

Position–Match Graph

Kinematics: position versus time, linear motion, graphing

GLX setup file: **position match**

Qty	Equipment and Materials	Part Number
1	PASPORT Xplorer GLX	PS-2002
1	PASPORT Motion Sensor	PS-2103
1	Pulley Mounting Rod	SA-9242
1	Motion Sensor Reflector Board (optional)	

Purpose

The purpose of this activity is to explore graphs of motion (position versus time). Use a Motion Sensor to measure your motion as you move back-and-forth in front of a flat reflector along a straight line at different speeds. The challenge is to move in such a way that a plot of your motion will ‘match’ the position versus time graph that is provided for you. Use the Xplorer GLX to record and display the data.

Background

When describing the motion of an object, knowing where it is relative to a reference point, how fast and in what direction it is moving, and how it is accelerating (changing its rate of motion) is essential. A sonar ranging device such as the PASPORT Motion Sensor uses pulses of ultrasound that reflect from an object to determine the position of the object. As the object moves, the change in its position is measured many times each second. The change in position from moment to moment is expressed as a velocity (meters per second). The change in velocity from moment to moment is expressed as an acceleration (meters per second per second).

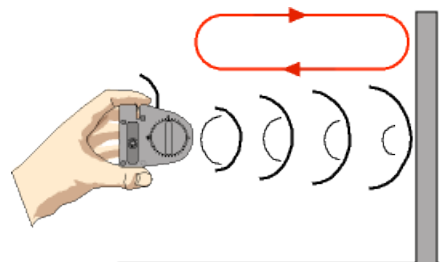


Fig. 1: Motion Sensor

The position of an object at a particular time can be plotted on a graph. A graph is a mathematical picture of the motion of an object. For this reason, it is important to understand how to interpret a graph of position versus time. In this activity you will plot a graph of your motion in real-time, that is, as the motion is happening.

Pre-lab Questions

What will happen on a real-time graph of position versus time as you move the Motion Sensor *away from* a wall? What will happen on the real-time graph of position versus time as you move the Motion Sensor *toward* a wall?

Safety Precaution

- Follow all directions for using the equipment.

Procedure

GLX Setup

1. Turn on the GLX (Ⓢ) and open the GLX setup file labeled **position match** (check the Appendix at the end of this activity.)
 - The setup file has a ‘target’ graph of Position (m) versus Time (s) for you to match. It also has a calculation for ‘Match Score’ ($\text{m}\cdot\text{s}^2$).
2. Connect the Motion Sensor to one of the sensor ports on the top end of the GLX.

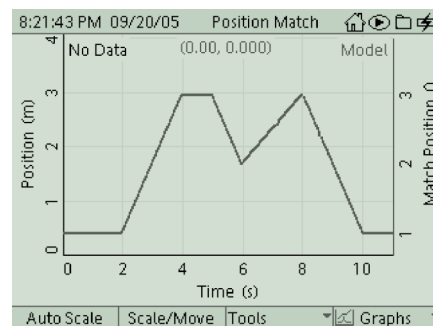


Fig. 2: position match file

Equipment Setup

1. Move the range selection switch at the top of the Motion Sensor to the ‘far’ (person) setting.
2. Screw a pulley-mounting rod into the tripod socket on the back of the Xplorer GLX.
3. Mount the Motion Sensor on the pulley-mounting rod as shown. Turn the head of the Motion Sensor so it faces in the same direction as the top end of the Xplorer GLX.



Record Data

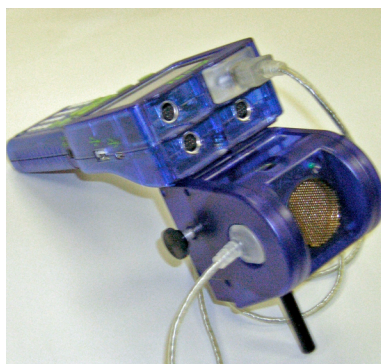


Fig. 3: Equipment setup

1. Stand in front of a wall or stand in front of a lab partner holding a flat board.
2. Observe the Graph on the Xplorer GLX.
3. Press Start (▶) on the GLX to begin recording data.
4. Move back-and-forth relative to the wall in order to match the position-time graph.
5. After 11 seconds, press Stop (▶) to end data recording.



