Steady Eddy: Hand-shake test with Logger Pro

Ian Jacobs: Physics Advisor, KVIS, Rayong, Thailand.

Motion detectors are sonar devices that measure the time for 40 000 Hz ultrasound pulses to return from the closest object. They operate like the echo-location systems of insect eating bats and have about the same accuracy (± 0.1 mm). Distance is calculated from the time delay and requires the speed of sound (ultrasound) that is slightly temperature dependent. Logger Pro allows ambient temperature to be entered but for this exercise factory calibration is sufficient.

Two motion detectors are connected to a Lab Pro interface that is in turn connected to a computer running Logger Pro.

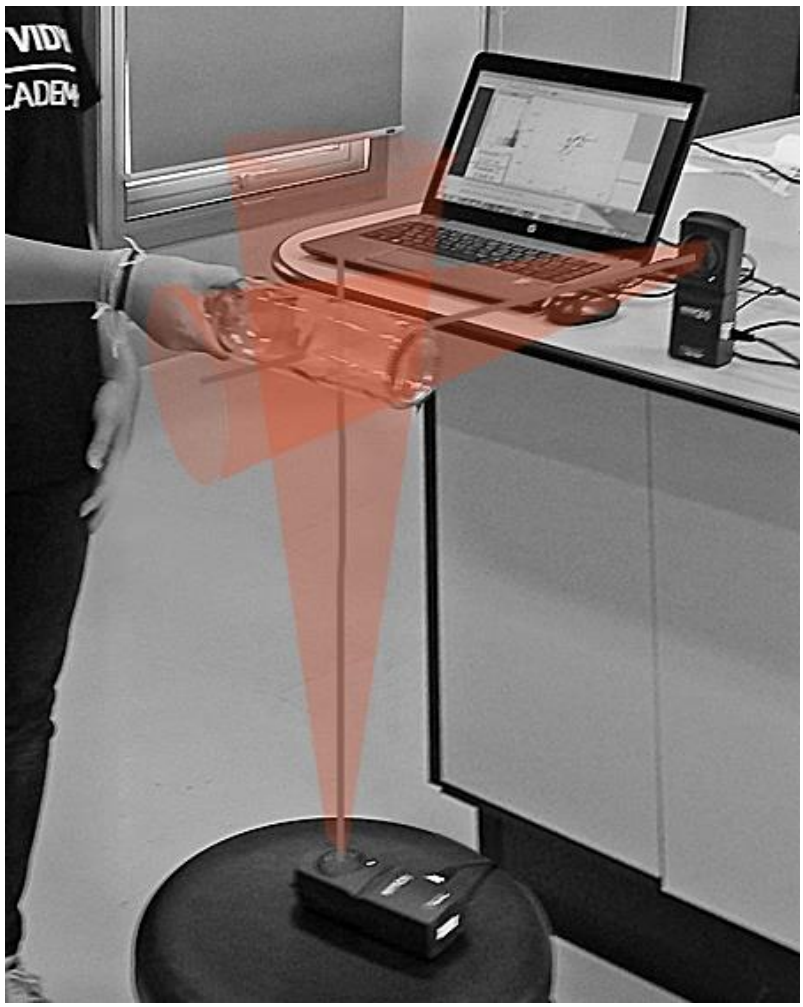


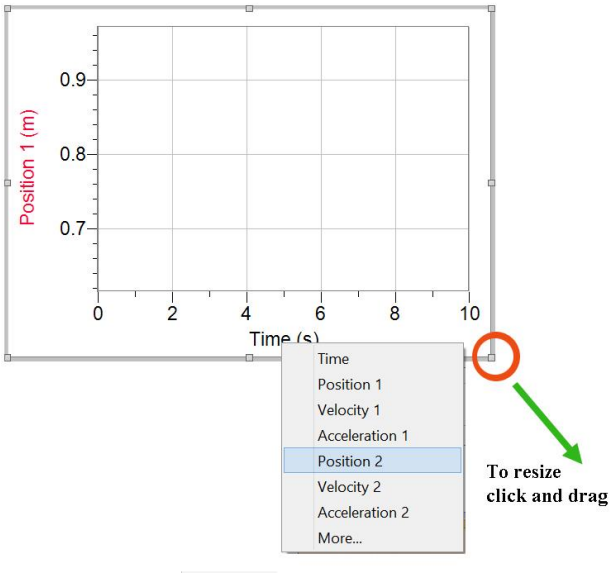
Fig 1 – the motion detectors record *x* and *y* position/time data for the hand-held bottle.

