ACTIVITY CONTENTS:

Matching Motion

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Matching Motion Introduction

Discovery Question:

Can I match my motion to an existing distance-time graph?

This activity will allow you to match a motion graph with real time movement.

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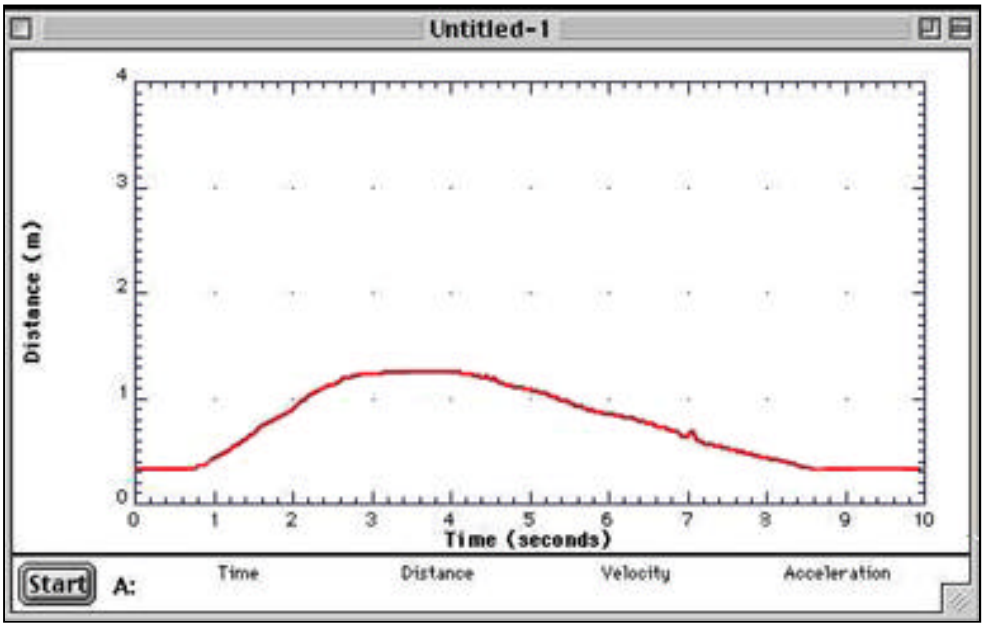
Thinking About the Question

Can I match my motion to an existing distance-time graph?

There are many examples of using technology to gather data about motion. For example, police use radar to determine how fast cars are traveling. Just as the radar detector uses radio waves to determine the speed of a car, the sonar ranger uses the speed of sound waves to determine speed and distance.

A sonar ranger uses a motion detector that sends out high frequency sound waves to a target object and waits for it to come back. The sonar ranger measures the time needed for the wave to leave and return to the detector. The software determines and displays the distance the pulse covered based on the speed of sound.

The graph below is an example of a distance-time graph captured as a student walked a straight line with their **back** to the sound pulse from a sonar ranger. With a partner determine the portion of the graph that indicates walking away from the detector, toward the detector, and standing still. What do you notice about the shape of the line in each case? Can you tell when there is faster or slower motion?



Can you match your motion to that shown on a graph? Go to "Investigations" to try it out.

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Matching Motion Materials

- sonar ranger (ultrasonic motion detector)
- stool
- masking tape
- meter stick
- pen
- long serial cord (3-5 meters)
- CCSR (sonar ranger) software

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Matching Motion Safety

If more than one sonar ranger is used in a classroom, separate each probe by at least two meters to prevent measurement interference. To prevent tripping, make sure the area that you are walking is clear.

