

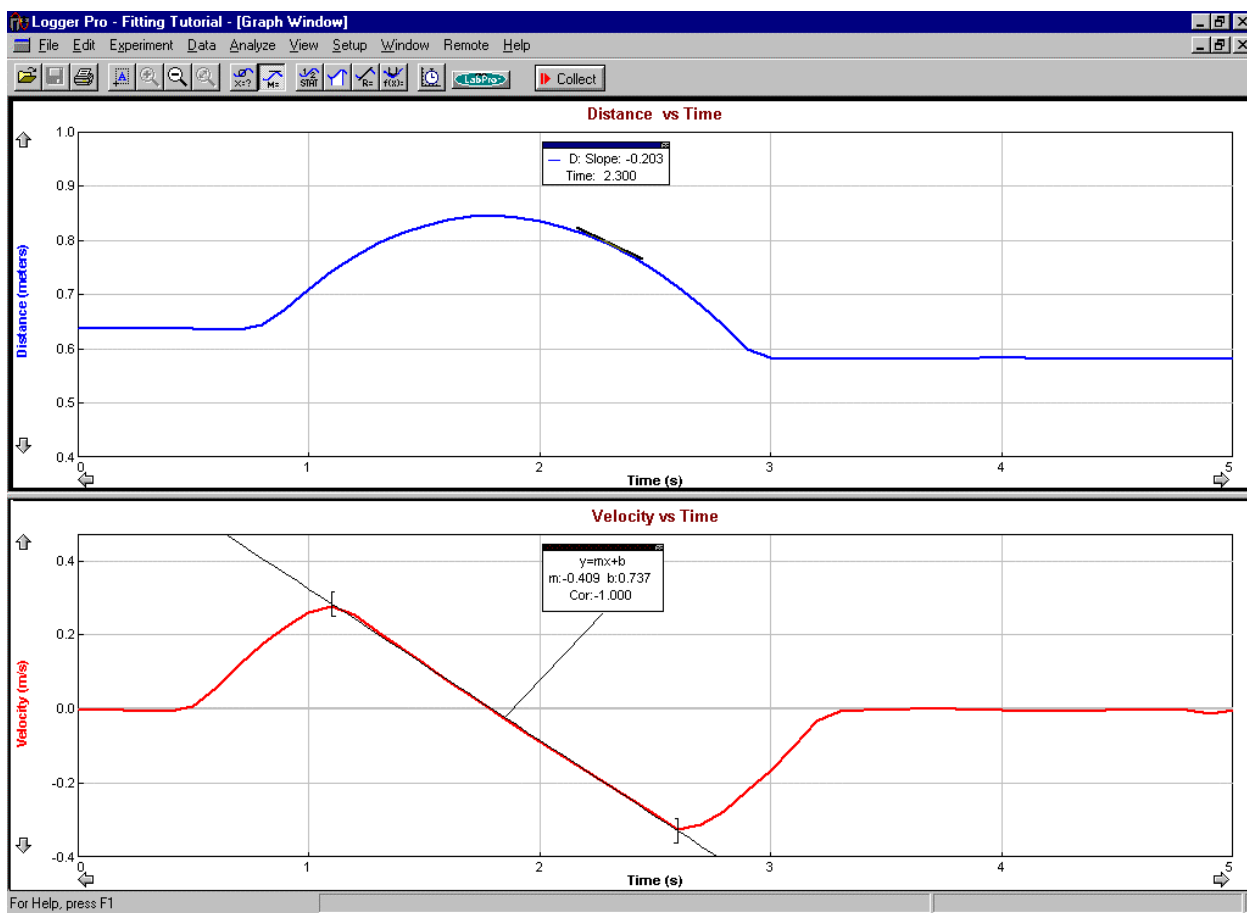
Logger ProTM

Tutorials

Version 2.1

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Logger *Pro* Tutorials

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Tutorial Overview

Purpose of tutorials

The *Logger Pro* package includes eight short tutorials for first-time users, either students or teachers. They are suitable for reference or for duplication and distribution to classes. First-time users should work through one introductory tutorial and the advanced tutorials as needed.

The tutorials are bound separately from the manual for easy duplication.

Introductory tutorials

The first two tutorials, Temperature Measurement and Motion Detection, are both introductions to using *Logger Pro*. All students can use Temperature Measurement, while Motion Detection is intended for physics or integrated science students.

Advanced tutorials

The remaining tutorials are intended to be read after either of the first two tutorials are completed, and provide instruction on performing specific tasks with *Logger Pro*. These tasks include

- analyzing data and changing what is graphed
- fitting curves to data
- saving files and printing or transferring data
- creating new columns for data
- temperature measurement using auto-ID
- Motion Detector use with auto-ID
- remote data collection

The advanced tutorials can be done in any order.

Preliminary setup

The tutorials assume that *Logger Pro* has been installed and an interface (a LabPro™, a ULI or a Serial Box Interface) is properly connected to the computer. Installation instructions are located in the Teacher's Guide.

Tutorial: Temperature Measurement with *Logger Pro*

About the tutorial

This tutorial will show you how to make simple measurements using a temperature probe and *Logger Pro*. You will also learn to perform some basic analysis of those data. You may never need to learn more about *Logger Pro*, but advanced users will want to explore the menus and the How To section to make the best use of the program's capabilities.

Verify the equipment setup

First, check to see that you have all of the equipment and software needed. You should locate these items:

- a PC running Windows® or a Power Macintosh
- *Logger Pro* software on your computer
- LabPro, Universal Lab Interface (ULI), or a Serial Box Interface, with power supply and interface cable
- Direct-Connect Temperature Probe, plugged into DIN 1 of the ULI or Port 1 of the Serial Box Interface. LabPro users can use this probe or the Stainless Steel Temperature Probe, connected to CH 1.
- 2 cups, one with hot and one with cold water

The interface

The interface converts the signals from the temperature sensor to a form that the computer can read. If you are using a Serial Box or ULI, be sure that the green light is on. The interface cable should already be connected to your computer.

Logger Pro

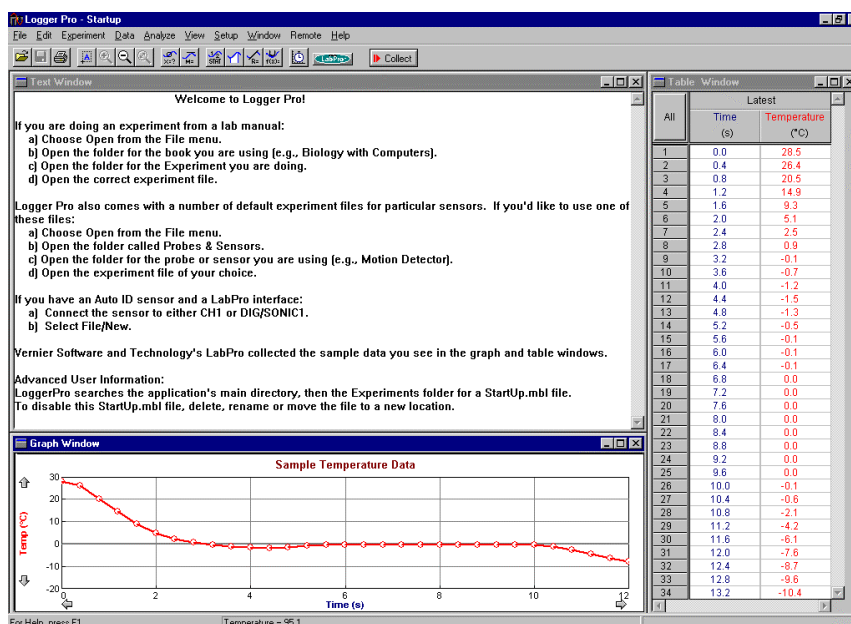
Logger Pro is the software that controls the interface and displays the results of the temperature sensor measurements. The remaining instructions will teach you to work with *Logger Pro*.

