Lab # 3 - Appendix B

Servo Module Interface

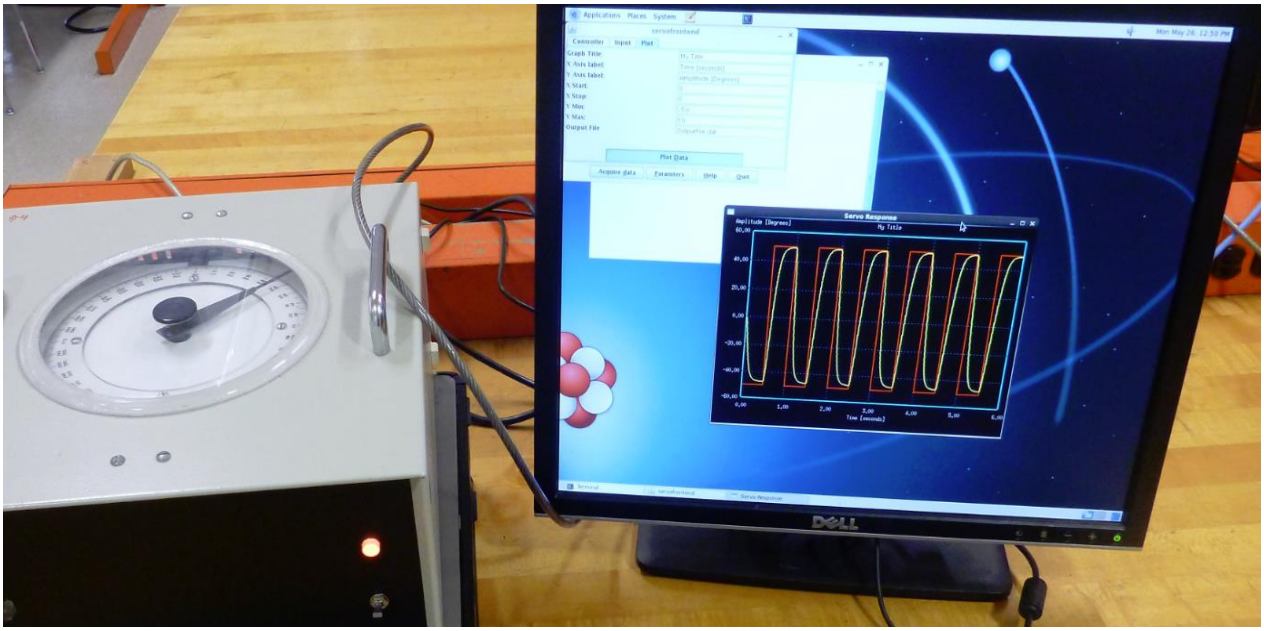

Figure 1: Servo Module in the Control Systems Lab

NOTE: This document was prepared with help of Mr. Jason Naughton, MA.Sc., Lead Engineer, and Mr. Nripendra Malhotra, B.Eng., Technical Support, in the Department of Electrical, Computer & Biomedical Engineering, It was last updated in January 2019.

The program activating the Servo is menu-driven and user-friendly. The lab setup in ENG413 is designed to control the servo motor using different controllers. The setup is used by students in ELE639 as well as in fourth year Control elective courses. Under the applications menu there is an ENG413 Controls menu which contains several options – see the screenshot in Figure 2.

To access the servo, the third year students will run the program "**Servo Desktop**". This program was upgraded in September 2018, and it now has the ability to plot much easier and gives zooming functionality. The interaction with the motor set has become simpler. Students no longer need to hit a reset button between simulations. There are two lights on the motor set now. One light

indicates power and the second one indicates whether the motor is ready to be controlled. When the later light is off it means that the motor is ready.

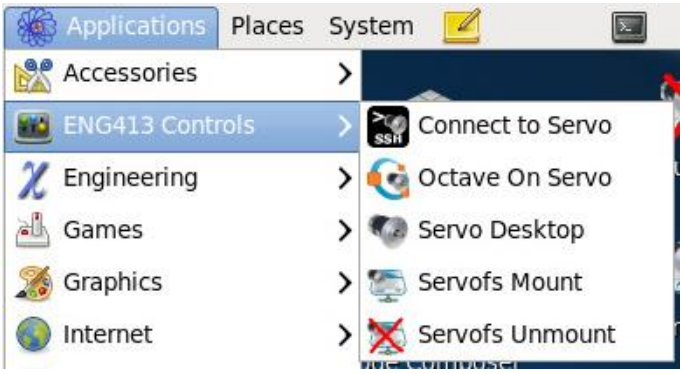

Figure 2: Desktop Menu in the Control Systems Lab

The two controllers used in ELE639 are PID (Proportional Integral Derivative) and Lead-Lag. Different parameters are used to control and maintain stability, overshoot, rise time, etc.