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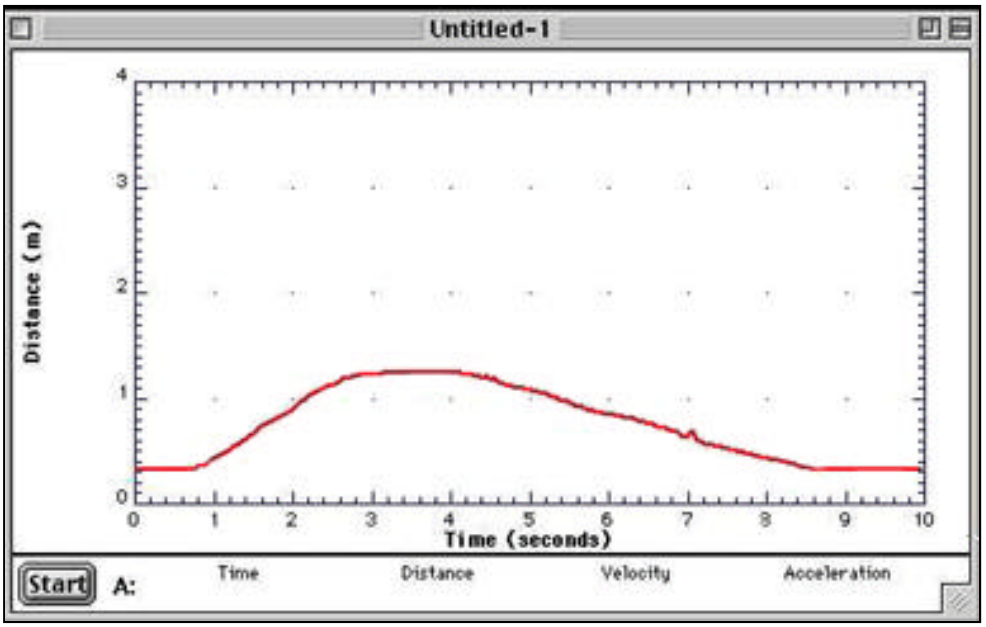
Matching Motion Investigation I

Messing around:

Try to make the graph shown in "Thinking About the Question". Refer to Technical Hints to see how to set up the walking track. Set the axis to 60 seconds. Set the distance to the length of your track. Refer to Technical Hints on how to run the sonar ranger software. Did you predict the right direction to move away from the sonar ranger? Did your speed change during the your walk?



Investigate the following motions on your track with the sonar ranger displaying real time graphs. Save and print each real time graph after each trial. See Technical Hints to see how to save and print graphs.

1. Starting at the computer, stand still for 10 seconds, walk quickly away from the computer for one meter, stand still for 10 seconds, and walk slowly away from the computer.

2. Starting half way down the track, stand still for 10 seconds, walk quickly away from the computer for one meter, stand still for 10 seconds, and walk slowly away from the computer.

Answer questions 1 and 2 in the "Analysis".