Start *Logger Pro*

- Using the method appropriate for your computer, start the *Logger Pro* application. (Double-click on the *Logger Pro* icon, or select *Logger Pro* in the Start Menu.)

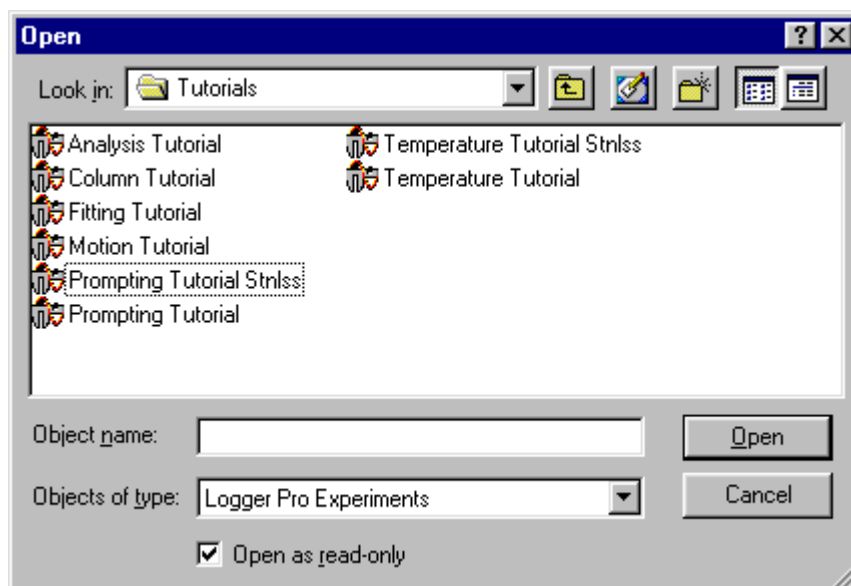
You should see a standard startup screen like the one shown below when using a Direct Connect temperature probe. (When using a Stainless Steel temperature probe, the LabPro auto-ID feature loads a preformatted experiment specifically for that probe.) If not, then *Logger Pro* is having trouble communicating with the interface. Be sure the interface is getting power so that the green light of the interface is on, and that the interface cable is plugged into both the computer and the interface. Try starting again.

Screen elements



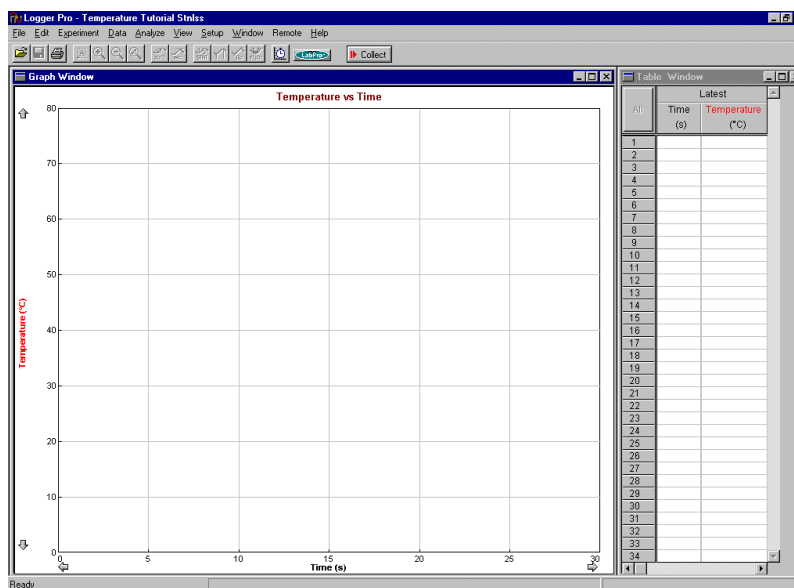
The Logger *Pro* screen contains, from top to bottom, the following major elements: the menu bar, a toolbar containing the Collect button, a graph window, a data window, and a status bar.

- ▶ Choose Open from the File menu.
- ▶ Click on the Tutorials folder and click on Open.
- ▶ Determine which Temperature Probe you are using: the Direct Connect with brass tube or the Stainless Steel with a stainless steel tip.
- ▶ Depending on which probe you have, choose the file *Temperature Tutorial* for the Direct Connect Probe or *Temperature Tutorial Stnlss* for the stainless probe. Click on Open to open the file.



- ▶ You may be prompted to save your data; for now, click on the No button to load the new file without saving.

The *Logger Pro* screen will look like this after you click OK to dismiss the experiment note:



Start data collection

- Click  on the *Logger Pro* screen.

Keep the temperature sensor sitting on the table, away from warm things like the computer. What's the room temperature? Now breathe on the sensor and watch the temperature rise. After 30 s data collection will stop. You can click  again to discard the current run and take more data.

Measure temperature of hot water

- Fill a cup with hot water and another with cold water.
- Click .

As data are being collected,

- place the sensor in the hot water to measure the temperature. Allow *Logger Pro* to complete data collection.

Notice that the sensor does not read the new temperature instantly, but that it takes a little while to respond. This is a characteristic of the sensor. About how long does it take for your sensor to stabilize at the water's temperature?

Store run

When you get a useful run, you will often want to preserve it for comparison to subsequent runs. To store your current run, choose Store Latest Run from the Data menu. These data will be preserved when you collect additional data. (Note: This action does not, however, save the data to disk. You do that using the file menu.)

- Once *Logger Pro* stops taking data, store your last run.

Measure temperature of cold water

- Start data collection while the sensor is still in the hot water.
- Move the sensor into your cold water after a few seconds of data have been collected, and allow *Logger Pro* to complete taking data.

What is the temperature of your cold water?

Prompted data acquisition—taking discrete data points

Sometimes when you take data with *Logger Pro* there is some information that you want to enter about each measurement. For example, suppose you want to measure the temperature of a water sample as you add warmer water. You might stop, stir, and measure the temperature

after every 10 mL-addition of water. *Prompted* data acquisition allows you to enter the volume of added water, and even to graph it. Here's an example of using prompted data acquisition. Don't be terribly careful about the water quantities below; the goal is to see how *Logger Pro* works in this mode, not to do a careful scientific experiment.

- ▶ As before, depending on your type of probe, open the experiment file *Prompting Tutorial* or *Prompting Tutorial Stainless* found in the Tutorial folder.
- ▶ You may be prompted to save your data; click on the No button to load the new file without saving.
- ▶ Fill a cup about halfway with cold water.
- ▶ Click .

Notice the Keep button that appears next to the Stop button:

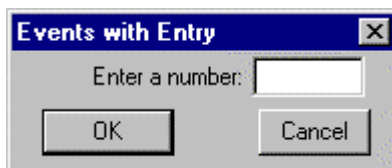


Put the temperature sensor in the water, and stir.

You can see the temperature reading in the status bar, but the value won't be recorded just yet.

- ▶ Once the temperature reading is stable, click on Keep to have *Logger Pro* record it.

Notice that *Logger Pro* is now prompting you for the volume of added water in the region just right of the Stop button.



- ▶ Type **0** (zero) after Enter a number and press Enter.
- ▶ Add about 10 mL (or a half-centimeter or so) of hot water to your cup, and stir with the temperature sensor for a few seconds.
- ▶ Click on Keep, and type **10** for the approximately 10 mL water you just added.
- ▶ Keep adding hot water in ~10-mL steps, stirring and recording the new temperature once the value stabilizes. For the second addition enter 20 for the water volume, which is the *total* volume you added since starting the experiment. Then repeat for 30, 40, and 50 mL.
- ▶ Click on Stop to end data collection.

Notice that you now have a graph of water temperature as a function of the volume of added water. You entered the water volume, and time is not displayed at all.

Quit *Logger Pro*

To quit *Logger Pro*,

- ▶ choose Quit or Exit from the File menu.

You will be prompted to save your data; for now, click on the No button to quit without saving.

