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**INTRODUCTION TO DATA STUDIO****PART I: FAMILIARIZATION****OBJECTIVE**

To become familiar with the operation of the Passport/Xplorer™ digital instruments and the DataStudio™ software.

**INTRODUCTION**

We will use the Passport/Xplorer™ devices to make measurements in many of the experiments in this laboratory. These devices plug into the laboratory computers and can be operated with the DataStudio™ software. We have several different probes available. The first probe that you will use is the Motion Sensor.

The Motion Sensor is really the ultra-sonic range finder developed by the Polaroid Corp. for their cameras. It consists of an ultrasonic transducer that emits pulses of acoustic waves at ultrasonic frequencies and measures the time of flight of the pulses from the Motion Sensor to an object and back. In effect it is a sonar device. The basic measurement is the echo time which the computer reports as a distance. (The distance is computed from the time and the speed of sound.) The DataStudio™ software can also give you a computed velocity and acceleration of the object that is reflecting the signal. The velocity calculations can be useful, but you must beware of computation difficulties, especially near the stopping and starting times of the sensor. The calculated accelerations are often unreliable.

You will be asked to calibrate the sensor for positions. Then knowing positions you can easily calculate velocities, either manually or with the DataStudio™ software.

In carrying out the **ACTIVITIES** you will find reference to data or other information that need to be entered into your data sheets. In addition, there will be questions that should be answered there. We will use **bold face** to alert you to these items that must be answered. Data sheets are found at the end of each experiment. After they have been filled out, they may be torn out and given to your instructor.

### ACTIVITY 1

1. Open DataStudio using the desktop icon.
2. Notice that the top toolbar has several buttons. You should see Summary and Setup buttons, among others. **List all items displayed on the toolbar.**
3. Three windows will pop up. You will see two of these windows displayed on the left-hand side of your screen. The Data menu should be empty. The Displays menu should have several items listed. **Name four of these listed items.**
4. The third window, at the bottom of your screen, should say

Plug in a PASPORT sensor to add a measurement to this activity.

### ACTIVITY 2

5. Press the Summary button (on the top toolbar) and observe what happens. **What did pressing the Summary button do?** Press the button once more.
6. On the Displays menu, double-click the graph icon to open a graph. Click on the X in the upper left corner of the graph window (the usual button to close a window). A message should pop up asking if you want to completely remove this display from your activity.

***Caution: Clicking OK or hitting the return key will completely remove the window from your activity. The graph will be deleted and you will not be able to retrieve it.***

7. Remove the graph window.

### ACTIVITY 3


8. Click on the Setup button. A window called Experiment Setup will appear. It displays the following message

There are no sensors in this activity. Please connect a PASPORT sensor or click the Add Sensor button to set up an activity.

9. Click the Add Sensor button. A window with a list of sensors will appear. **List four of the available sensors.**

10. Click on Motion Sensor and press OK. **Study all of the windows carefully and describe what happened when you selected Motion Sensor.**

#### ACTIVITY 4

11. If a graph window opened, close it as described previously.
12. The Experiment Setup window should now show a motion sensor icon (a stick figure). Notice that there is an exclamation point in a yellow circle overlapping the sensor icon.  This symbol indicates that no sensor is plugged in.
13. Under the motion sensor icon, there is a line with Sampling Rate listed. The default sampling rate is 10 Hz. Click on the plus or minus buttons to increase or decrease the sampling rate. **What is the maximum sampling rate achievable? What is the minimum sampling rate allowed?**
14. Notice that the units, Hz, may be changed by clicking on the up/down arrows and selecting different units. **List all the allowed units of sampling rate.**

#### ACTIVITY 5

15. The Experiment Setup window contains three boxes. They are labeled Position, Velocity, and Acceleration. The units in which these three quantities are measured are also listed.
16. Currently, the Position box is checked. Check the Velocity and Acceleration boxes. **What happens when you check these boxes?**
17. Click the Setup button again to make this screen disappear.

#### ACTIVITY 6

18. Connect the motion sensor to the computer via the USB link. **What happens to your icons when you plug in the motion sensor?**
19. Drag the Position icon from the Data menu down over the Graph icon in the Displays menu. A graph will appear. Notice that a window pops up at the bottom of the screen which reads

Click the Start button to begin collecting data.

### ACTIVITY 7

20. If the exclamation symbol is still overlapping your sensor icon, try reconnecting the motion sensor to the computer.
21. Set the motion probe on the table next to you. Point the front screened panel of the probe directly toward you.
22. Click the Start button now. You should hear the motion probe making a clicking sound. Wait several seconds, then press Stop. *You have just collected data.*

### ACTIVITY 8

23. Quit DataStudio without saving this activity. Leaving the motion sensor connected to the computer, restart DataStudio. Notice that you already have a position icon in the Data menu. A graph is automatically opened as well.
24. You should see a message at the bottom of your screen telling you to  
Click the Start button to begin collecting data.
25. Quit DataStudio without saving this activity. Disconnect the motion sensor.

### ACTIVITY 9

26. Reopen DataStudio once more. Everything should appear as it did when you first opened DataStudio (in Activity 1).
27. Instead of clicking Setup, go ahead and plug the motion sensor into the computer.
28. A position icon should appear in the Data menu and a graph window should pop up. Quit DataStudio.

