Graph Matching

Equipment:

1	Motion Sensor	PS-2103A
1	Car Sail	ME-9595
1	Table Clamp	ME-9472
1	45 cm Rod	ME-8736
	Required, but not included:	
1	PASPORT Interface	
1	PASCO Capstone	

Introduction

The purpose of this activity is to explore plots of position and velocity vs. time. The Motion Sensor is used to detect the motion of a person moving back and forth in front of the sensor along a straight line at different speeds. The challenge is to move in such a way that a plot of the motion 'matches' the graph that is provided. This is an excellent way to learn what the graphs mean.

Set-up

1. Use the Rod Clamp and 45 cm Rod to fasten the Motion Sensor to the table, as shown in Figure 1. You will need at least 3 m of empty room in front of the sensor.
2. Connect the Motion Sensor to the Interface. Set the Motion Sensor to the "people" setting.
3. Aim the Motion Sensor at your midsection when you are standing in front of the sensor. You will hold the large blue "sail" from the ME-9595 (see Fig. 1) in front of your body to improve your results, since a reflection from different parts of your body as you move can mimic rapid motion back and forth.
4. Position the computer monitor so you can see the screen while you move away from the Motion Sensor.
5. Open the PASCO Capstone file called "04 Graph Matching.cap".

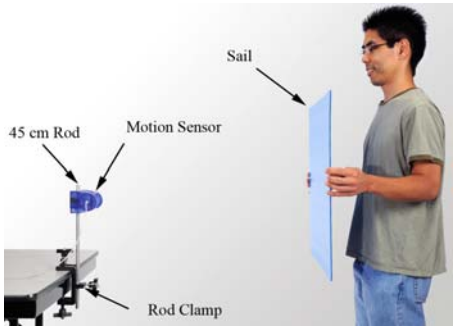


Figure 1: The large blue "sail" from the ME-9595 Car Sail is used as a target to improve the graph results using the Motion Sensor.

Procedure

Practice

1. You will stand about 1 meter in front of the Motion Sensor, holding the "sail" as shown in Figure 1.

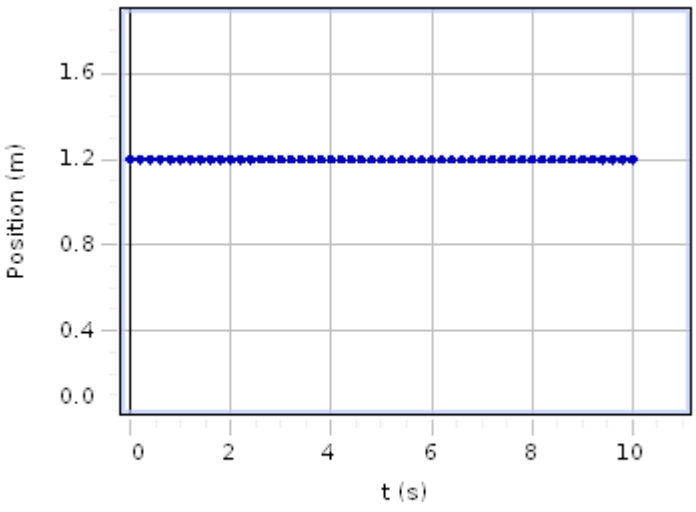
2. Click on Record. The Motion Sensor will make a faint clicking noise and the green LED will flash to tell you it is on. There is a 3-second delay before data begins to be recorded. This delay gives you time to adjust your position.

3. Walk towards and then away from the sensor, watching the graph as you move. The recording will stop automatically after 10 sec. Did the graph correctly record your position?