Tutorial: Motion Detection with Logger *Pro*

About the tutorial

This tutorial will lead you through making simple measurements using the Motion Detector and Logger *Pro*. You may never need to learn more about Logger *Pro* and the Motion Detector, but advanced users will want to explore the menus and the How To section to make the best use of Logger *Pro*'s capabilities.

Verify the equipment setup

First, check to see that you have all of the equipment and software needed. You will need to find these items:

- Macintosh or PC running Windows
- Logger *Pro* software on your computer
- LabPro or ULI with power supply and interface cable. The Serial Box Interface cannot be used with this tutorial.
- **Motion Detector connected to DIG/SONIC 2 of the LabPro or Port 2 of the ULI.** Note that it is the *second* channel used for the Motion Detector in this tutorial.
- meter stick

***Pay close attention here ➡**

The Motion Detector

The Motion Detector is used to measure the distance from itself to a target object. It emits ultrasonic pulses and detects the echo from the target. The usable range of the Motion Detector is about 0.5 to 6 meters.

The LabPro and ULI

The LabPro and ULI are interfaces that convert the signals from the Motion Detector to a form that the computer can read. If you have a ULI, turn it on and be sure that the green light is on.

Logger *Pro*

Logger *Pro* is the software which controls the interface and displays the results of the Motion Detector measurements. Much of the remaining instruction will teach you to work with Logger *Pro*.

Set up the Motion Detector

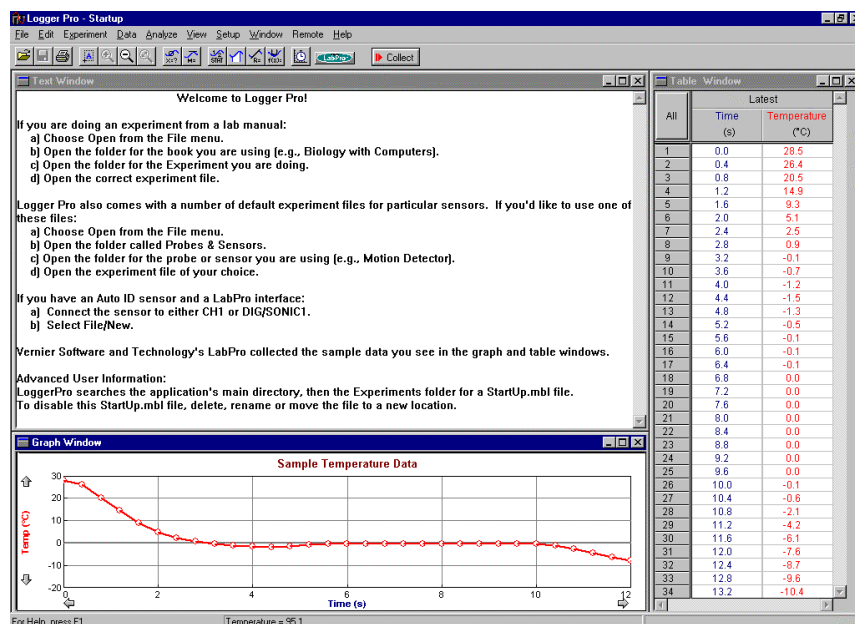
- Place the Motion Detector on your desk or table with the gold disk pointing upward.

Be sure that there are no obstructions above the Motion Detector (the ceiling is OK!) or closer than 0.5 m to the side. You will soon use your hand as the moving target for the Motion Detector.

Start Logger *Pro*

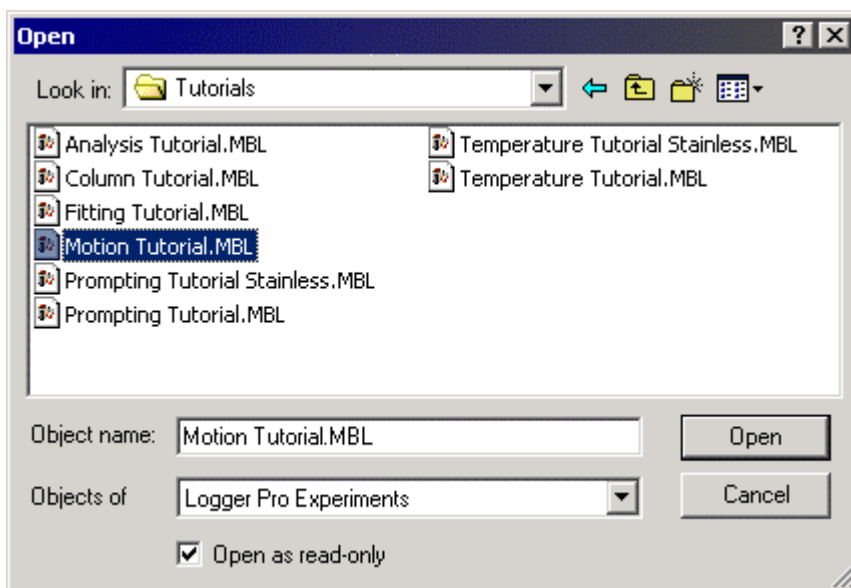
- Using the method appropriate for your computer, start the Logger *Pro* application.

You should see a screen like the one shown below. (When using the Motion Detector with a LabPro, the auto-ID feature loads a preformatted experiment specifically for that probe.) If not, then Logger *Pro* is having trouble communicating with the interface. Be sure the interface is turned on, plugged in, and the interface cable is plugged into both the computer and the interface. Try starting again.



Open an experiment file

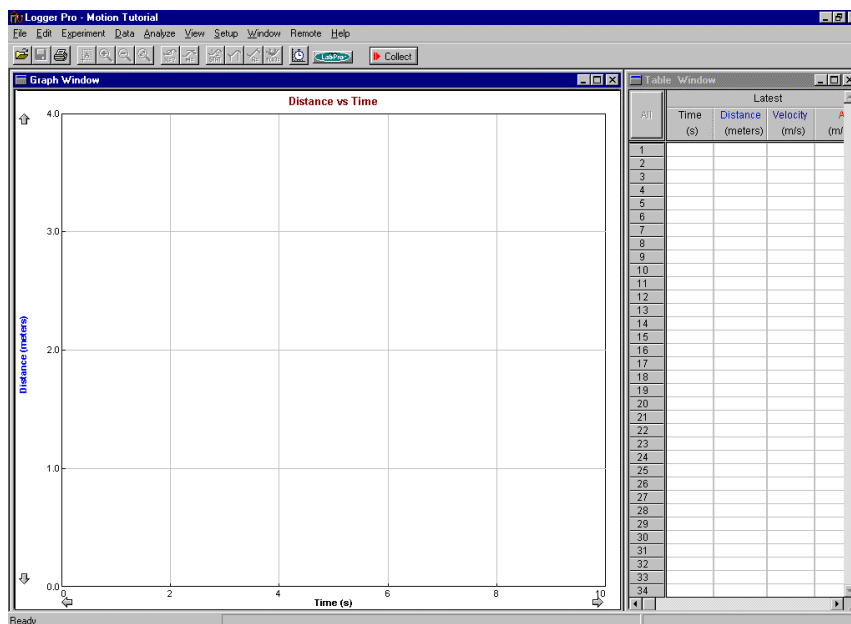
- Choose Open from the File menu.
- Click on the Tutorials folder and click on Open.
- In the file list that appears choose the file *Motion Tutorial* from the Tutorials folder and click on Open.



- You may be prompted to save your data; for now, click on the No button to load the new file without saving.
- Click on the OK button in the Experiment Notes dialog that appears.

By opening this file you are loading a particular configuration for Logger Pro so that it's ready to take data with the Motion Detector.