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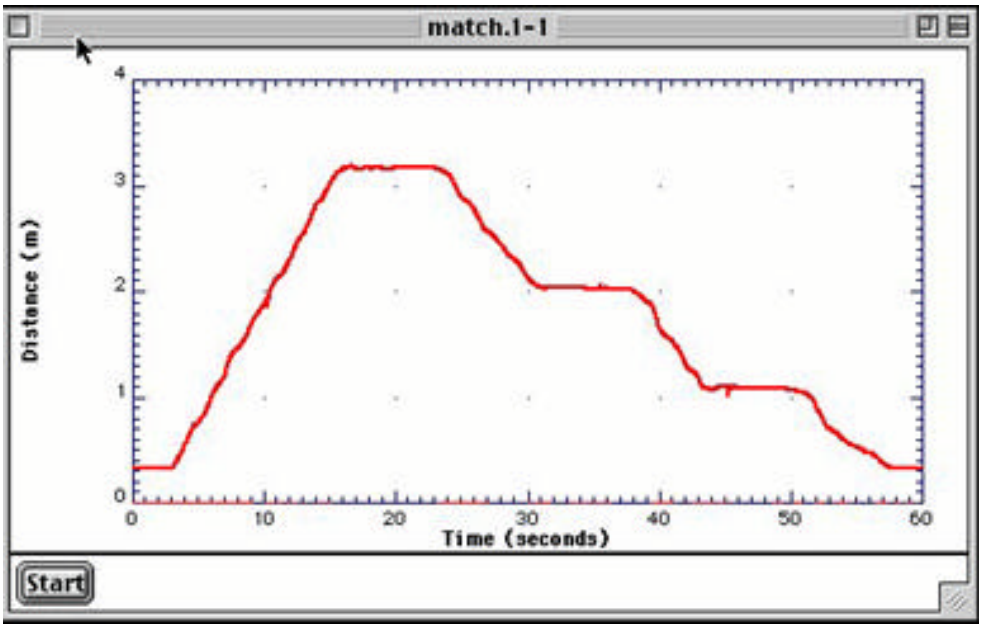
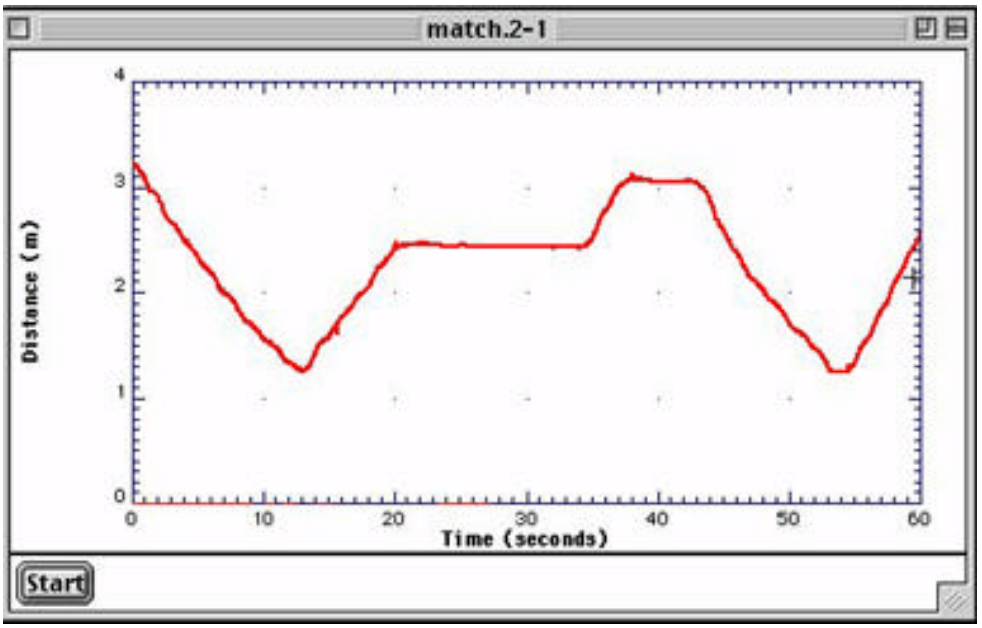
Matching Motion Investigation II

Matching constant motion graphs

Look at and think about the following two graphs for motion. Discuss the motion needed to reproduce each graph with your partners. Recreate the following graphs using your body as the object in motion.

1. 

2. 

Save and print each real time graph after each trial. See Technical Hints to see how to save and print graphs. Repeat as many times as you need to reproduce each graph. Answer questions 3 through 5 in the "Analysis" for these graphs.