A person tries to hold the bottle perfectly still in the "detection cones" while position/time data are plotted in Logger Pro. (*Watch the bottle, not the monitor*.)

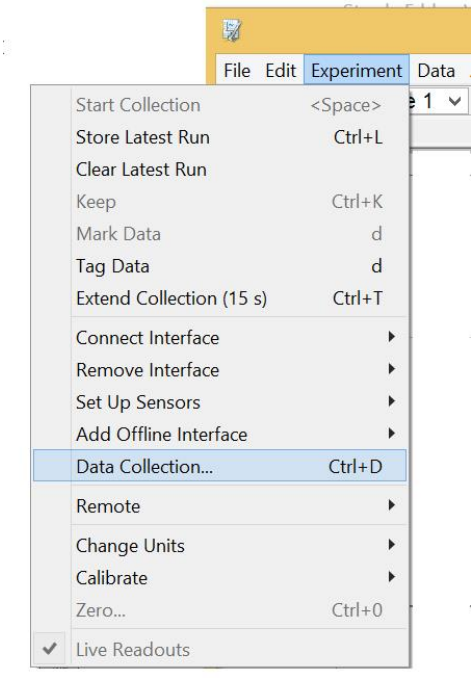
You may follow these instructions

1 Connect two motion detectors to the Lab interface. The plugs will only fit in the right places on the Lab Pro. Connect the Lab Pro to the computer with the USB cord. Open Logger Pro.

2 Resize the position/time graph on the monitor. *Left-click* on the time axis label. Change Time to Position 2.

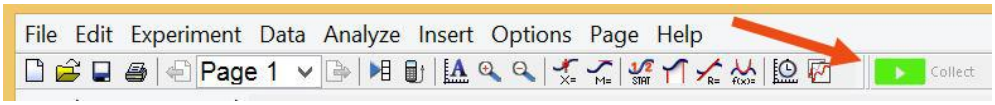


3 Go to *Data Collection* in the *Experiment* menu and open the data collection panel (not shown).

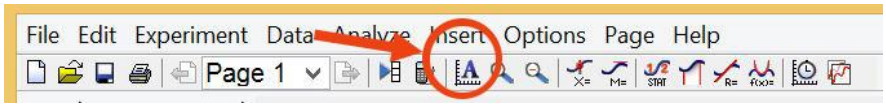


Set the data rate (to 30/s) and the recording time (to 10 s).

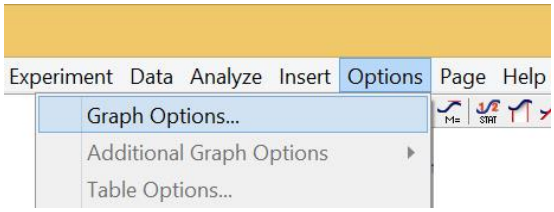
4 Hold the bottle steady, *look at the end of the bottle and a distant marker.* Ask your partner to click the bright green *Collect* button.