Screen elements



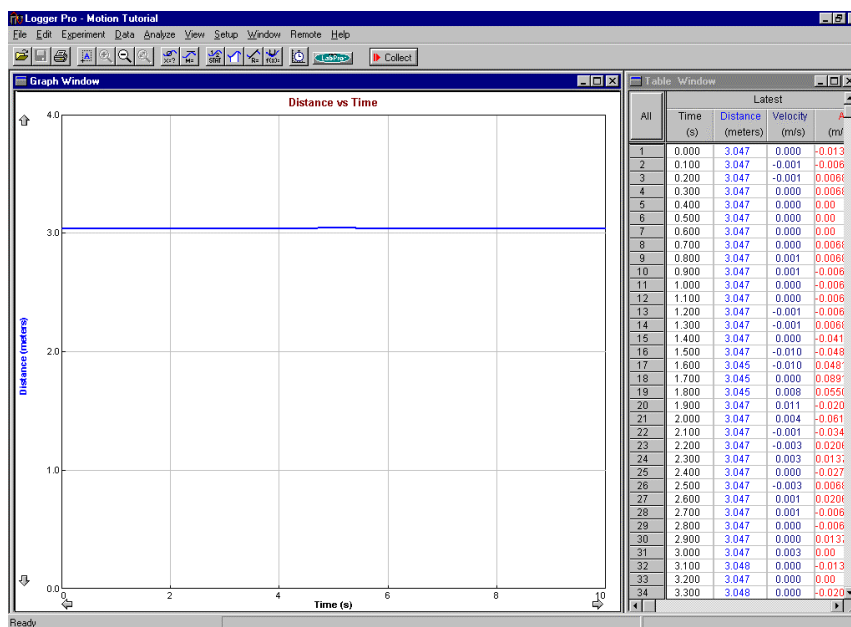
The Logger *Pro* screen contains, from top to bottom, the following major elements: the menu bar, a toolbar containing a  button, graph and data windows, and a status bar.

Start data collection

For your first measurement with Logger *Pro* and the Motion Detector, why not measure how high the ceiling is above you?

- Click  on the screen.

You may hear a clicking sound from the Motion Detector—that is normal. Observe the graph that is being drawn. Logger *Pro* will take data for ten seconds. You should see a graph like this one (you may need to click on the Autoscale Once button to bring the line on scale) .



In this case it shows that the ceiling is about 3 m above the Motion Detector, and that it isn't moving. On your graph, the vertical axis is distance, and the horizontal axis is time.

- Check to see that the distance reported makes sense, and verify it with a meter stick.

If the Motion Detector measurement is noisy or obviously wrong, then you've got some other object in the way of the Motion Detector. It's possible that the Motion Detector is reporting the distance to a light fixture, so try different placements on the table.

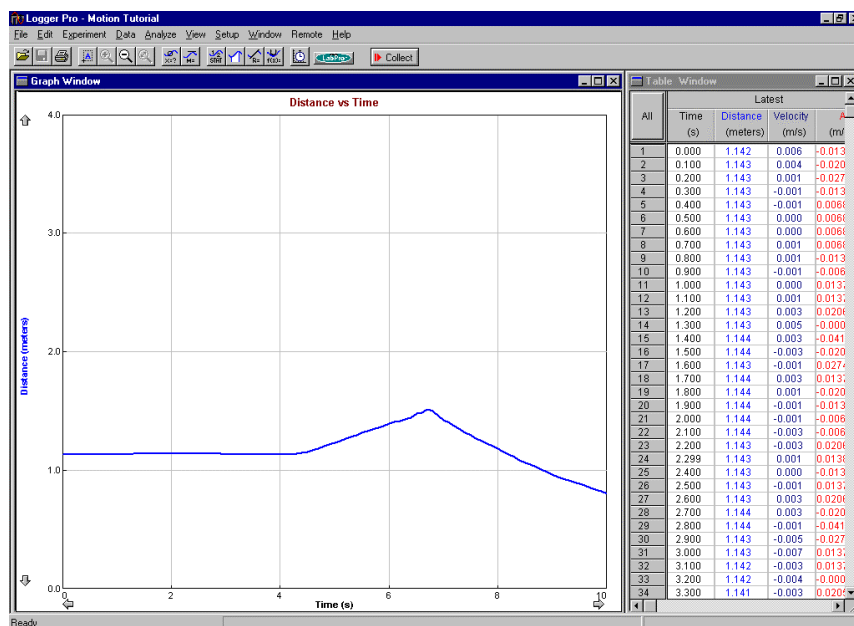
As data are gathered, the graph line extends to the right in real time. Data collection will stop once the right side of the graph is reached, or sooner if you click on the stop button. In the future you will want to use this real-time feature to help you connect an object's motion to its graphical representation.

- Now hold your hand steady about a meter above the Motion Detector and click .

The data you gathered on ceiling position will disappear, and now the position of your hand is recorded.

- Before data collection stops, move your hand up and down a bit to see how the graph responds. Don't get closer than 0.5 m to the detector¹.

You should see something like this:



Can you point to the place on the graph when your hand was farthest from the Motion Detector? How about the closest? For the sample screen shown here, the times of farthest and nearest position are about 0.80 m and 1.50 m, respectively. Note that if you pull your hand away from the Motion Detector, the Motion Detector records the ceiling position instead. The distance to the nearest object in front of the

¹If the Motion Detector's target gets closer than about 0.5 m, the reported distance will probably be wrong. You might try an experiment to see how close you can get to your detector and still get useful data.

Store run

Motion Detector is always reported. If you click on the Autoscale Once button the graph will rescale and make it easier to read the values.

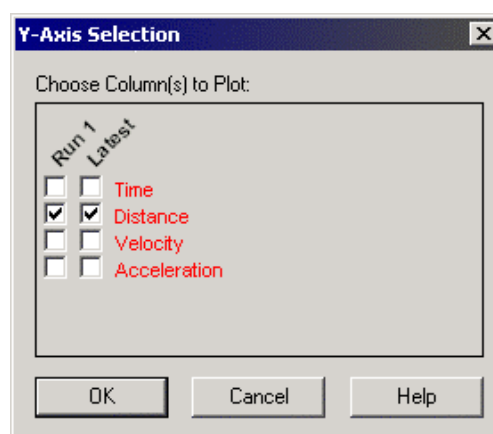
When you get a useful run, you will often want to preserve it for comparison to subsequent runs. To store your last run, choose Store Latest Run from the Data menu. Those data will be preserved when you collect additional data. This action does not, however, save the data to the hard disk or a floppy disk. If you quit *Logger Pro* without explicitly saving, the data will be lost.

- ▶ Store your latest run by choosing Store Latest Run from the Data menu.
- ▶ Take another run of your hand motion, and see how it compares to your last run.

Can you exactly match your stored motion? It's hard!

Displaying velocity and acceleration

Logger Pro can also display the velocity and acceleration of the detected object. Click on the y-axis label, and you will get this dialog:



To display the velocity and acceleration plots, check the items in the list and click on OK. It is easy to make a complicated and hard-to-read graph, so deselect any runs or columns you do not want to see.

Some tips for using the Motion Detector

- In using the Motion Detector, it is important to realize that the ultrasound is emitted in a cone about 30° wide. Anything within the cone of ultrasound can cause a reflection and possibly an accidental measurement. A common problem in using Motion Detectors is getting unintentional reflections from a desk, chair, or computer in the room.
- If you begin with a velocity or acceleration graph and obtain a confusing display, switch back to the distance graph to see if it makes sense. If not, the Motion Detector may not be properly detecting the target.
- The Motion Detector does not properly detect objects closer than 0.5 m. The maximum range is about 6 m, but stray objects in the wide detection cone can be problematic at this distance.
- Sometimes a target may not supply a strong reflection of the ultrasound. For example, if the target is a person wearing a bulky sweater, the resulting graph may be inconsistent.
- If the velocity and acceleration graphs are noisy, try to increase the strength of the ultrasonic reflection from the target by increasing the target's area.

Quit Logger *Pro*

- Logger *Pro* will warn you if the motion detector is not receiving any echoes. This can sometimes happen outside or in large rooms. Make sure a wall or ceiling is always in front of the motion detector.