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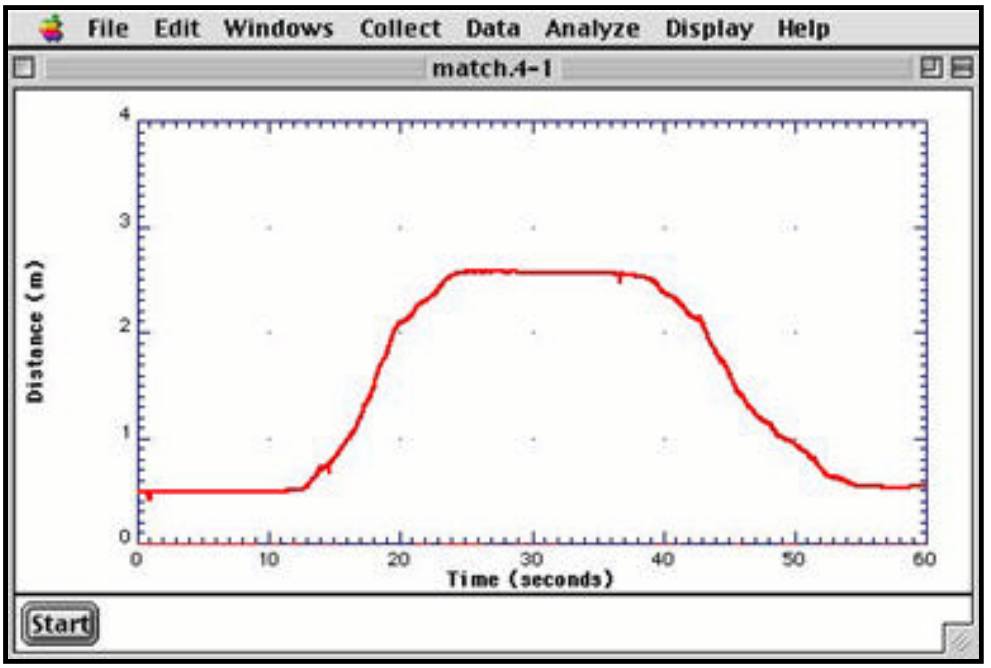
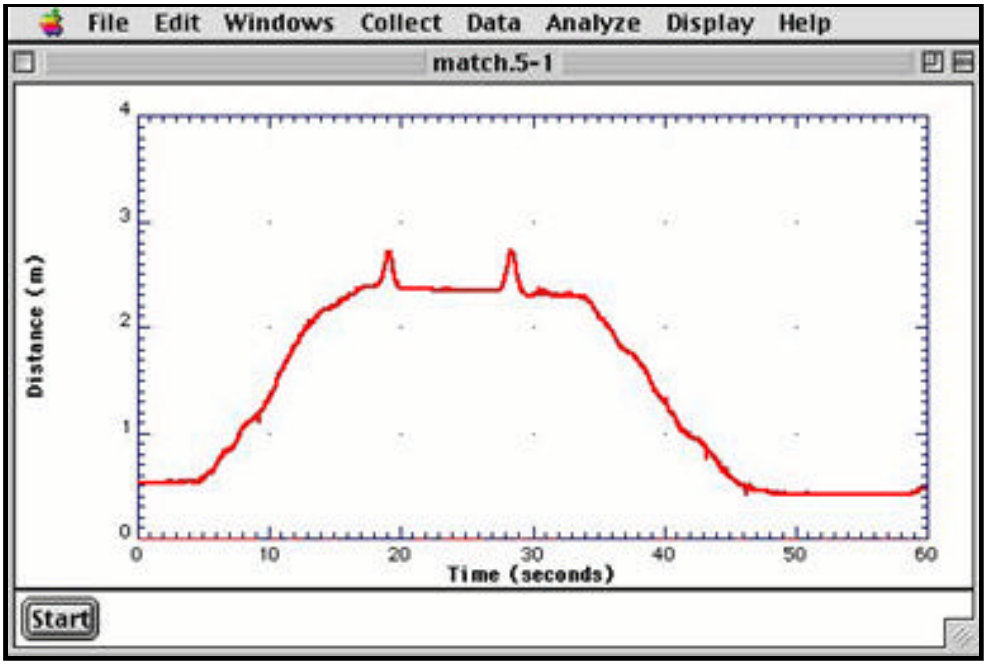
Matching Motion Investigation III

Matching changing motion graphs

Look at and think about the following two graphs for motion. Discuss the motion needed to reproduce each graph with your partners. Recreate the following graphs using your body as the object in motion.

1. 

2. 

Save and print each real time graph after each trial. See Technical Hints to see how to save and print graphs. Repeat as many times as you need to reproduce each graph. Answer questions 3, 4, and 5 in the "Analysis" for these graphs.