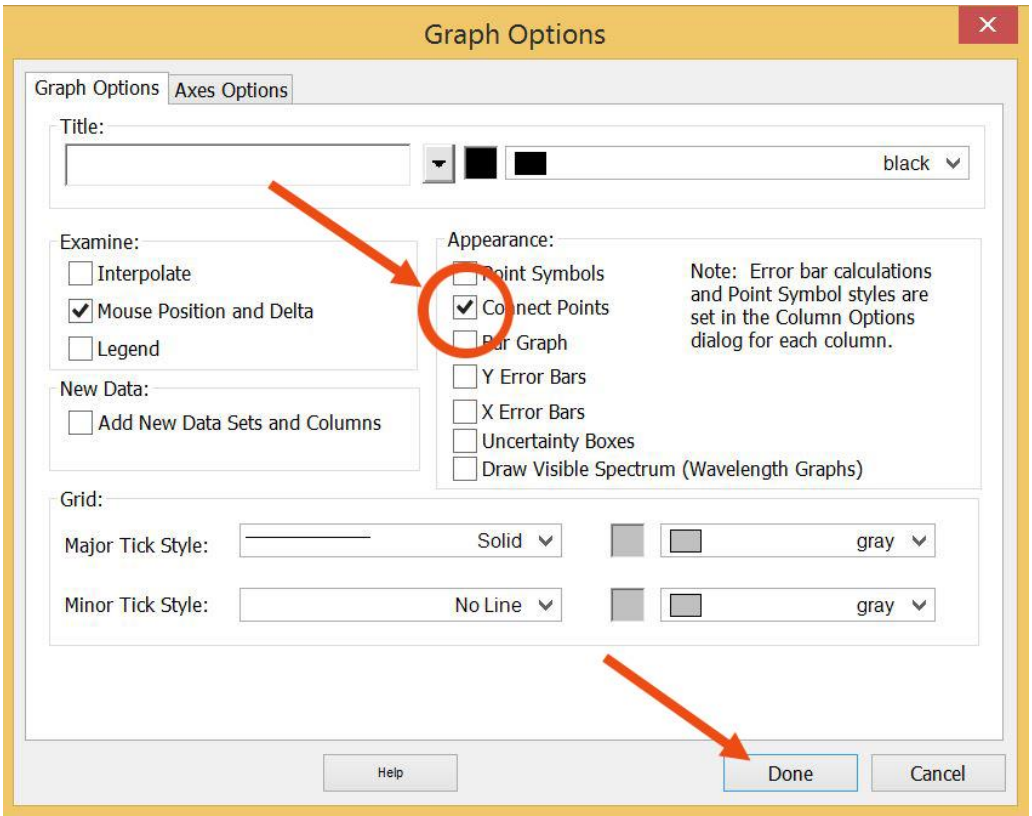
5 When collection has stopped hit Autoscale.