Fig. 4: Procedure

Analysis

1. Press the **F4** button (F4) to open the menu and select ‘Graph 2’. Press (✓) to activate your choice.
 - The ‘error’ graph will give a score in units of ‘m*s’. The *lower* the score, the better you were at matching the graph of position versus time.
2. Press the **F4** button and select ‘Graph 1’ to return to the original graph. Press (✓) to activate your choice.
3. In ‘Graph 1’, press (✓) to activate the vertical axis menu. Use the arrow buttons to select the Run number menu and press (✓) to open the menu. Select the Run number and delete the data run, if necessary.
4. Repeat the previous steps several times and record your best score in the Lab Report section.

Record your results in the Lab Report.

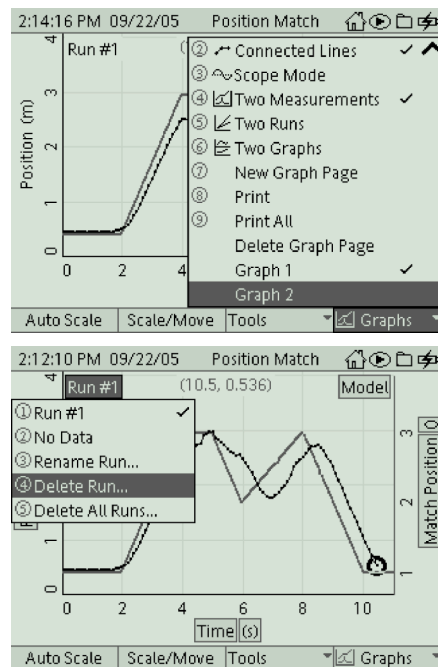





Fig. 5: Analysis

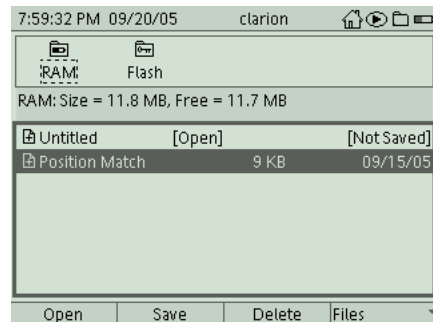
Appendix

Opening a GLX File

To open a specific GLX file, go to the Home Screen (press ). In the Home Screen, select Data Files and press the Activate () button. In the Data Files screen, use the cursor keys to navigate to the file you want. Press *F1* () to open the file. Press the Home button to return to the Home Screen. Press *F1* to open the Graph screen.



Data Files Icon



Lab Report - Activity 1: Position–Match Graph

Name _____ Date _____

Pre-Lab Questions

1. What will happen on a real-time graph of position versus time as you move the Motion Sensor *away from* a wall? (Draw a sketch of how the graph will look.)

2. What will happen on the real-time graph of position versus time as you move the Motion Sensor *toward* a wall? (Draw a sketch of how the graph will look.)

Data

Best (*lowest*) Position-Match Score = _____

Questions

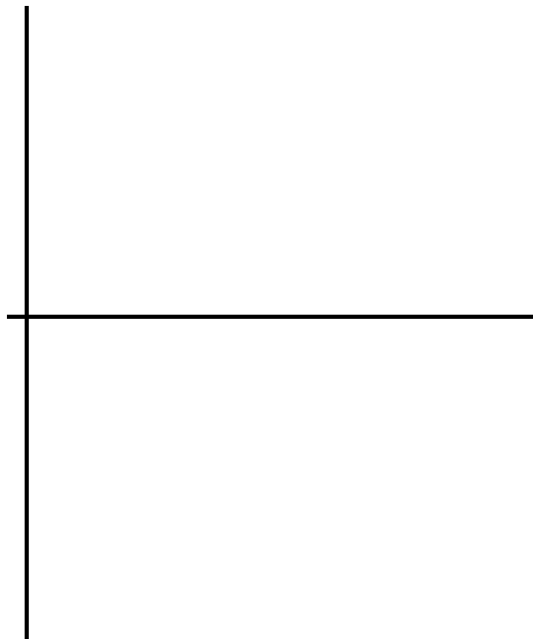
1. How well did your motion graph match the provided graph.

2. What was the meaning of the part of the position plot where the slope was positive (upward)?

3. Were certain parts of the plots easier to match than other parts? Why or why not?

Conclusion

1. Make a sketch of a *velocity versus time* graph from the position versus time graph including labels and units for the y- and x-axes.



2. Write a short paragraph that describes your motion in the graph. Include speeds, directions, positions, etc. Be as descriptive as possible.