You've now learned how to gather motion data using the Motion Detector with Logger *Pro*. Other tutorials will show you how to analyze your data, to fit curves to the data, to save and print your data, and to define new columns for data.

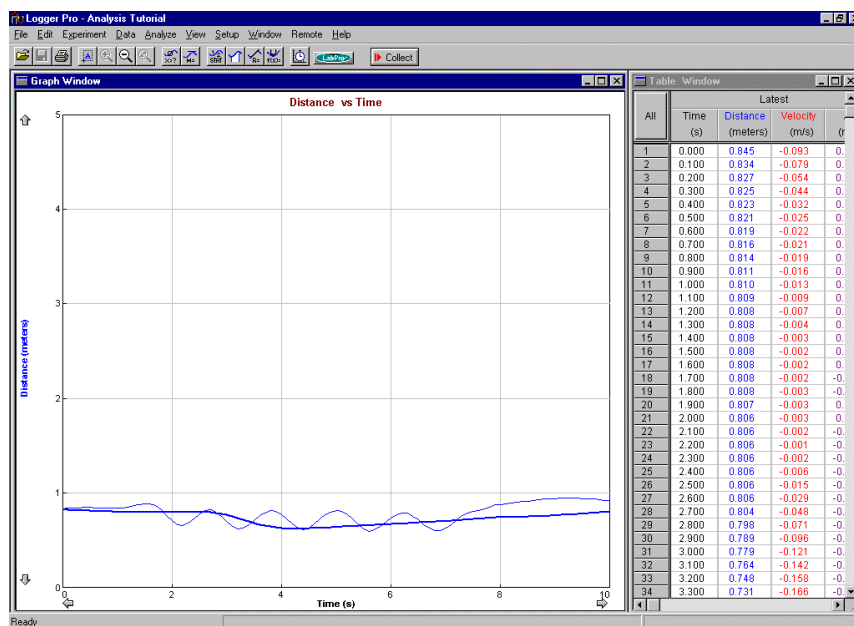
- Quit Logger *Pro* by choosing Quit or Exit from the File menu. Do not save any changes.

Tutorial: Analyzing Data

Once you have taken some data with *Logger Pro*, there are a number of things you can do with those data to understand them. This tutorial will teach you how to use some of the analysis features of *Logger Pro*.

- Start up *Logger Pro*
- Choose Open from the File menu.
- Select the file *Analysis Tutorial* from the Tutorials folder and click on Open.
- OK the Experiment Notes dialog.

You have just loaded sample data to use in this tutorial.



Changing the graph

There are a number of useful ways to display the data gathered by *Logger Pro*. You might want to simply change the limits on the y axis to study a portion of the data. Or, you might want to add a descriptive title to the graph. You can do both of these by clicking different parts of the screen.

First, try changing the limits of the y-axis. The numbers at either end of the axis can be edited.

- Click on the 5 at the top end of the y-axis. The number will be highlighted.
- Type a 3 to replace it and press enter.

The graph will rescale. You can change the horizontal axis in the same way.

You can also ask *Logger Pro* to rescale the graph automatically.

- Choose Autoscale Once from the View menu or click on the Autoscale Once button on the toolbar.



The graph now shows the entire range of data.

Change the graph title

You can change the graph title.

- Click on the graph title.
- Type in a new title of your choice and click on OK.

Your title is now in place.

Inspecting data

Sometimes you will want to see the coordinates of a particular place on a graph.

- Choose Examine from the Analyze menu, or click on the  Examine button on the toolbar.
- Move the pointer along the graph.

Notice the new legend that appears on the graph. Then, as you move the pointer across the graph, you will see a numerical readout change, reporting the coordinates of each plotted quantity at the indicated time.

Data table window

As you move the pointer across a graph the data table scrolls to the corresponding time. Data columns are color-coded to match the lines drawn on the graphs.

You can turn off the readout floating box and cursor.

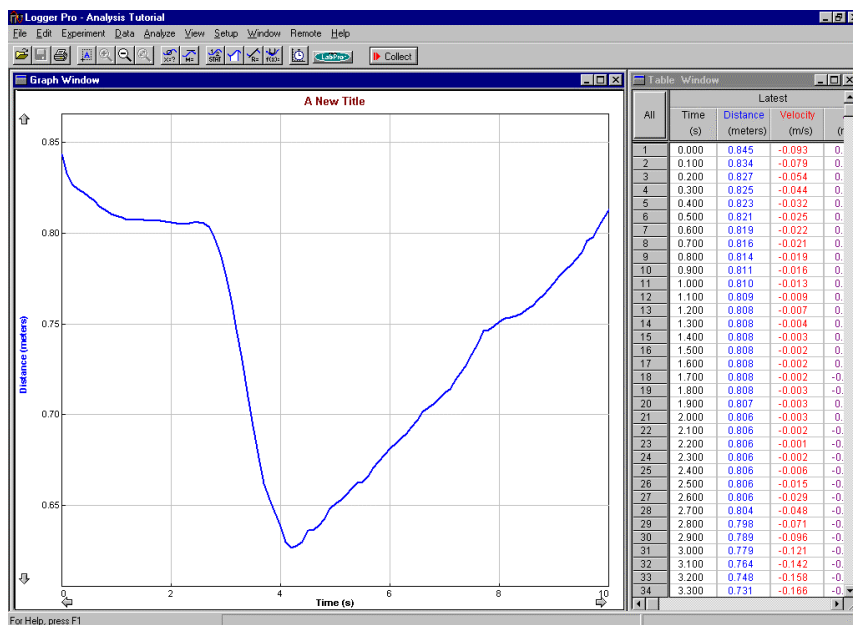
- Select Examine again from the Analyze menu to turn off Examine mode. You can also click on the Examine button again to turn off the mode.

Removing data

To remove a set of data, you can choose Delete Run from the Data menu. While the mouse pointer is over Delete Run you will see a list of all the stored data, including the latest run.

- Delete all but the latest run now.
- Choose Set Axes to Autoscale from the View menu to reset the y-axis range.

Your graph screen should have only the most recent data plotted now.



Changing what is graphed

Any column of data from a single run can be plotted against any other column. Time, while usually plotted on the horizontal axis, need not be plotted at all if it is not appropriate. For example, you might want to plot

velocity as a function of position in some dynamics studies. To do this you must change what is plotted on one or both axes.

- Click on the y-axis label.

You will see a dialog box with all of the column headings in the data table available.

- Click on the selection boxes so that only the Velocity column is checked.
- Click on OK.
- Click on the x-axis label to get the x-axis selection dialog.
- Click on the Distance selection button and click on OK.

You should see a plot of velocity as a function of position. Physicists call this a *phase plot*. Now you will change the plot back to a conventional velocity as a function of time graph.

- Click on the x-axis label to get the x-axis selection dialog.
- Click on the Time selection button and click on OK.

You should see a velocity vs. time graph.

Tangent lines

Logger Pro can draw tangent lines to any curve on screen.

- Choose Tangent from the Analyze menu or click on the tangent button on the toolbar, and point at a portion of the data with the mouse.



Logger Pro will draw the tangent line at the current mouse pointer position; its slope is displayed in the legend box. Move the pointer to see other tangents.

- Turn off tangent mode by choosing Tangent from the Analyze menu again (or you can use the toolbar).

Integrals

Similar to the tangent function, you can integrate your data. To integrate a region,

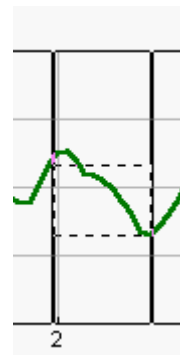
- select a region of your data by dragging across it with your mouse.

Two vertical bars should appear to indicate the selected region.

- Choose Integrate from the Analyze menu or click on the integral button on the toolbar.



The area between the curve and the horizontal axis will be shaded, and the numerical result displayed in a *floating box* as shown here. You can drag the box to any place on the graph you want. To remove the integral, click on the upper right corner of the floating box. To integrate all of the data choose integral with no selection made in the graph window or data table.



