Week 13
Oscillatory Spring/Mass Experiment

1. ## Scope

1.1 Goal

To demonstrate the principle of conservation of energy by observing the dynamics of an oscillatory spring/mass system.

1.2 Units of measurement to use

United States Customary units

1.3 Safety Concerns

Students must stand clear of the spring/mass while it is oscillating

2. ## Reference Documents

Students may need to refer to Senix spec. sheet/guidelines if a different configuration is desired for the Ultrasonic Sensor (e.g. changing the sample rate)

3. ## Terminology

- **Include in procedure but leave empty for faculty to fill in**

4. ## Summary of Test Method

The first part of the experiment will involve determining the spring constant for the spring provided by the instructor. This will be done by varying the masses that are hung from the spring and recording the changes in stretched length of the spring. The second part will involve demonstrating Conservation of Energy by initiating the oscillation of the spring/mass setup and using the Lab View interface to record the position vs. time. Using this data, students can compute the different forms of energy.

5. ## Apparatus

Test stand
Ultrasonic Sensor

6. ## Reagents and Materials

Manual measurement tool
Allen wrench set (1/8 – 1/4 inches)
Varying masses
Mass hanger
Spring (different k value for each group)
2 spring hanger sliders with t-slot inserts

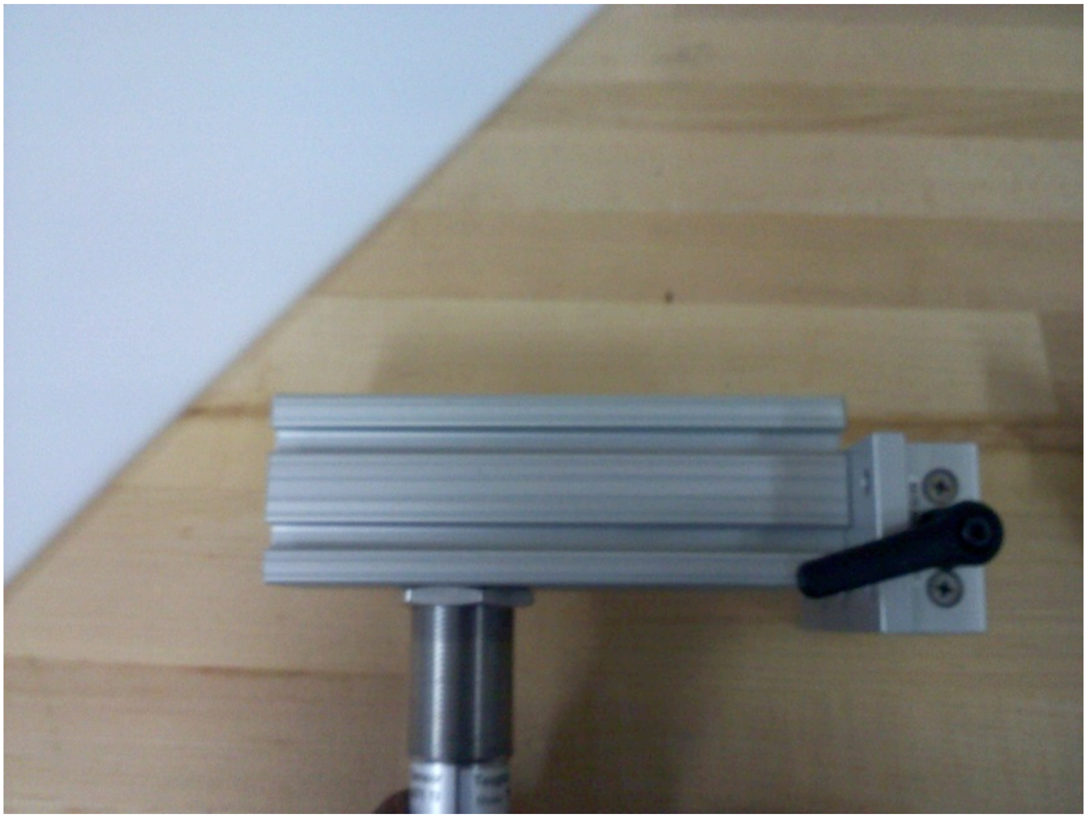
1 ¼ inch bolt, length 2”

7. Sampling, Test Specimens

To compute the spring constant, five experimental runs will be conducted by varying the masses hanging from the spring ranging from 50 grams to 100 grams. Each subsequent run will increase the mass by 10 grams. To demonstrate Conservation of Energy, one experimental run will be conducted with a constant mass on the spring. The mass will be initiated to oscillate and students will begin recording position vs. time data through the Lab View interface.

