Position vs. Time – Understanding Motion

Fall 2009

Introduction

We can understand position as a function of time with the aid of a motion sensor attached to a computer. In this experiment, you will observe the relationship between the motion of an object and a graph of position vs. time for the object. *You* will be the object in motion! The goal of this experiment is to use the motion of your body to understand the difference between a *constant velocity* (moving at a steady rate) and *acceleration* (moving at a changing rate). Each person in your group will hand in their own report. As you go through the exercise, you will draw a picture of the graph you followed and answer each question. Be sure to restate the questions that are asked of you. More details follow in the "Discussion" section below.

Experiment

1. Begin by double-clicking the "Data Studio" icon that appears on the desktop.
2. If you are using a desktop computer, double-click "Position and Time.ds"; if you are using a laptop, double-click "Position and Time – Laptop.ds" (these files are located in T:\Phys103). Each file is customized for the resolution of the computer display.
3. Read through each page, clicking the right arrow at the bottom to advance to the next page.

The apparatus consists of a Sonic Ranger (a device which emits and receives sound waves) connected to a computer via a "Science Workshop 500 Interface". The computer is running an experiment created in Data Studio. As you flip through the pages of the experiment, you will see various graphs of position as a function of time. As you move towards or away from the Sonic Ranger, a plot of your motion will appear on the screen. The goal is to try to match the graph of your motion to the one you see in the workbook.

Here are some items to consider:

- You will work in groups of two or three. If you are the "mover", signal your partner to click the **Start** button; you will then have five seconds to fix your initial position before the data collection begins. The data collection will automatically stop after 10 seconds.
- A score is displayed for each run. It is calculated by adding up the absolute value of the difference between the desired path, and the measurement of the path you take. Lower numbers indicate a better match. Record your score in your report, as well as that of your lab partner.
- If you want to retry a run, you will find it easier to remove the previous graph. From the "Experiments" menu, choose "Delete Last Data Run" or "Delete ALL Data Runs".
- Throughout the experiment, you will be asked questions regarding the graphs and your motion. *Draw and label* the graphs that appear with each question, and summarize your motion (e.g. "I moved away from the Sonic Ranger with a constant velocity."). Be sure to briefly state and answer the questions.

Discussion

- This week you will be writing a very informal report. It should start with the name of the experiment, the date, and the names of those in your group. Your report will contain answers to the questions that were asked throughout the experiment (*write in complete sentences, please*), a copy of the graphs in each question, and the scores of the members of your group. Any comments you wish to make pertaining to your experimental results are welcome.
- While performing this experiment, you should be thinking about the relationship between the appearance of a graph and its associated motion. For example, how does a graph depicting motion *away* from the Ranger at a constant velocity differ from a graph showing accelerated motion *towards* the Ranger? This will help in your understanding the difference between velocity and acceleration in the coming weeks.