Integral:
1.250 m*s

- Remove the integral by clicking the upper-right corner of the floating box.

Statistics

You can also ask Logger Pro to calculate the mean, maximum, minimum, and standard deviation on part or all of your data. To find statistics on part of the data,

- select a range of data by dragging across it.

- Choose Statistics from the Analyze menu. You can also press the statistics button on the toolbar.



A moveable floating box will appear with the results. To remove the floating box, click on the upper-right corner of the floating box. For statistics of the entire data set choose Statistics with no data selected. If you have already selected data, clear that selection by clicking once in the graph region of the graph. The vertical selection bars will disappear.

Quit Logger Pro

You've now learned how to change the graph scale, obtain numerical data from the graph, draw integrals and tangent lines, and perform statistical calculations on a data set. Another tutorial will show you how to fit lines and curves to your data.

- Quit Logger Pro by choosing Quit or Exit from the File menu. Do not save any changes.

Tutorial: Fitting Lines and Curves to Data

Logger *Pro* will fit a variety of functions to your data, and then plot the function and report the fit statistics. This tutorial will lead you through a number of fitting exercises.

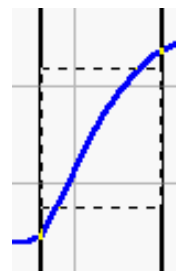
- ▶ Start up Logger *Pro*.
- ▶ Choose Open from the File menu.
- ▶ Select the file *Fitting Tutorial* from the Tutorials folder and click on Open.

You have just loaded some sample data to use in this tutorial.

Fitting a straight line to data

Often data show a linear trend, and you want to know the slope of that trend. Locate a part of the data that seem to follow a more or less straight line. It doesn't have to be very straight.

- ▶ Select these data by dragging the mouse pointer across the region.
- ▶ Choose Linear Fit from the Analyze menu. You can also click on the Linear Fit button on the toolbar.²



Logger *Pro* now plots the best-fitting line and displays the fit statistics in a floating box. Since your selection is not necessarily the same as used here, your fit parameters may differ.

Removing a fit

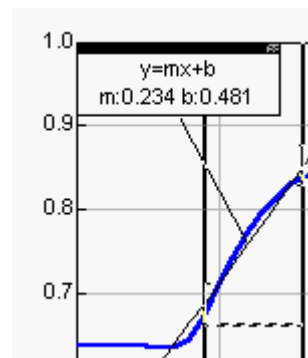
To remove a fitted line and parameters,

- ▶ click on the close box (the upper right corner) of the floating box.

Fitting more complex functions to data

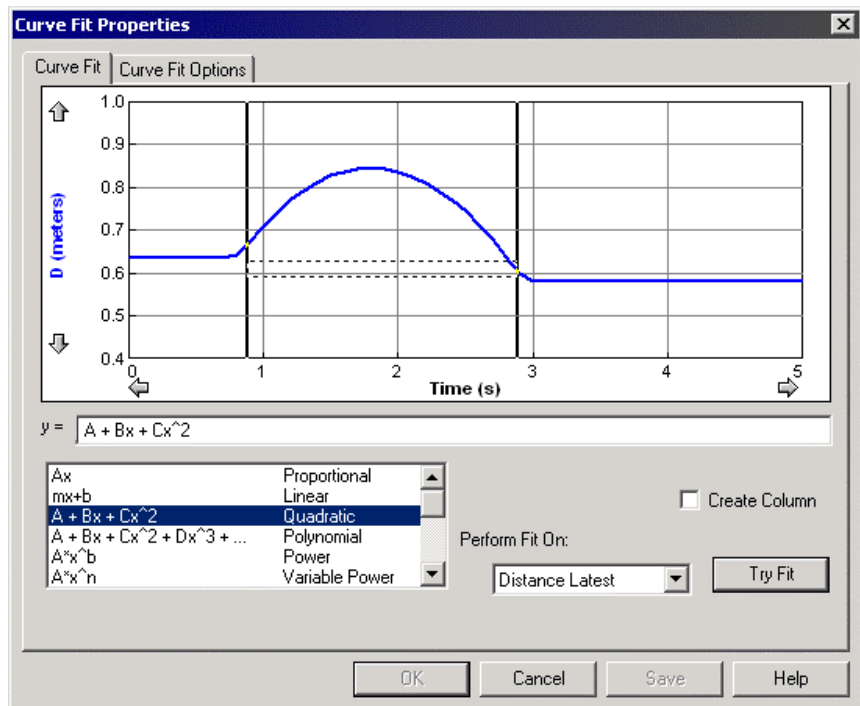
You can also fit more complex functions to your data.

- ▶ Select the curved region of data with the mouse.
- ▶ Choose Curve Fit from the Analyze menu. You can also click on the Curve Fit button on the toolbar.



A dialog box will open:

²You can also perform a linear fit using the more general Curve Fit command, but more steps are required.



You can select the desired function from the scrolling list at the lower left by clicking it. For this example,

- choose the Quadratic function from the Function list.
- Choose the Distance Latest column from the Perform Fit On list.
- Click on the Try Fit button at lower right.

You will see a trial fit drawn on the draft graph. You can modify the fit as desired by changing the selection range or equation used, and clicking Try Fit again. Once you are satisfied with the fit,

- click on OK to return to the main graph window.

Interpolate

Once you have performed a fit, you can use it to interpolate between data points.

- Choose Interpolate from the Analyze menu.

Move the cursor to the desired region, and read off the coordinates of the curve from the legend box. Note that you are not reading the coordinates of the data but of the fitted line.

- Turn off interpolate mode by choosing Interpolate from the Analyze menu again.

Removing a fit

As before, you can remove a fit by clicking the close box of the floating box.

- Remove the fit.

Quit Logger Pro

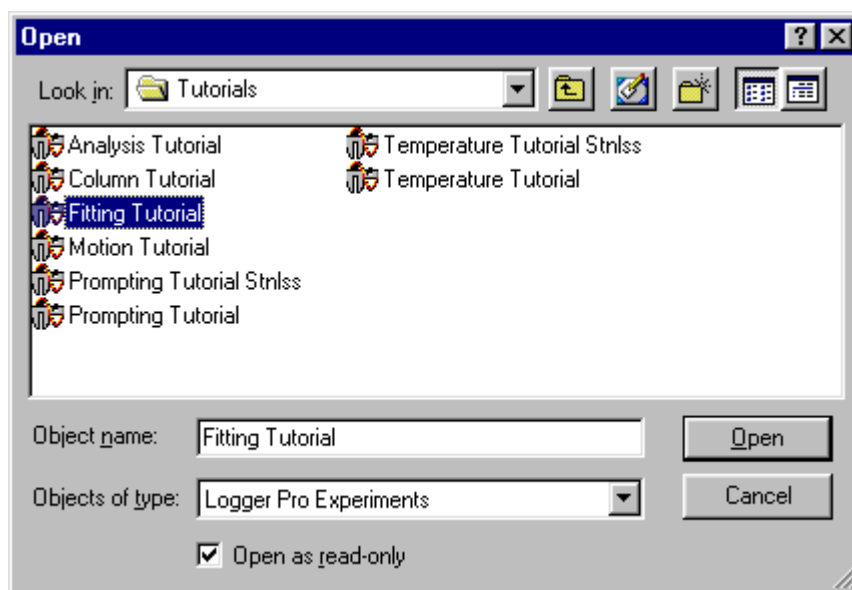
You have now learned how to fit a line or a curve to your data, how to interpolate using those fits, and how to remove curve fits.

- Quit Logger Pro by choosing Quit or Exit from the File menu. Do not save any changes.

Tutorial: Saving Files, Printing, and Transferring Data

Once you get some useful data, you may want to save them to a floppy disk or a hard disk for future use, print them, or transfer them to another application such as a spreadsheet. This tutorial will show you how to do these things with some sample data found in a file. To load the file,

- ▶ Start up *Logger Pro*
- ▶ Choose Open from the File menu, and locate the file *Fitting Tutorial* in the Tutorials folder.