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Matching Motion Technical Hints

- Setting up the walking track
- Opening CCSR (sonar ranger) software
- Running CCSR (sonar ranger) sofware
- Printing the graph
- Opening draw program
- Creating a drawing
- Creating a prediction
- Writing on a draw program

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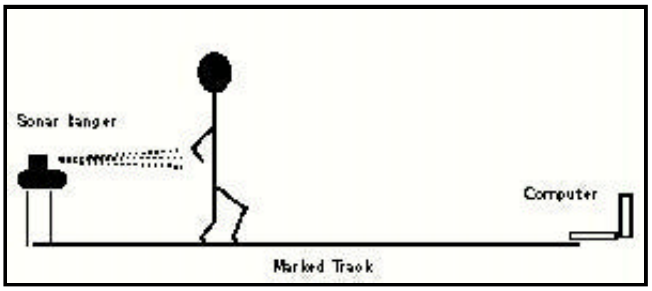
Matching Motion Technical Hints

To set up the walking track:

1. Find an open distance around 1 meter wide and 10 to 15 meters long (possibly in a hallway).
2. Using masking tape, mark off the straight line distance with half meter divisions.
3. Set the computer at one end of the masking tape pointed in the direction that you will be walking. You should be able to view the screen while you are walking. Using the long serial cord, place the sonar ranger on a stool at the other end of the marked tape. Make sure the sonar ranger is aligned with the tape.



4. Before you start moving down the track with your **back** facing the probe, a group member will need to trigger the probe and say "GO" before you start moving along the line.

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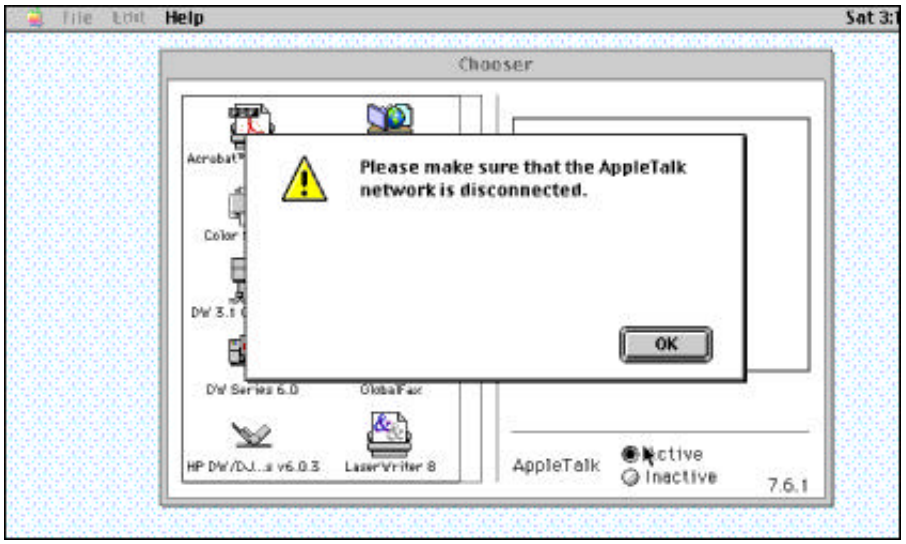
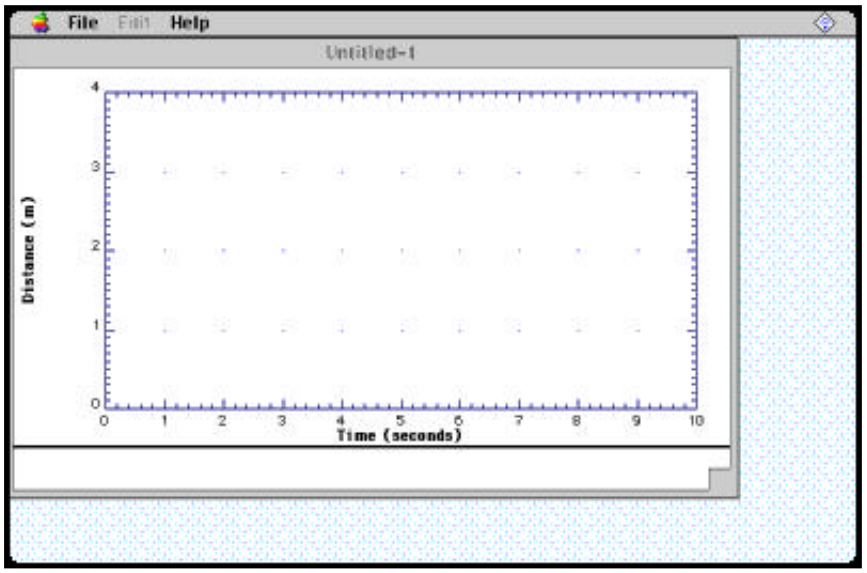
Matching Motion Technical Hints