6 Go to *Options* to open the *Graph Options* window.

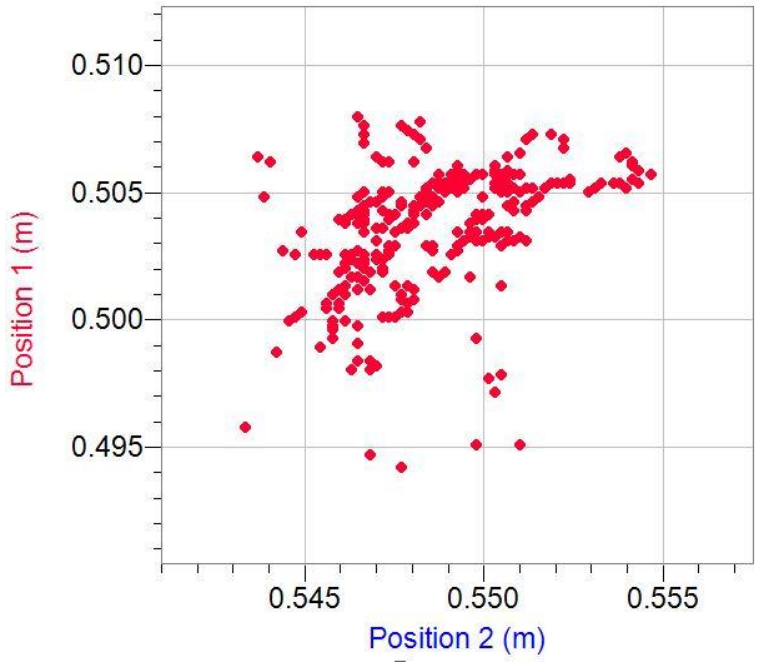


7 To turn off connecting lines by *left-clicking* on the tick.



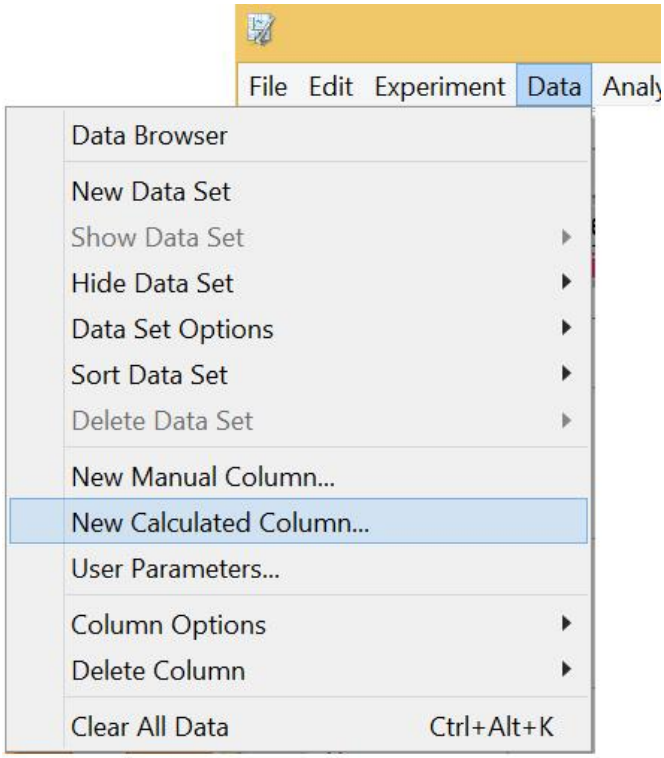
Click Done

The graph now looks like this ….

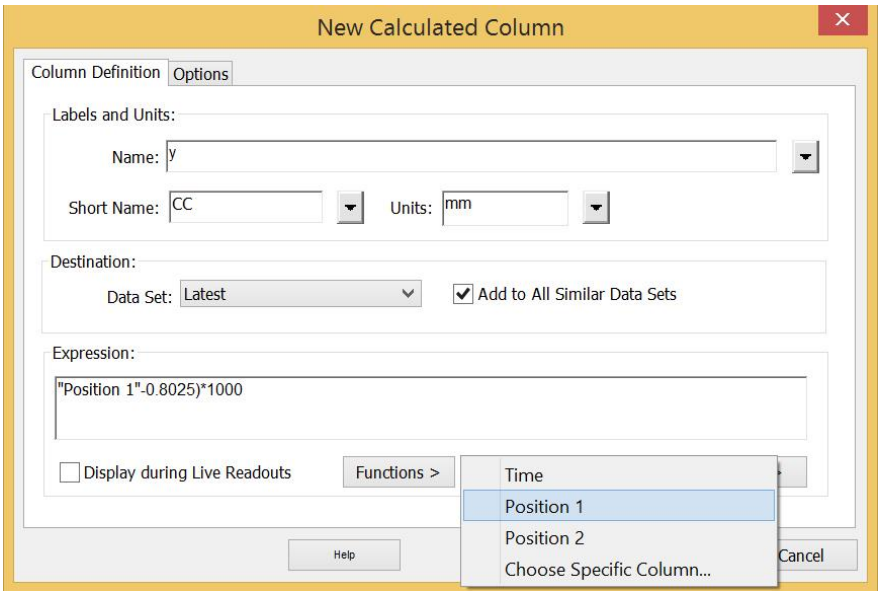


Graph 1 – Data points without connecting lines.

8 To set the zero near the centre of the dots and to change the scales on the axes to mm go to the *Data* index to open the *New Calculated Column* panel.