Note the field at the bottom of the dialog box marked Open as read-only. When this box is filled (the default), the Save command and the Save toolbar button are disabled in order to protect the original file. Usually you will want to save files under new names using Save As.... Leave the check box filled.

- ▶ Click on Fitting Tutorial to select, and click on Open.

Saving an experiment file

It is very useful to preserve the current state of *Logger Pro* in a file. For example, you might configure *Logger Pro* to carry out a particular experiment, perform a calibration, and take some sample data. All the work just done can be retrieved later by opening a file. Such an *experiment file* contains the entire *Logger Pro* state: the sensor configuration including calibration (either from file or custom), the graph setup, and any data just collected or stored.

As an exercise, you will save a copy of the experiment file you just opened to a floppy disk.

- ▶ Insert a formatted floppy disk into your computer.
- ▶ Choose Save As from the File menu.
- ▶ Navigate to the floppy disk drive by using the drop down menu at the top of the dialog box. Scroll to the floppy disk drive and select it.

You will be prompted to choose a file name and a location for the file. Be sure you know in what folder you are about to save the file. Ask your instructor if you're not sure where to put the file.

- ▶ Enter a file name other than *Fitting Tutorial*.
- ▶ Click on the Save button to save your file.

Retrieving an experiment file

After saving the experiment to disk, you can retrieve it by choosing Open from the File menu as you did at the beginning of this tutorial. It is not necessary to do that now.

Printing a graph

When you get a graph the way you like it, you can print it.

- ▶ Click on the graph window to select it.
- ▶ Select Print Window from the File menu.
- ▶ Click on Print or OK as appropriate for your computer.

Your graph will be printed.

Printing data

You can also print a data table by selecting it and selecting Print Window for the File menu, but be careful. It is easy to acquire many pages of data. You may want to reduce the number of data points collected when setting up the experiment. The print preview command in the file menu will show what will be printed.

Transferring data to other applications

You may want to copy data to a spreadsheet or a graphing program.

- ▶ Click on the All button in the upper left of the Data Table Window to select the data.
- ▶ Choose Copy from the Edit menu.

In a moment you will switch to the receiving application. You do not need to quit *Logger Pro*; in fact it is much easier if you leave *Logger Pro* running so you can return to it later.

- ▶ Start up or switch to the receiving application.
- ▶ Position the insertion point or active cell in the upper left of the region where you want your data to be placed.
- ▶ Choose Paste from the Edit menu.

Your data will be placed in the receiving application, ready for further analysis.

Quit *Logger Pro*

You have now learned how to save an experiment with its data to a file, to retrieve such a file from disk, and how to transfer data to another application.

- ▶ Quit *Logger Pro* by choosing Quit or Exit from the File menu. Do not save any changes.
- ▶ Locate the experiment file you saved earlier and delete it (*not the Fitting Tutorial file*).

Tutorial: Auto-ID Temperature Measurement (LabPro Only)

The LabPro interface is capable of automatically identifying newer sensors.³ For example, if you launch *Logger Pro* with the Stainless Steel Temperature Probe connected to CH 1, *Logger Pro* will be ready to collect data immediately.

- ▶ Connect a Stainless Steel Temperature Probe to the CH 1 input.
- ▶ Start up *Logger Pro*. Notice that the graph is appropriate for the Temperature Probe.
- ▶ Click .

Logger Pro will collect data for 200 seconds. Grasp the probe tip to warm or cool it to see a change in temperature.

Change the graph

The default data collection parameters may not be optimum for your experiment. There are several ways to quickly change the time *Logger Pro* collects and presents data.

First, try changing the limits of the y-axis. This change only affects the way data are graphed. The numbers at either end of the axis can be edited.

- ▶ Click on the **100** at the top end of the y-axis. The number will be highlighted.
- ▶ Type a **50** to replace it and press enter.

The graph will rescale.

Collect data for a longer time

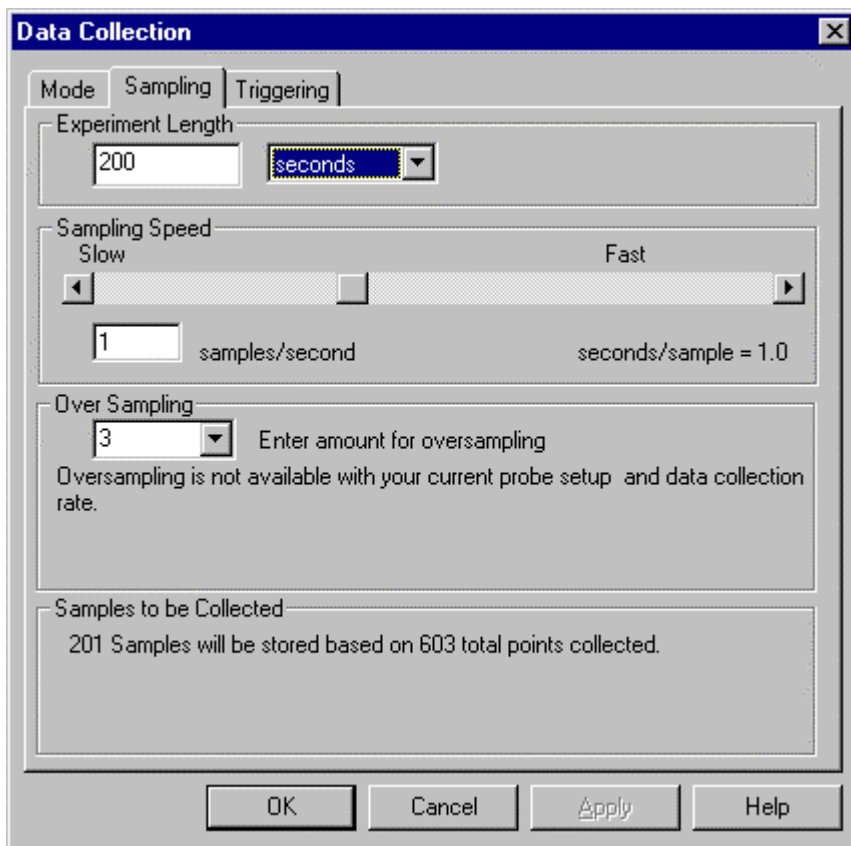
If you want to collect data for a longer period of time, you can change the limits of the horizontal axis in the same way you changed the temperature axis. For example, to collect data for a longer period of time, change the **200** at the right end of the time axis to a larger number.

Change data rate

³ LabPro cannot identify older sensors with 5-pin DIN connectors, and so you must manually select an experiment file for these sensors.

To change the data collection rate, click on the Setup Data Collection button on the toolbar. Click on the Sampling tab. You will see a dialog box like the one on the following page. To change the rate at which the LabPro collects data, either move the slider or change the numeric entry in the Sampling Speed field.

You can also change the experiment length by changing the value in the Experiment Length field. This step does the same thing as changing the time axis label as you did above.



Make more changes

You can go on from here to make more changes to the configuration of *Logger Pro*, or you can open an experiment file that more closely fits the measurement you are making. Once you have optimized *Logger Pro* for your experiment, you may want to save an experiment file with a unique name for later use.

Quit *Logger Pro*

You have now learned how to use sensor auto-ID in *Logger Pro*.

- Quit *Logger Pro* by choosing Quit or Exit from the File menu. Do not save any changes.

Tutorial: Auto-ID Motion Measurement (LabPro Only)

The LabPro interface is capable of automatically identifying newer sensors. For example, if you launch *Logger Pro* with a Motion Detector connected to DIG/SONIC 1, *Logger Pro* will be ready to collect data immediately.

- ▶ Connect a Motion Detector to the DIG/SONIC 1 input.
- ▶ Place the Motion Detector on your desk or table with the gold disk pointing upward. Be sure that there are no obstructions above the Motion Detector or closer than 0.5 m to the side.
- ▶ Start up *Logger Pro*. Notice that the graph is appropriate for the Motion Detector.
- ▶ Click .