Graph Matching

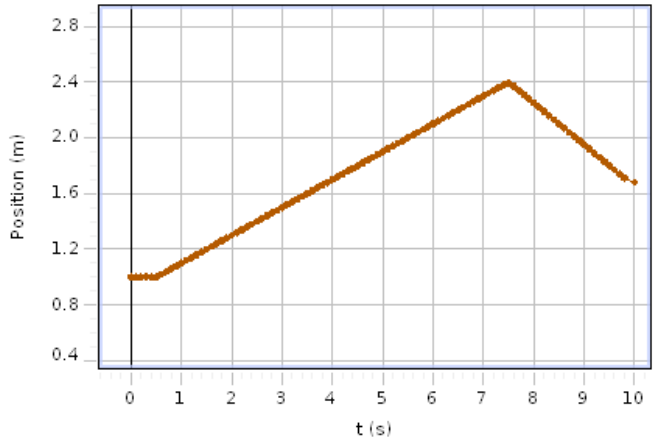
1. On each of the following pages, there is a graph you will try to match. The first three are position graphs, and the next four are velocity graphs. For the velocity graphs, start about 1/2 meter from the Motion Sensor. For the position graphs, you can see the starting distance on the graph, and you should try to start at that position.

2. Try to match the graph by moving forward or backward. The Score display will show how closely you match the graph. The closer it is to 100, the better. It is fairly easy to get a score above 95 on the position plots. The velocity plots are harder and scores above 80 are good.

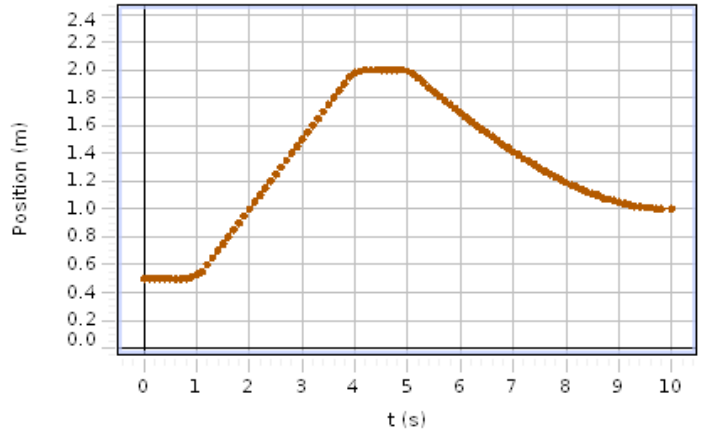


Position 1

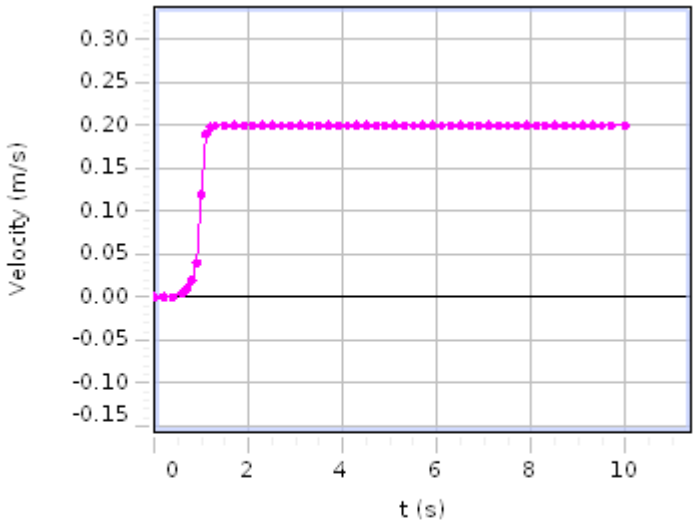
1. Before you click on Record, think about where you should stand initially and how you should move to match the graph. Then click on record. Try to match the graph. The recording will stop automatically after 10 sec.
2. Repeat the data recording process as many times as you need (time permitting) to get your best match.
3. See which lab partner can get the best score. On a piece of paper, note which Run #'s were the best and who did them.
4. You can delete unwanted runs using the Delete feature in the bottom control bar.
5. If you want to examine a previous run, use the black triangle by the Run Select icon in the graph tool pallet above the graph.
6. Repeat the process for the rest of the graphs.