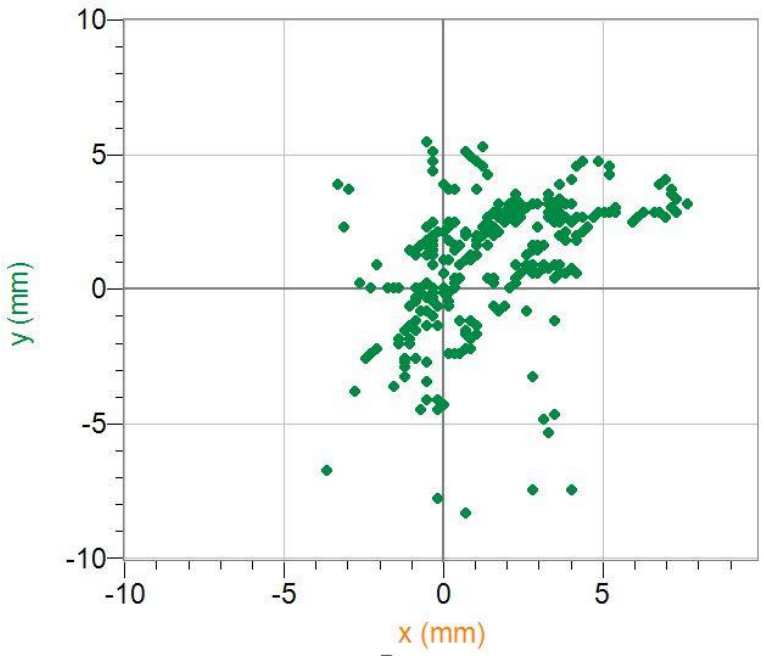


9 In the New Calculated Column panel below change the labels and units and type the calculation wanted into the *Expression panel*. **Note:** *Position 1* must be entered from the *Functions menu* as shown.



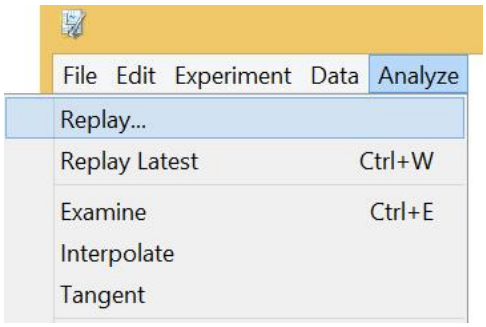
The equation in the expression panel above is missing an opening bracket. The program will tell you when you make a mistake like this.

10 Make a second *New Calculated Column* for x from Position 2. Left click on the Axis labels in Graph 1 and change them to x and y. Your graph will now look like this …



Graph 2 – Graph 1 with more appropriate scales on the axes.

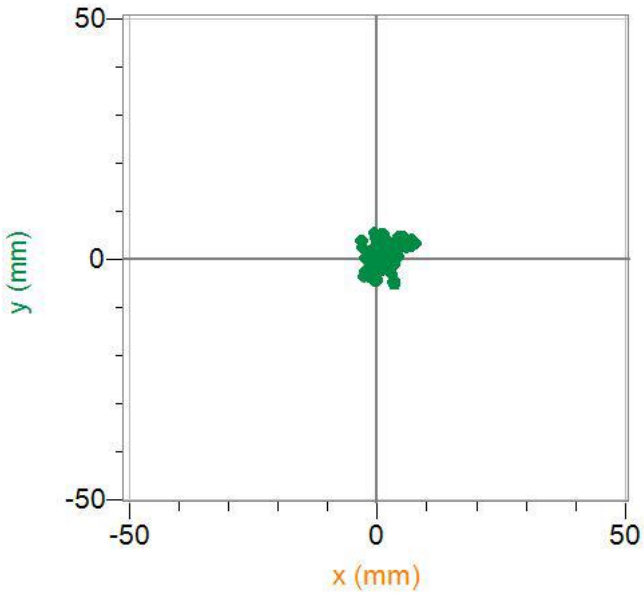
12 Go to the *Analyze* menu and open the *Replay* panel (not shown).



Watch the replay and note the difference between *shake* and *drift*.

A Scientist never publishes a first attempt at data collection with new equipment. Repeat the measurement. Next time, watch the end of the bottle very carefully and try to reduce drift to leave only the effect of shaking. Everyone shakes. You will not be able to hold the bottle perfectly still. Stand back, extend your arm and try to hold the bottle as steady as possible. ***Do not put your arm on a desk or try to hold your elbow against your body.***

13 Repeat the measurement. Insert a second graph scaled as shown below so you can find the starting position. Have your partner hit the green *collect button* again. If the starting point is the same the detailed shake graph will be zeroed without you having to do any adjustments.



14 Save your Logger pro file. Close the program. **Change places.** Give your partner the bottle and open a new Logger Pro. All students must do both jobs. Before next lesson everyone is to learn to do the things above with Logger Pro. There is more to come. Get this right first.

