Harmonic Motion

1 Assignment

In this lab, you will be exploring simple harmonic motion. At your lab station, you should have a set of different colored springs, a mass hanger, and a set of masses. You *cannot*, however, use a meter stick or any other device for measuring S.I. units of distance.

For this lab, your team is tasked with determining the spring constant, k, for 3 of the springs using the equipment available. Your team should determine these constants by analyzing the harmonic motion of the mass and spring (see Section 3.2).

2 Deliverables

For your lab report, 10% of the grade will be for following the guidelines in the lab report template. Another 10% will be allocated for the Abstract and Introduction of your report. The remaining percentage will be based on your inclusion of:

1. *[20%]* a description of the procedure your team developed to measure the spring constant, k, and its uncertainty from the tracking camera data
2. *[30%, 10% for each spring]* plots showing the position as a function of time for each of the springs tested. Make sure to label the plots with the color of the spring in question.
3. *[30%, 10% for each spring]* the value of k for each spring, along with the uncertainty associated with this measurement

3 Technical Information

3.1 Using the tracking camera

Since you do not have access to a meter stick for this lab, you will not be able to use `6_track_motion_and_print.py` script to measure in centimeters. You can, however, use `6_track_motion_and_print.py` or `4_track_and_print_with_camera_input.py` to record pixel information. The pixel tracking information should be sufficient for you to perform the analysis for this lab.

3.2 Harmonic motion

The position of a harmonic oscillator as a function of time is given by the equation:

$$x(t) = A\cos(\omega t + \phi) \tag{1}$$

where A is the amplitude, ω is the angular frequency, and ϕ is the phase. For the case of a spring and mass system:

$$\omega = \sqrt{\frac{k}{m}} \tag{2}$$

where k is the spring constant and m is the mass. Angular frequency is related to the period, T, of an oscillator by:

$$\omega = \frac{2\pi}{T} \tag{3}$$

4 Hazard Assessment

In order to avoid doing damage to the lab springs, keep the mass hung from the springs below *750 g*.