To open CCSR (sonar ranger) software:

Make sure that AppleTalk is turned **off** by selecting the Chooser from the Control Panel from below the Apple menu.



Start CCSR by double clicking on its icon.



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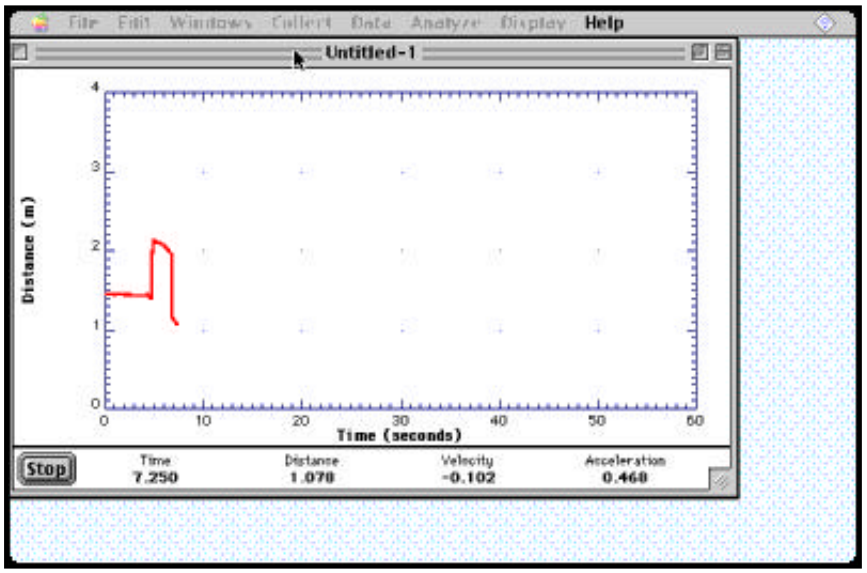
Matching Motion Technical Hints

To run CCSR (sonar ranger) software:

1. After the CCSR opens, open the Display menu and click on Set all Min, Max. Change 10 seconds to 60 seconds. You may not use all the time, but it will be available if needed.
2. Open Collect menu, and click on Start (either under the Collect menu or on the sonar detector).



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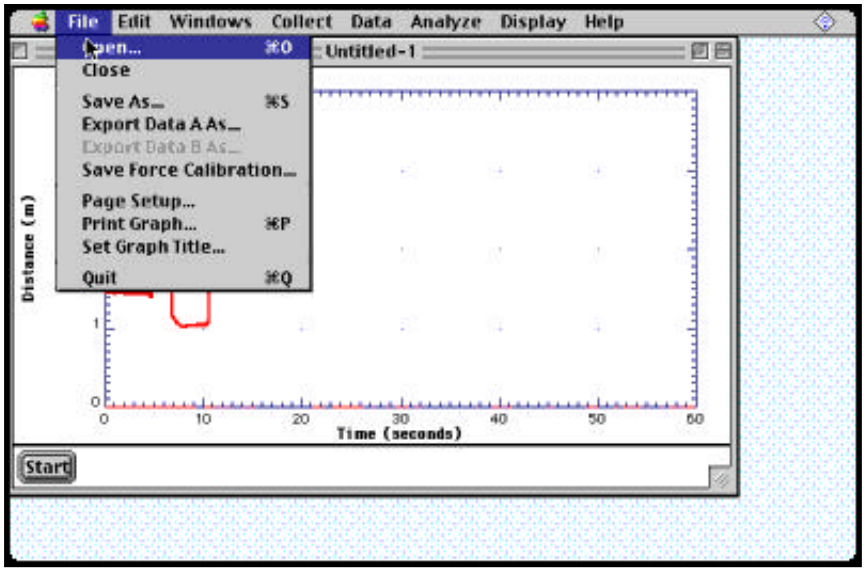
Matching Motion Technical Hints