15 HOMEWORK: Hand in a printed graph (Graph 2) with your data with your name on it.

Ten questions

1 With what accuracy can a bat find the distance to a flying mosquito in complete darkness?

2 How many connection cables are required for these measurements?

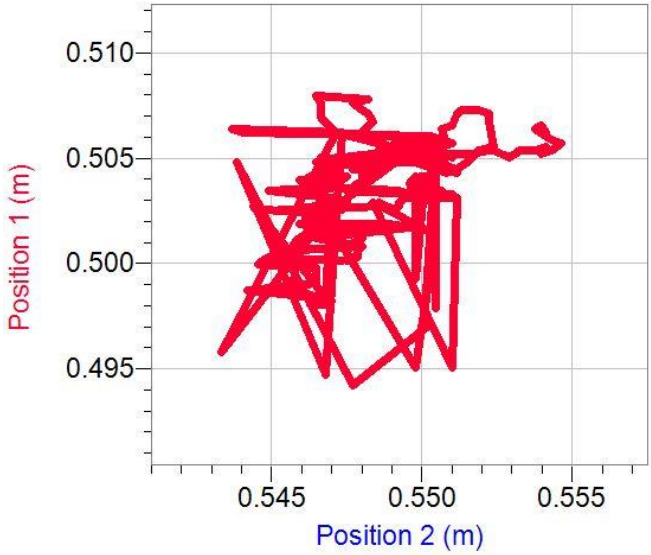
3 Why is it very important to put the cables back in the boxes when you are finished?

4 What is meant on page 1 by a "detection cone"?

5 How do you resize a graph on the monitor screen?

6 Where is the *Autoscale* button on the Logger Pro screen?

7 If your graph looks like this with lines, what do you do next?



8 In instruction **12**, what does the writer say a scientist never does?

9 In instruction **12**, in what menu do you find *replay*?

10 In instruction **12** what is meant by '*shake*' and '*drift*'?

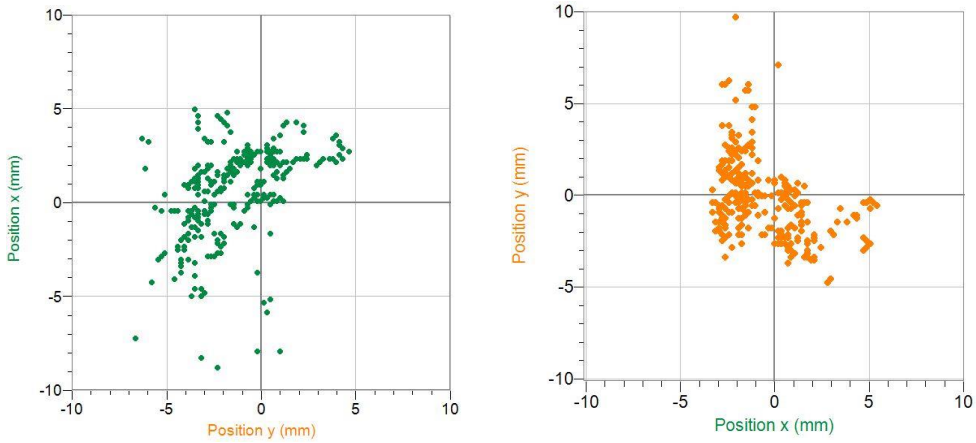
Project suggestions

The first task is to learn how to use the equipment we have. The next task is to think about what you could do with it.

I have some questions.

1 Is hand-shake related to age?

I have two data sets. The green set was made by a student who is 16. The orange set was made by her instructor who is 72. Are they the same within errors? If so, is that surprising?



Would it be interesting to test sets of subjects who were 5, 15, 25, 50 and 75? Is there a difference between males and females in these age groups? Would this project be physics or something else?

2 Is hand-shake affected by drugs? Sugar, caffeine, alcohol, (other things)?

Caffeine and sugar are in tea and coffee and Coke. What is in Diet Coke to replace the sugar?

Would it be interesting to test sets of subjects who were of different ages? Is there a difference between males and females in these age groups? Would this project be physics or something else?

3 Would a hand-shake test be one way to find the early symptoms of Parkinson's disease, or some other medical conditions that might respond to early treatment?

Would it be worth talking to medial people about this?

I don't know the answers to any of these questions. That is the nature of science. To ask questions to which there are, right now, no answers.