# Motor Control Lab 01: System Setup and PID Tuning

## 1 Rules Before You Start

1. Please treat the motor kit as an unprotected smart phone. Always put the motor kit inside its box when you are not doing experiments.
2. You are not allowed to perform any change or rewiring to the hardware, except for unscrewing and switching between inertia/pendulum/inverted pendulum mode. If you encounter any problem, report to professor Tsao and the TA immediately.
3. We will have a student demonstration in week 10. You will return the motor kit right after the demonstration.
4. Modification of the software or having your own code is encouraged.
5. Release the red enable button when the motor goes unstable.

## 2 Quick Startup

1. Making sure the motor kit is under inverted pendulum mode.
2. Connecting power connectors and USB for the myRIO.
3. Installing drivers (a pop-up window will guide you step by step).
4. Opening "MotorLab.lvproj".
5. Right-clicking "myRIO-1900 (172.22.11.2)" >>"Connect".
6. Opening and executing "InvPendCtrlSample.vi".
7. Holding the inertia to the desired initial position.
8. Pressing the red enable button
9. Clicking "Run Control". Your first experiment is now running!
10. Downloading the experimental data and importing to Matlab.

# 3 Checklist

1. Figuring out the system architecture
   - What's the control input? What's the input range?
   - What's the plant output? What's the output unit?
   - What's the sampling rate?
   - What's the sensor quantization level? (Hint: how many rad per encoder count?)
2. With the preset PID control gains, obtaining experimental data for disturbance rejection (e.g., push the inertia by your finger).
   - Saving experimental data and generating your plots in Matlab (always including reference, input, and output).
   - Is there any control saturation in your experiment?
3. Tuning the PID gains for faster disturbance rejection. (To have a relatively fair comparison, try your best to produce the same amount of disturbance.)
   - Listing the PID gains after tuning and generating your plots in Matlab.
   - Is there any control saturation in your experiment? Is it more or less frequent than using the preset PID gains? Why?
4. Tuning the PID gains to decrease settling time for disturbance rejection while keeping the same response speed as you get in #3.
   - Listing the PID gains after tuning and generating your plots in Matlab.
5. Using the PID gains you tune in #4 but assigning the integral gain $K_i$ to be zero. Using this new controller for disturbance rejection.
   - Listing the PID gains after tuning and generating your plots in Matlab.
   - Does the inertia come back the initial position after disturbance? Why?

 