To print the graph:

1. Once your graph is finished, select Save As under File menu and name your graph. Say yes to saving calibration.

2. Open File menu, and click on Print Graph.



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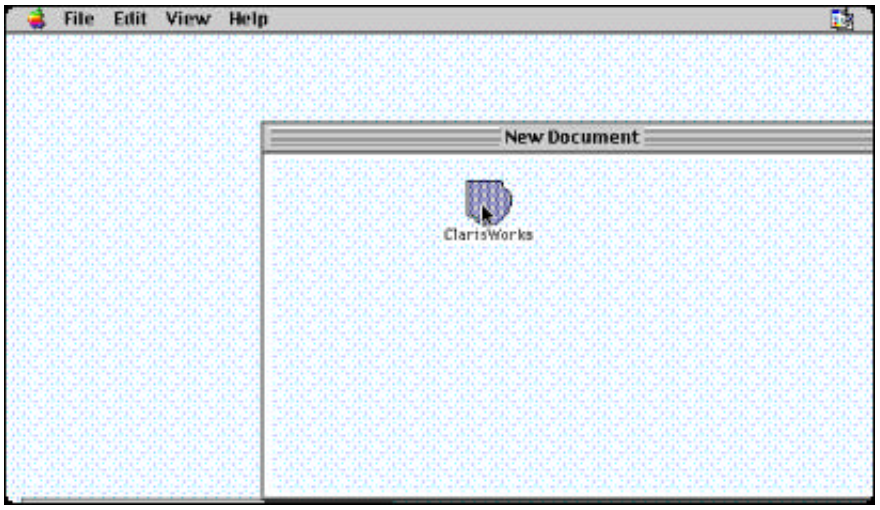
Matching Motion Technical Hints

To open a draw program:

Select the drawing option in ClarisWorks.



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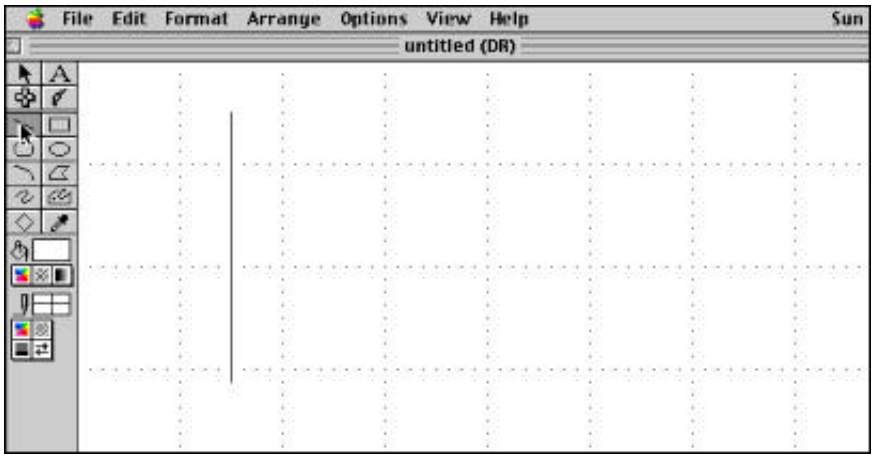
Matching Motion Technical Hints

To create a drawing:

1. Select the Line tool from the left menu (Tool panel) by clicking on the button.
2. Draw a pair of distance-time axes. Select the A (Text tool) to label the axes. You must click off of each item after drawing and reselect the tool you need before drawing the next item.