Servofrontend is a program which provides a front-end GUI for the students for easy control design. It is designed so that students have more time understanding the concept of PID and Lead-Lag rather than spending time on actually implementing controllers in ELE639.

The servo motor and the **servofrontend** is used only if the students want data from the motor or want to compare results of the motor to the simulated results. The following section provides a detailed description of **servofrontend** program and of different controllers and its parameters, waveforms and its parameters and plotting of the data.

TIP: It is strongly recommended that a subdirectory is used for all the work because there will be different data files which will be generated using different parameters.

GUI Servofrontend has three tabs, i.e. Controller, Input and Plot, as shown in Figure 3.

The **Controller** tab is used for selecting different controllers, as shown in Figure 3. The **Input** tab is used for selecting different input waveforms. Options are shown in
Figure *4*. The following waveforms are available: Step, Sine, Square, Ramp, Pulse and From File.

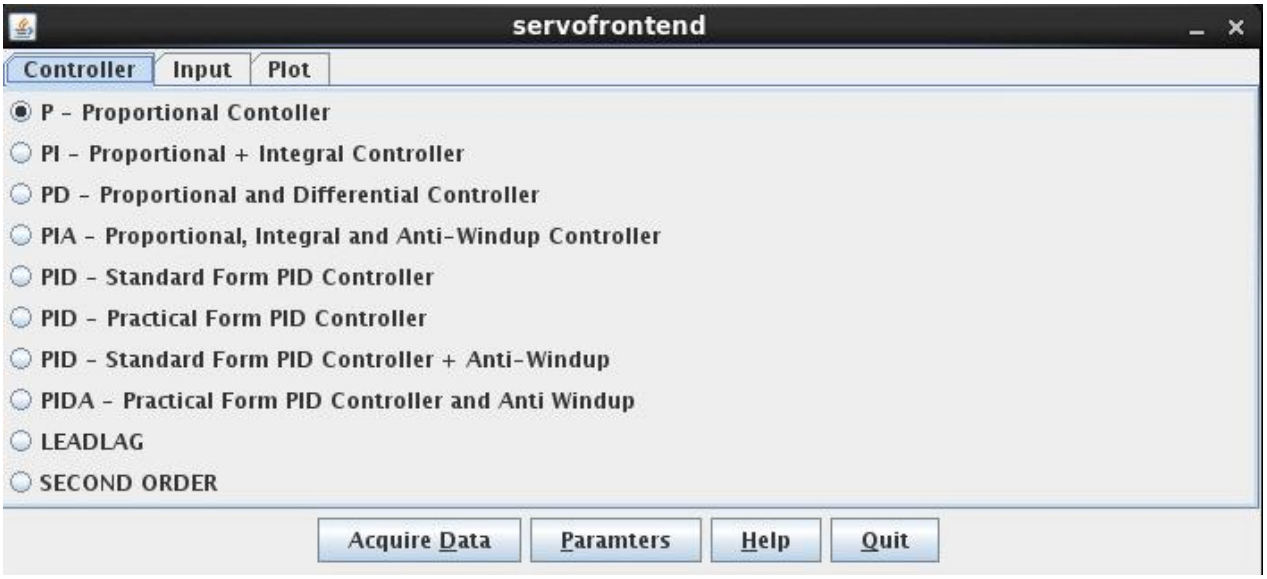

Figure 3: Servofrontend User Interface

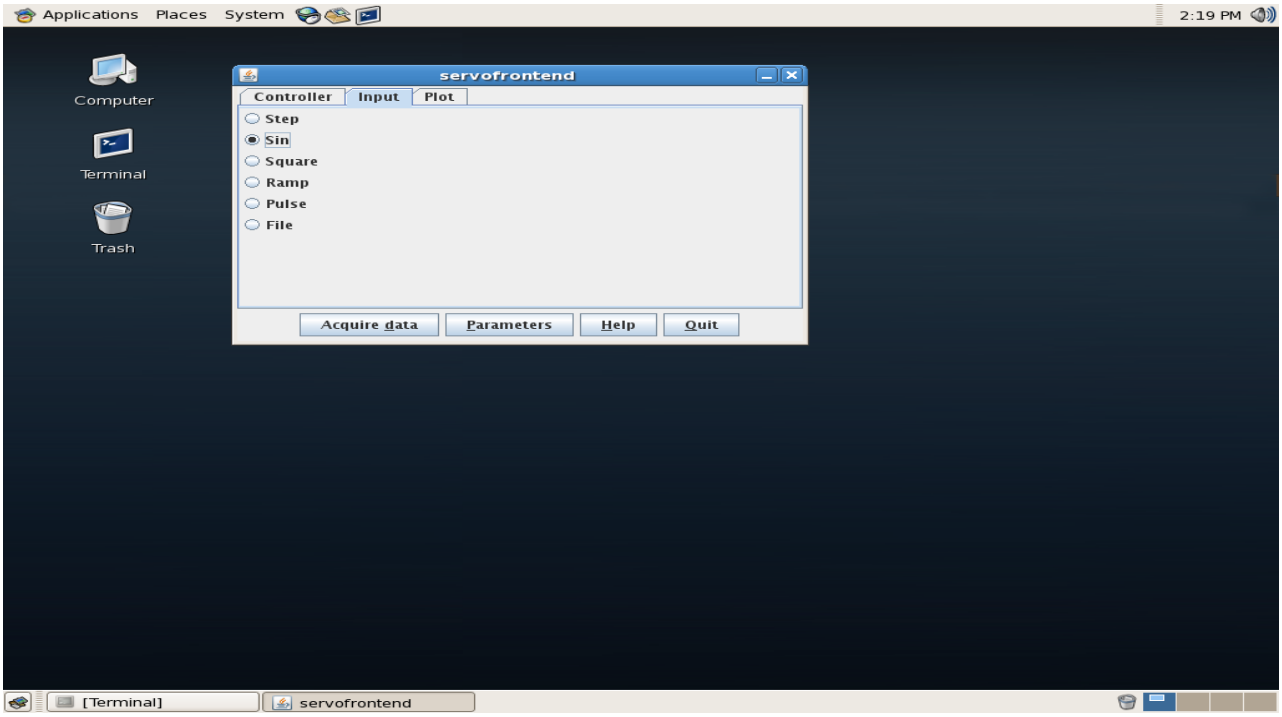

Figure 4: Input Tab

From File option for **Input** is used when either a random input (like noise input), or the input specifically designed by the user (like a detailed trajectory to be followed) is to be used for the controller. The trajectory can be designed in MATLAB, written out as an ASCII file and imported into the servo. Once the Controller and the Input are selected, click on **Parameters** and open another window with parameters. For example **Controller: P** and **Input: sin** will show the window

with P (controller) and Peak amplitude, frequency, phase shift, sampling time (Input) and the name of the ASCII output file at the bottom left, as shown in
Figure 5.