8. Preparation of Apparatus

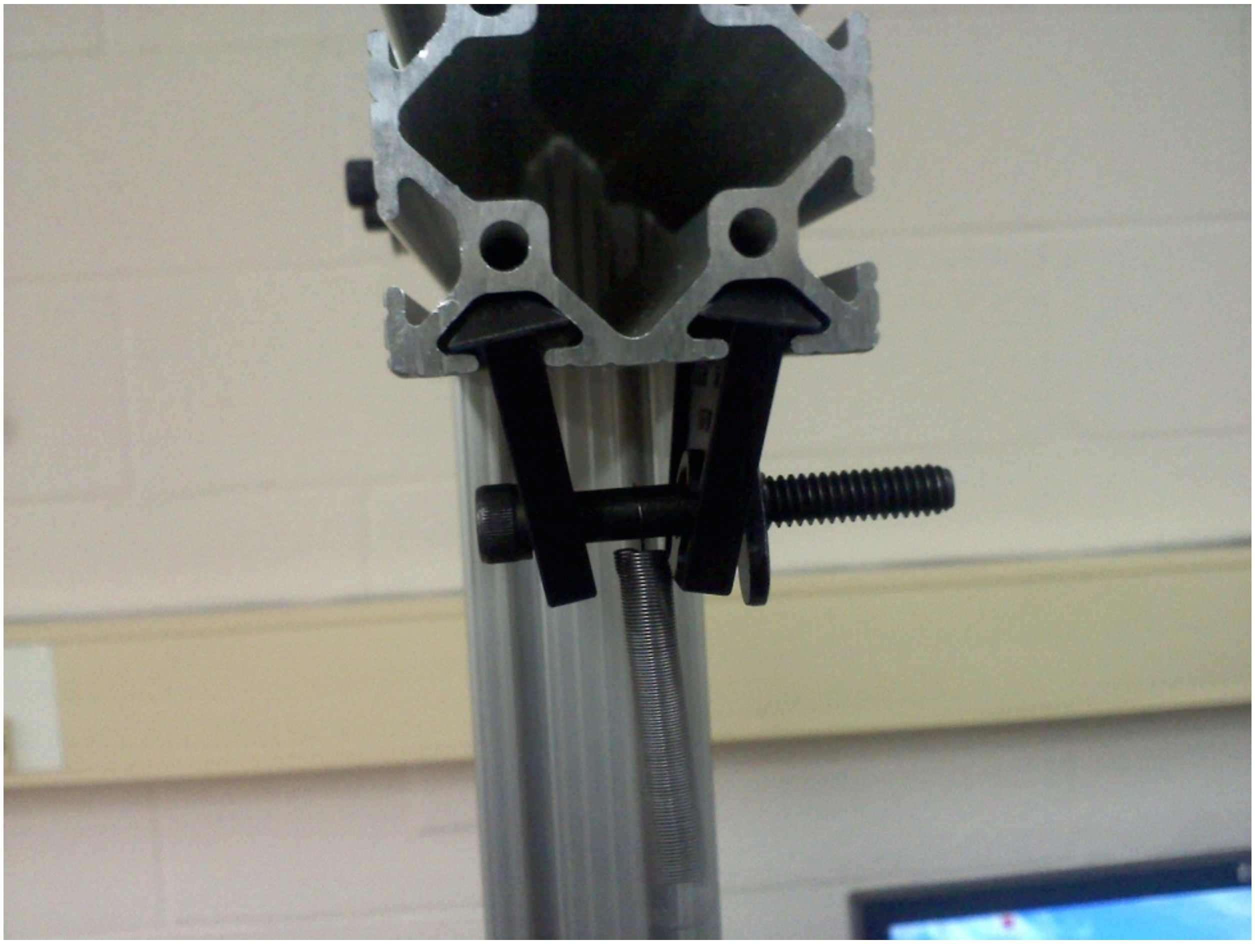
Step 1: Setup upper post segment of the test stand in vertical configuration as shown above. Use the directions from previous labs for setup.



Step 2: Mount the slider on the aluminum extrusion on the opposite end of the sensor as shown above. Make sure the slider is tightly screwed into the lower two threaded holes on the end of the extrusion.

Step 3: Align the slider with the t-slots over the top of the test stand and slide it down the post until it stops and lock it in place by tightening the black brake handle.

Step 4: In the same way, mount the spring mounting aluminum extrusion on the test stand and lock it in place near the top of the test stand.



Step 5: Slide the two spring hanging inserts in the t-slot channels on the spring mounting extrusion. Insert the 1/4-inch diameter bolt through the holes in the inserts and thread a t-nut at the end of the bolt to secure it in place. Hang the provided spring from the bolt as shown above.

Step 6: Log into the computer and start the LabView “distance measurement” program that will be used to capture the sensor data. Make sure the sensor is connected to the DAQ device and the power supply plugged to an outlet. Connect the sensor to the computer by plugging the USB cord into the port on the computer. At this time, you should hear a buzzing sound coming from the sensor, indicating that it is turned on.

9. Calibration & Standardization

Perform a test run to make sure the sensor is working. Press ‘Record’ on the LabView program and move your hand up and down above the sensor. If you see data on the LabView graph, It should be working.

10. Conditioning

11. Procedure

Calculate the spring constant

1. Use the measuring tape to measure the length of the un-stretched spring and record in an Engineering Logbook.

2. Record its weight in the Logbook and place the mass hanger on the bottom hook of the spring. Make sure to align the mass so that it directly above the sensor's line of sight.
3. Record the stretched length of the spring and add 10 grams to the mass hanger

4. Repeat step three 4 more times to collect a total of 5 data sets of mass and corresponding stretched spring length.
5. Use spring and gravity force equations learned in class to calculate the spring constant.

Calculate the Energy

1. Add masses to the hanger so that it hangs 4-8 inches from the surface of the sensor.
2. Pull the mass down about an inch and then release it. Try to your best ability to pull it straight down so there isn't any horizontal motion in the oscillation. Let it oscillate a few times to so that unwanted motion can dampen out.
3. Click the "REC" button on the LabView interface to begin recording data.
4. The plot of the position vs. time of the oscillating mass will appear in the Graph display in LabView. Continue recording until you get about 10 seconds of clean data.
5. Click "STOP" button to end data recording.

12. Calculation/ Interpretation of Results

Using the time and position data, compute the PE (gravity), PE (spring), KE, and TE. This portion of lab is to be completed after class hours as directed by the instructor

13. Report

"This portion of lab is to be completed prior to deadline after class hours"

14. Precision & Bias