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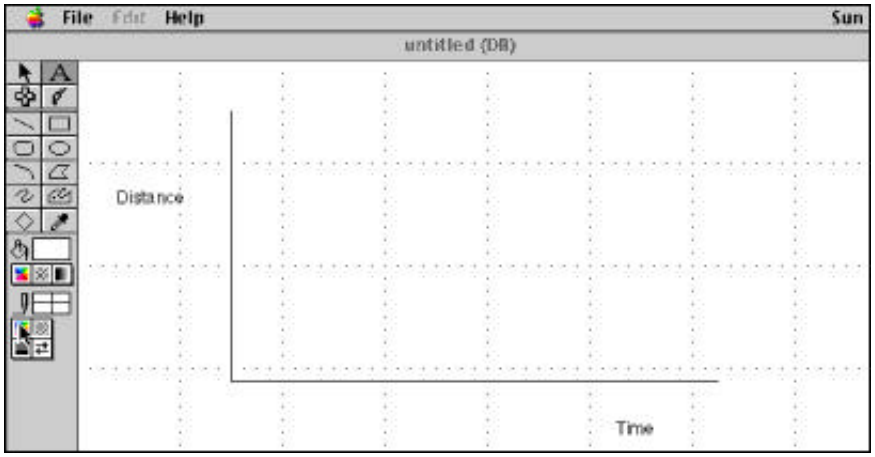
Matching Motion Technical Hints

To draw your prediction:

To draw your prediction:

1. Select the Line tool.
2. From the Pen color pallete select a red color. This will make the cross bars red on the screen.
3. Draw your prediction inside the axes.



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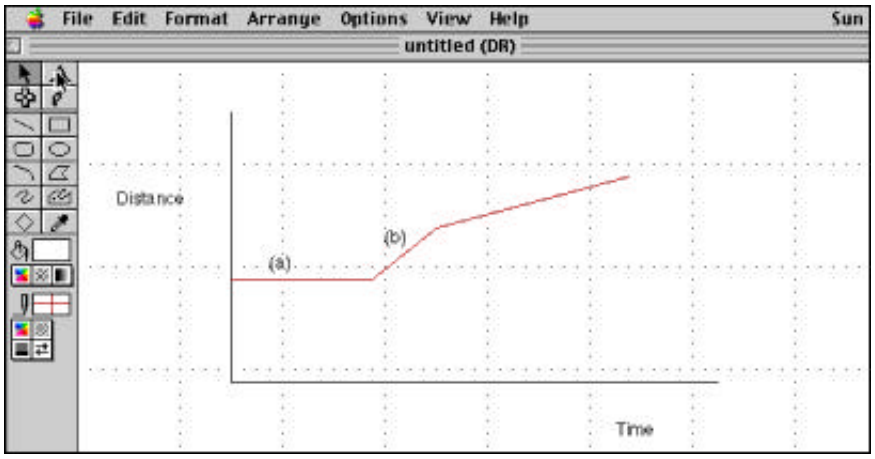
Matching Motion Technical Hints

To write on your drawing:

1. Use the A (Text tool) to write your description of the movement.
2. Save and name your prediction under the File menu.



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Matching Motion Analysis

Use your graph print outs to complete the following on paper:

1. Look at the first graph you have created. Label portions of the print out that represents walking toward ("T") and away ("A") from the sonar ranger and standing still ("S"). What do you notice about the shape of the lines at different points?

2. Compare your first and second graphs? How are they the same? How are they different?

3. With your partner look carefully and discuss your graphs so that you can write a short description for each graph that tells the story of your movement. Be sure to include numerical information about the direction of your motion, the speed of your motion, and your distance from the starting point when changes in direction and speed occurred.

4. Look at the print out of the first and third graphs that you created. What similarities or differences do you notice about the shape of the lines in the two graphs?

5. Look at the portion of each of these graphs that represents your motion from 10 to 20 seconds after you started. What do you notice about the shape of these two lines?

Be prepared to discuss your answers to these questions with the class.

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Matching Motion Further Investigation

Design your own challenge match graphs in the draw program. See Technical Hints to see how to use the draw program. Have other students try to reproduce the graphs. Use the Text tool in the draw program to explain the motion needed to obtain each portion of your challenge graphs.

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