Using the Logbook Force sensor

The instructions in this paper are designed to show:

- How to set up and use a Force Sensor.
- How to set up some simple investigations using a Force Sensor, Datadisc and a Logbook Datalogger.

Setting Up The Force Sensor

Before the using the Force Sensor, it will be useful to familiarise yourself with the features which make this such a versatile sensor:

- ❖ <u>Please note that the normal maximum working load of the sensor is 50 Newtons, and that any force greater than 100 Newtons will **irreparably** damage the sensor. To give you a gauge, a ping pong ball, dropped from 10 cms generates an impact force equal to around 10 Newtons (a bag of sugar equivalent weight force – try the experiment described below).</u>

- ✓ The Force Sensor has a default zero position, which allows for ± 50 Newtons to be applied to the sensor.

- ✓ After a force has been applied the sensor can be re-zeroed using the zero button on the sensor case. The sensor is designed to measure dynamic forces and the zero point can change slightly between recordings. Static recordings should be carried out using the Force Meter (S1800).

- ✓ Connect the Force Sensor to a Logbook datalogger and start Datadisc. Select the meter window from the toolbar or the 'measure' menu. If you need assistance Setting-up a Logbook Datalogger, see the Teachers' Guide.

- ✓ The buttons in the Meter of Datadisc Pt allow the sensor to have 9.8N set to allow calibration if needed, using a 1Kg mass, and for the values from the sensor to be inverted.

- ✓ There is a threaded stud on the sensor onto which you can screw a small platform adapter or a hook adapter.

- ✓ The hole on the sensor allows a Clamping Stud to be screwed in place and the sensor attached to a stand boss.

- ✓ With the platform adapter attached the Force sensor can be used to measure such forces as the impact force of a small object striking the platform.

- ✓ With a hook attached the Force sensor can be used as a to measure the forces acting in a spring system.

Investigating Damping In A Spring System

1. Arrange the Logbook force sensor on a retort stand and clamp, and attach both springs provided with the Force Sensor accessory kit, connected in line, to a mass of around 500g.

2. Connect the Force Sensor to a Logbook Datalogger or similar interface, and then to Datadisc Pt.

3. Open the Meter in Datadisc, set zero, using the zero button on the Force Sensor, and then move the meter window to the side of the screen and reduce the window's size so that it is visible at the side of the viewing area.

4. Then start the 'record' dialogue from 'measure', check 'choose interval and number of points', set the interval to 10 milliseconds, and press 'Go' (meter will disappear temporarily).

5. Hold the mass up and use to meter window to ensure the same force is applied at the start of each investigation.

6. Then press the green button and release the mass immediately, and smoothly.

7. When you have achieved a suitably good recording, save it and then repeat the recording with a large piece of card inserted in between the masses, in order to damp the system.

Undamped

Damped
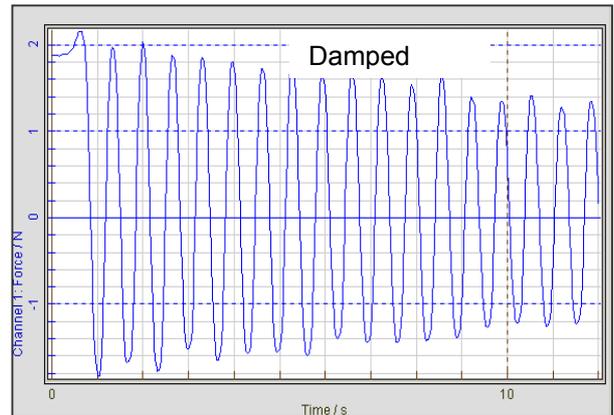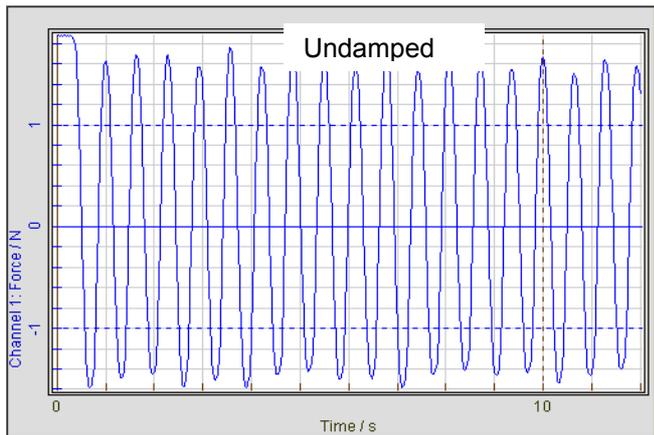
8. You can see the effect of damping in this way, and by using the 'Graph→Cursor→Spot' you can find the values of force in the two systems after some time

Analysis of spring system results

By using the 'data→calculate→Spectrum analysis' function it is possible to find the resonant frequency of the system.

Investigating Impact Forces Of A Ping Pong Ball

1. Attach the platform adapter to the Force Sensor, connect that to a Fast* Logbook Datalogger, or similar interface**, and connect the Datalogger to a computer with Datadisc.
2. Select 'measure→fast', check the 'Chan(s) | trig' on the channel used.
3. Select 'Pre-trigger 96pts' and then press the green record button.
4. Now drop a tennis ball onto the platform from around 25 cm. The recording produced will show the impact force on the sensor, followed by the reaction from the sensor to that force. Then repeat the recording but drop from 12 cm. Below is a recording made in this way. The red graph is from 25 cm and shows an impact around 34 N whilst that from 12 cm gives around 21.6N, as shown by the spot cursor.

*Logbook XD, ML, UL, WL. **CL 200, CL 50.

Tennis Ball on Platter from 25 and 12cm
Force: 21.6 N | Time: 1.8 ms