### SUMMARY

After this introduction, you should be able to set up a motion sensor probe for use with DataStudio.

You should also be able to change the types of data (Position, Velocity, and Acceleration) as well as varying the sampling rate.

You are now ready to begin using the sensors. Move on to the Motion Sensor experiment.

Data sheets to hand in.

Name \_\_\_\_\_

# INTRODUCTION TO DATA STUDIO

## PART I: DATA SHEETS

### ACTIVITY 1

List all items displayed on the toolbar.

Name four of the items listed in the Displays menu.

- 1.
- 2.
- 3.
- 4.

### ACTIVITY 2

What did pressing the Summary button do?

### ACTIVITY 3

List four of the available sensors.

- |    |    |
|----|----|
| 1. | 3. |
| 2. | 4. |

Study all of the windows carefully and describe what happened when you selected Motion Sensor.

**ACTIVITY 4**

What is the maximum sampling rate achievable? \_\_\_\_\_

What is the minimum sampling rate allowed? \_\_\_\_\_

List all the allowed units of sampling rate.

**ACTIVITY 5**

What happens when you check the Velocity and Acceleration boxes?

**ACTIVITY 6**

What happens to your icons when you plug in the motion sensor?

**ACTIVITIES 7-9**

No questions in these activities.

## 1

**INTRODUCTION TO DATA STUDIO****PART II: MOTION SENSOR****INTRODUCTION**

In making any measurement you need to be aware of the reliability of the instruments you are using. Can they be trusted to give you correct results? There are two terms that we use to describe instrumental reliability, **accuracy** and **precision**. If you make several measurements and the readings are very close together, then you say that the instrument is precise. That is, the spread in the measurements is small and the uncertainty in the readings is small. If the average of the measurements is close to the correct reading, then the instrument is said to be accurate.

In some cases, your instruments will be both accurate and precise. However, they could be accurate but not precise, precise but not accurate, or neither. For this reason, you should always calibrate instruments by comparing them to a standard. In the activities below you will compare the measurements of distance made with the Motion Sensor to those made with a meter stick.

**ACTIVITY 1**

- Connect the motion sensor to your computer. Double-click on the Motion Sensor.ds icon to open the Introduction to DataStudio: Motion Sensor lab. Several graphs and menus should pop up as well.
- Do not blindly trust the motion sensor. You should determine if it is taking accurate measurements. Notice that the motion sensor has two range settings. One setting is denoted with a cart symbol and the other with a stick figure. In the following activities, you will compare the two settings.

**ACTIVITY 2**

1. Set the motion probe for the people range and perform the following steps:
  - a. Position the probe approximately 0.5 m from the wall. Make sure the screened panel is facing the wall and is perpendicular to it.

- b. Measure the distance from the wall to the screened panel on the front of the motion probe with a meter stick.  
**Record your measurement.**
- c. Press the Start button and allow the probe to collect data for several seconds. Press the Stop button. Drag this data run to the Graph icon to generate a new graph.
- d. Rescale the graph along the y-axis to get the most effective scale. (See the DataStudio™ activity Graph Introduction.ds on your desktop for help.) **What is the distance determined by the motion sensor?**
- e. Repeat steps 1a-d for measurements for several distances between 0.5 m and 5 m. (See the data table.) **What is the range of the motion probe using the people range?**
- f. **What are the limits of the motion probe in terms of accuracy?**

### ACTIVITY 3

2. Set the motion probe for the cart range and perform the following steps:
  - a. Position the probe approximately 0.5 m from the wall. Make sure the screened panel is facing the wall and is perpendicular to it.
  - b. Measure the distance from the wall to the screened panel on the front of the motion probe with a meter stick.  
**Record your measurement.**
  - c. Press the Start button and allow the probe to collect data for several seconds. Press the Stop button. Drag this data run to the Graph icon to generate a new graph.
  - d. Rescale the graph along the y-axis to get the most effective scale. **What is the distance determined by the motion sensor?**
  - e. Repeat steps 2a-d for measurements at 1m, 2 m, 3 m, and 5 m. **What is the range of the motion probe using the cart range?**
  - f. **What are the limits of the motion probe in terms of accuracy?**



Data sheets to be handed in.

Name \_\_\_\_\_

# INTRODUCTION TO DATA STUDIO:

## PART II: MOTION SENSOR

### DATA SHEETS

#### ACTIVITY 1

No questions for this activity.

#### ACTIVITY 2

##### People-Range Distance Measurements

Approximate Distance (m)	Measured Distance [Meter-stick] (m)	Measured Distance [Motion Sensor] (m)
0.50		
0.75		
1.00		
1.50		
2.00		
3.00		
5.00		

**What is the range of the motion probe using the people range?**

**What are the limits of the motion probe in terms of accuracy?**

**ACTIVITY 3**

## Cart Range Distance Measurements

Approximate Distance (m)	Measured Distance [Meter-stick] (m)	Measured Distance [Motion Sensor] (m)
0.50		
0.75		
1.00		
1.50		
2.00		
3.00		
5.00		

**What is the range of the motion probe using the cart range?**

**What are the limits of the motion probe in terms of accuracy?**