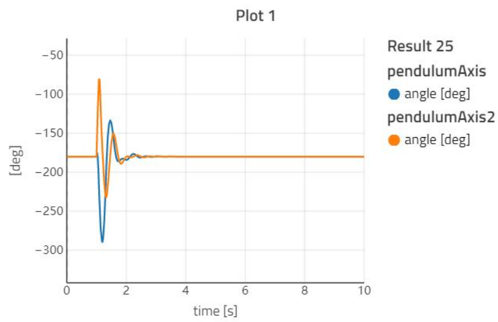


With the same disturbance, the pendulum 1 has almost the same plot as previous. For the pendulum 2, it has a dampening constant half as large as for the first pendulum bearing, but it still stops oscillation much earlier than the pendulum 1.

3. Adding a damping controller







With the given L of {100.0, 9.65721819, 103.07438354, -1.40000991, 87.40106372, -3.88918398}, u = - L * x, and the same disturbance, the two pendulums and the rotor all can stop oscillation very soon. So this LQR controller works well.