

V. Using LoggerPro

“Nothing is more terrible than to see ignorance in action.”

J. W. Goethe (1749-1832)

LoggerPro is a general-purpose program for acquiring, graphing and analyzing data. It can accept input from a video camera, read a video file or, through the LabPro interface device, acquire data from a variety of other sensors. Pictorial data can be reduced to x-y coordinates of selected objects, while sensor data is presented in tabular form as a function of time. The program will prepare plots of the data, compute statistics like the mean, fit specified curves to a data series, and calculate derived quantities. Basic operations will be described here. Additional information can be found in the internal help system and in the *LoggerPro 3 Quick Reference* guide available in the lab room.

To start LoggerPro you can click on the caliper icon in the main toolbar, or double-click on one of the startup files with a .cmbl extension on the desktop. The startup file can configure graphs, sensors and other features for a particular experiment, so this is the preferred method.

If the program is already running, you can get a clean copy with File > New on the taskbar, or load a new startup file with File > Open... When doing so, or when quitting the program, you will be prompted to save your previous work. This is usually not necessary but if you do wish to save, use File > Save As... and follow the dialog to create a new file so that the original is available for other students.

DATA COLLECTION - SENSORS

Be sure that the power supply for the LabPro is plugged in, and that it is connected to the computer by a USB cable. The sensors needed for a particular exercise will usually already be connected to the LabPro interface, but the program needs to know what sensors are connected to each port, and how they should be calibrated or actuated. Loading the startup file specified for each exercise will provide the proper configuration, a data table with useful columns, and graphs as needed. In the unlikely event that the startup file settings are not adequate, modifications can be made with the menu entries under Experiment and Data. If you do make changes, *do not save them* under the original file name.

Once the program and sensors are configured, you start data collection by clicking the Collect button. After a brief pause, the sensors will be read at regular intervals until the Stop button is clicked or the time limit is reached. Data will appear in the table and on the graph, if

present, as it is obtained. When data collection is complete, you can use the graphing and data analysis functions as needed.

DATA COLLECTION - VIDEO

Video is used to measure and analyze the motion of objects, often in two dimensions. Two steps are required: A movie of the desired motion is captured in a LoggerPro window, and then the movie is analyzed in a separate window.

Recording. Be sure the camera is plugged in, turned on to MOVIE mode, and connected to the computer. Start LoggerPro and open a recording window by going to Insert > Video Capture.... Check that the image is what you want, and then click on the Start Capture button to begin recording. Carry out the desired action and then click the Stop Capture button to stop recording. Close the recording window by clicking on the dot at the upper left corner.

Measuring. The analysis window should now contain your new movie. Movie player controls are on the bottom at the left, or you can move along the movie series with the blue slider control. Click on the icon with three dots and a triangle at the bottom right to open the analysis toolbar. The actual measurement process consists of marking the desired point in each movie frame and then marking a known length in one frame to convert picture positions to physical dimensions.

To mark points, click on the second icon in the vertical row, the one with a dot in crossed lines. Position the crosshair cursor at the desired place in the picture and click. The program will record the coordinates, put a colored dot at that location, and advance to the next frame. Repeat until you have marked all the positions of interest for the motion you are studying.

If you need to mark a second set of positions in the movie, click on the icon with two dots and lines to pull down the menu. Select Add point series and mark the new points as needed. The same pull-down menu lets you add more series, or choose among the series you have already created. Caution: For reasons known only to the programmers, each point series is associated with a different time base. When plotting, be sure all variables on both axes of your graph are from the same point series.

To calibrate the scale, move to a frame that shows something of known length which is at the same distance from the camera as the object of interest. (The object itself may be used if nothing better is available.) Click on the ruler icon, which is fourth from the top in the analysis toolbar. Put the arrow cursor at one end of the known length, then click and drag to the other end. Enter the length in the pop-up window. The computer will convert pixel coordinates to real distances and place the values in the data table and onto the graph.

To translate or rotate the coordinate axes, click on the third icon in the vertical row, the one with x-y axes and a small arrow. Position the arrow cursor at the desired origin and click.

Yellow lines will indicate the new axes, which you can click and drag to adjust. To rotate the coordinate system, click on the yellow dot and drag the cursor. The new coordinate axes will be used for all the data, whether marked before or after the transformation.

GRAPHING

Data from sensors or a movie is usually graphed automatically when appropriate. To change the graph scales, click at either end of the x or y axis. Enter the maximum or minimum scale value desired and push return. To change the quantity being graphed on either axis, click on the axis label and select the desired variable from the menu.

You can add additional columns for manual data entry using Data > New Manual Column. To calculate a new column from data in previous columns, use Data > New Calculated Column... and follow the dialog that pops up. The pull-down menus in the box allow you to pick from the available variables and functions to calculate the new column entries.

To use LoggerPro as a manual graphing tool, load the startup file Graph.cmbl. This will produce a data table with two columns for manual data entry. Type data into the cells of the table, and it will be plotted on the adjacent graph. Adjustments can be made as before.

ANALYSIS OF GRAPHED DATA

A number of analytic tools can be activated by menu items under Analyze or by clicking on icons in the task bar. The analysis will use all the data in the selected graph, unless a subset has been selected by clicking and dragging on the graph or data table. The tools most useful for this course are

Statistics or Stat icon: Computes mean, standard deviation and some other statistics for the selected data.

Integral or curve and area icon: Calculates area under the selected portion of the curve.

Linear Fit or $R =$ icon: Fits a straight line to the data and displays slope, intercept and correlation coefficient. To obtain error estimates for the fit parameters, double click on the display box and check the option in the dialog.

Curve Fit or $f(x) =$ icon: Fits any of several functions to the data. Choose the desired function and follow instructions in the dialog box.