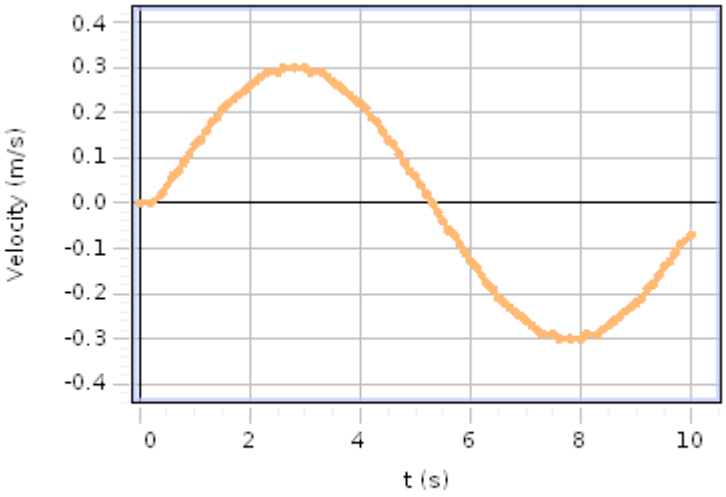
Position 2



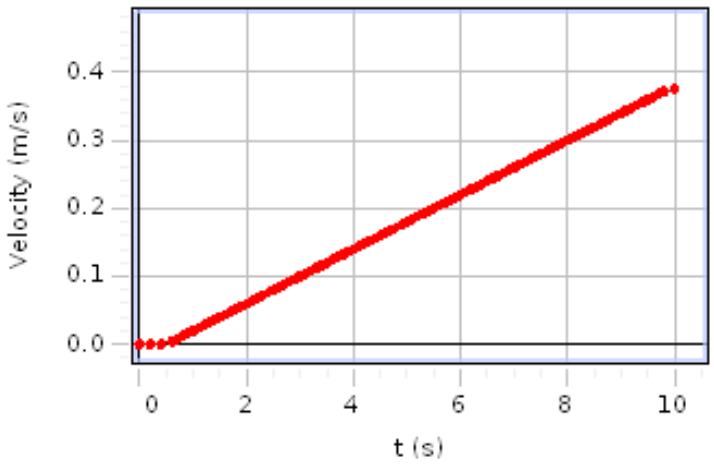
Position 3



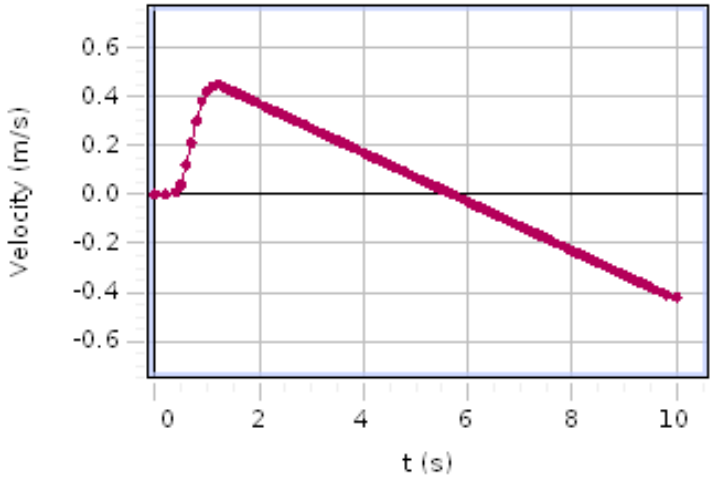
Velocity 1



Velocity 2



Velocity 3



Velocity 4

Analysis

Position Plots

1. What does a horizontal line mean?
2. What is the difference between the parts of the plot with positive slope and the parts with negative slope?
3. On the Position 3 plot, what is happening between 5 and 10 seconds?
4. What parts of the plot were easier to match? What parts of the plot were the hardest to match? Why?

Velocity Plots

1. What does a horizontal line mean?

2. What is the difference between the parts of the plot with positive slope and the parts with negative slope?

3. Consider the Velocity 2 plot. What is the difference between places where the slope is large and places where it is near zero?

4. Consider the Velocity 2 plot. Where is the acceleration largest? What is the speed at that point?

5. Which of the four Velocity plots could qualitatively describe the vertical speed of a ball thrown vertically upward?