Logger Pro will collect motion data for 10 seconds. Move your hand up and down above the Motion Detector, but do not get closer than 0.4 m.

Change the graph

The default data collection parameters may not be optimum for your experiment. There are several ways to quickly change the time *Logger Pro* collects and presents data.

First, try changing the limits of the y-axis on the distance graph. This change only affects the way data are graphed. The numbers at either end of the axis can be edited.

- ▶ Click on the number at the top end of the y-axis. The number will be highlighted.
- ▶ Type a **2** to replace it and press enter.

The graph will rescale.

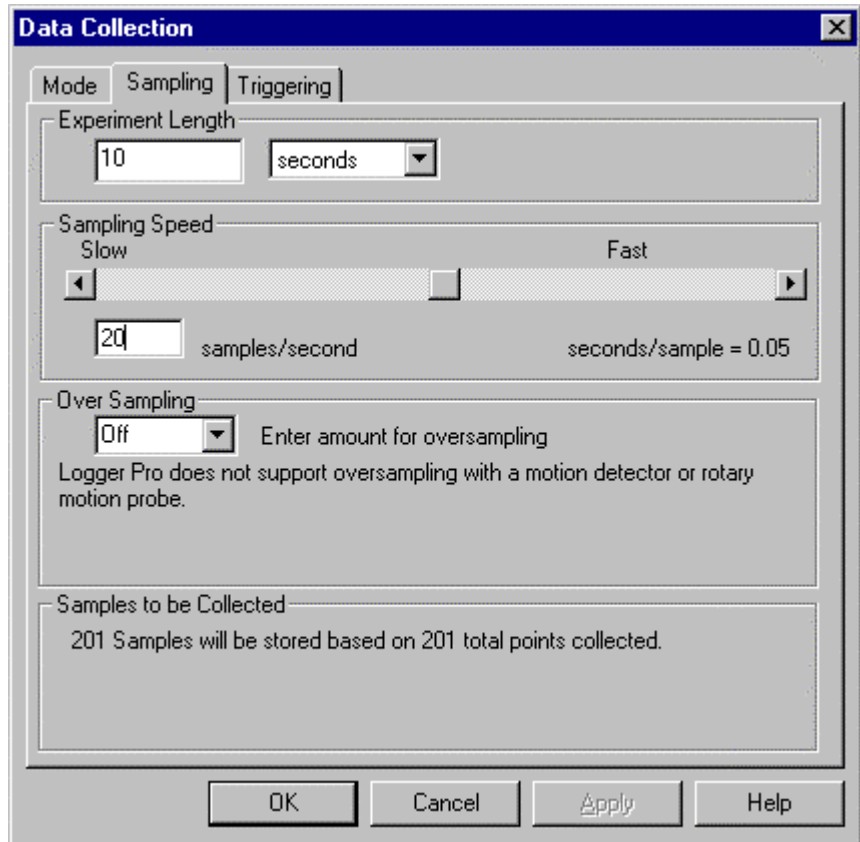
Collect data for a longer time

If you want to collect data for a longer period of time, you can change the limits of the horizontal axis in the same way you changed the distance axis. For example, to collect data for a longer period of time, change the **10** at the right end of the time axis to a larger number.

Change data rate

To change the data collection rate, click on the Setup Data Collection button on the toolbar. Click on the Sampling tab. You will see a dialog box like the one on the following page. You can change the experiment length by changing the value in the Experiment Length field. This step does the same thing as changing the time axis label as you did above.

You can also change the rate at which the LabPro collects data. Either move the slider or change the numeric entry in the Sampling Speed field.



Make more changes

You can go on from here to make more changes to the configuration of *Logger Pro*, or you can open an experiment file that more closely fits the measurement you are making. Once you have optimized *Logger Pro* for your experiment, you may want to save an experiment file with a unique name for later use.

Quit *Logger Pro*

You have now learned how to use sensor auto-ID in *Logger Pro*.

- Quit *Logger Pro* by choosing Quit or Exit from the File menu. Do not save any changes.

Tutorial: Remote Data Collection (LabPro Only)

For some experiments it is useful to collect data without the LabPro connected to the computer. For example, you may want to leave a Temperature Probe and a LabPro in a closed automobile on a hot sunny day to see just how quickly the interior warms. Or, you might want to take an Accelerometer on a roller coaster ride. In either case the computer is an inconvenience at best!

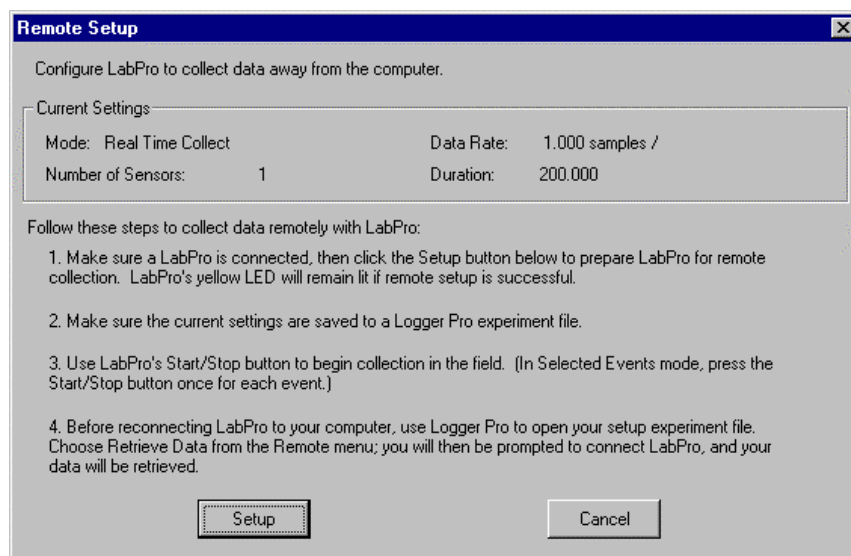
Logger *Pro* and LabPro together can perform remote data collection. Once Logger *Pro* has prepared the interface, you can disconnect the computer and take just the LabPro and sensor to perform your experiment. Most often you will use battery power, but remote data collection can still be performed using the AC power adapter.

For convenience here we will use the auto-ID feature to quickly set up Logger *Pro* for measuring temperature. Alternatively, any experiment file that does not use triggering can be used for remote data collection.

Set Up LabPro for Remote Data Collection

- ▶ Connect a Stainless Steel Temperature Probe to the CH 1 input.
- ▶ Start up Logger *Pro*.
- ▶ Select Set Up LabPro... from the Remote menu.

You will see the following dialog box.



- ▶ Click Setup to prepare LabPro for remote data collection.
- ▶ Disconnect LabPro from the communications cable. Notice that the yellow light is on. This indicates that LabPro is prepared to collect data.
- ▶ The computer can either be left on this screen of Logger *Pro* or you can leave the application. However if you leave, you must return to the same experiment file in order to have the correct column labels. If you are depending on auto-ID for setting up Logger *Pro*, then it is best to leave the computer at this screen during data collection.

Collect Data Remotely

- ▶ When you are ready to collect data, press the START/STOP button on the LabPro. LabPro will beep and collect data for 200 seconds. When it is done all lights will be off. If you want to stop data collection before 200 seconds, press START/STOP again.

Download Data to Logger Pro

- ▶ Return to the computer. Connect LabPro to the communications cable.
- ▶ Select Retrieve Data on the “LabPro Has Data” dialog if it appears, or choose Retrieve Data from LabPro from the Remote menu.

Your data will be graphed. From this point you can use Logger *Pro* as in previous tutorials for analysis and other purposes.

Quit Logger Pro

You have now learned how to use remote data collection in Logger *Pro*.

- ▶ Quit Logger *Pro* by choosing Quit or Exit from the File menu. Do not save any changes.

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