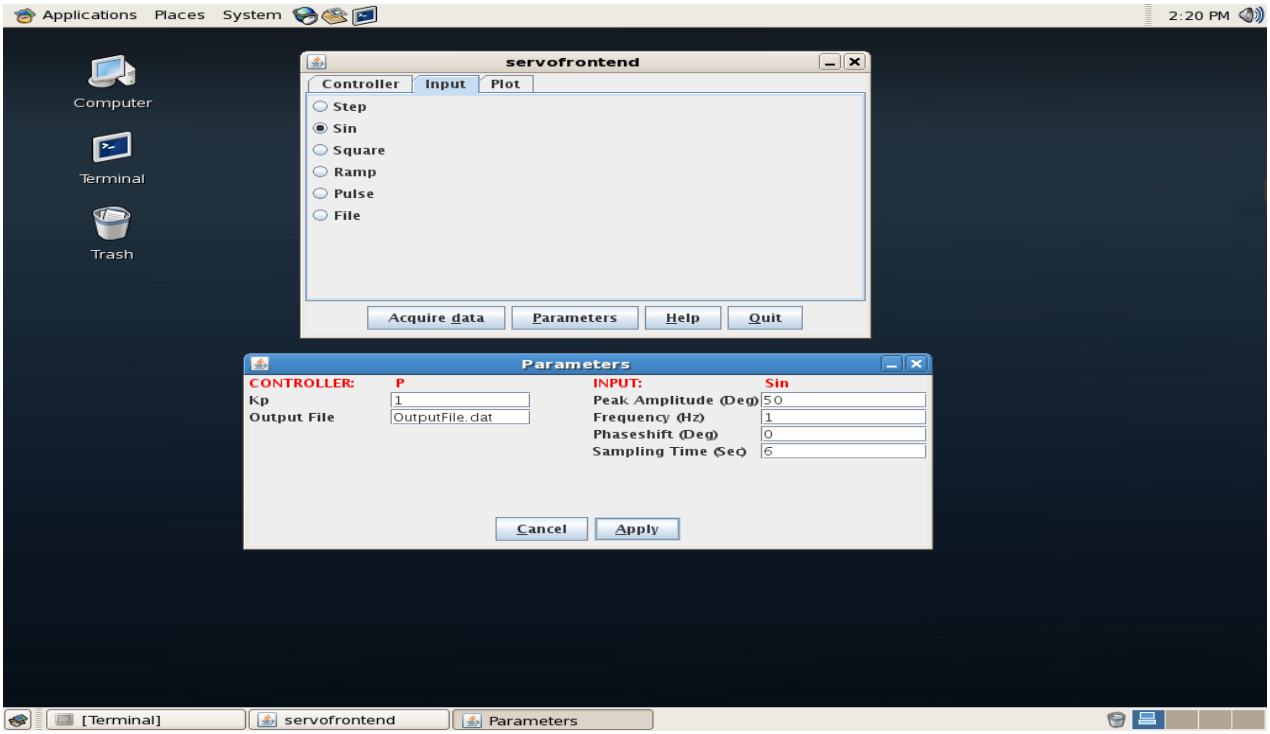

Figure 5: Parameters Interface

These parameters are assigned values and can be changed just by clicking on the empty space and using backspace. The output file name is specified to store the data acquired from the DSP board in an ASCII file, which can then be imported into MATLAB/Simulink. The screen capture in Figure 6 shows what such a file looks like. Note that if the fields are not correctly filled i.e. if a letter is written in it, the program will prompt for a correct input, and if the field is left empty, a default value is assigned to the parameter. Once the fields are completed, click **Apply** and window will disappear.

Click on **Acquire Data** and another window will pop up which will show the correct inputs of all the fields, as shown in Figure 7. To start the servomotor, press **Run.** There are two lights on the motor set. One light indicates power and the second one indicates whether the motor is ready to be controlled. When the later light is off it means that the motor is ready. The final, third tab, **Plot**, is used for plotting the data gathered from the motor, and is shown in
Figure *8*. Different options are: Title, Label for X-axis (eg. Time (sec)), Label for Y-axis (eg. Degrees), X axis start (begining Time), X axis stop (end time), Minimum amplitude, and Maximum amplitude. The collected data is displayed by the GUI clicking on **Plot Data** in the **Plot** tab window. This will display data, as shown in an example in
Figure *9*.

Note the display is shown in reverse colours, as Simulink Scope plots are on black background, and as such, impractical to print. This menu can also be used to zoom in at a certain area. **X**(start/stop) is for time and **Y**(min/max) for the amplitude. If inputs need changes then click **Cancel** and repeat the process for the parameters. For help on controllers and its parameter click on **Help**. To quit program, click **Quit**. Some other quick tips:

- Acquire Data: Alt d, Parameters: Alt p, Help: Alt h, Quit: Alt q
- For parameter window: Apply: Alt a, Cancel: Alt c
- Correct panel window for parameter: Run: Alt r, Cancel: Alt c

```
gosha@winnipeg: ~/servo_stuff$ more OutputFile.dat
0.000000        0.872620        0.081759
0.002000        1.500758        0.081759
0.004000        2.128658        0.081759
0.006000        2.756223        0.081759
0.008000        3.383351        0.081759
0.010000        4.009946        0.081759
0.012000        4.635908        0.102198
0.014000        5.261138        0.102198
0.016000        5.885536        0.143078
0.018000        6.509006        0.143078
0.020000        7.131447        0.163517
0.022000        7.752762        0.204397
0.024000        8.372853        0.245276
0.026000        8.991623        0.286156
0.028000        9.608971        0.347475
0.030000        10.224803       0.347475
0.032000        10.839021       0.429233
0.034000        11.451526       0.510992
0.036000        12.062223       0.592751
0.038000        12.671016       0.694949
0.040000        13.277807       0.817587
0.042000        13.882501       0.817587
--More--(0%)
```

Figure 6: Screen Capture of Output File

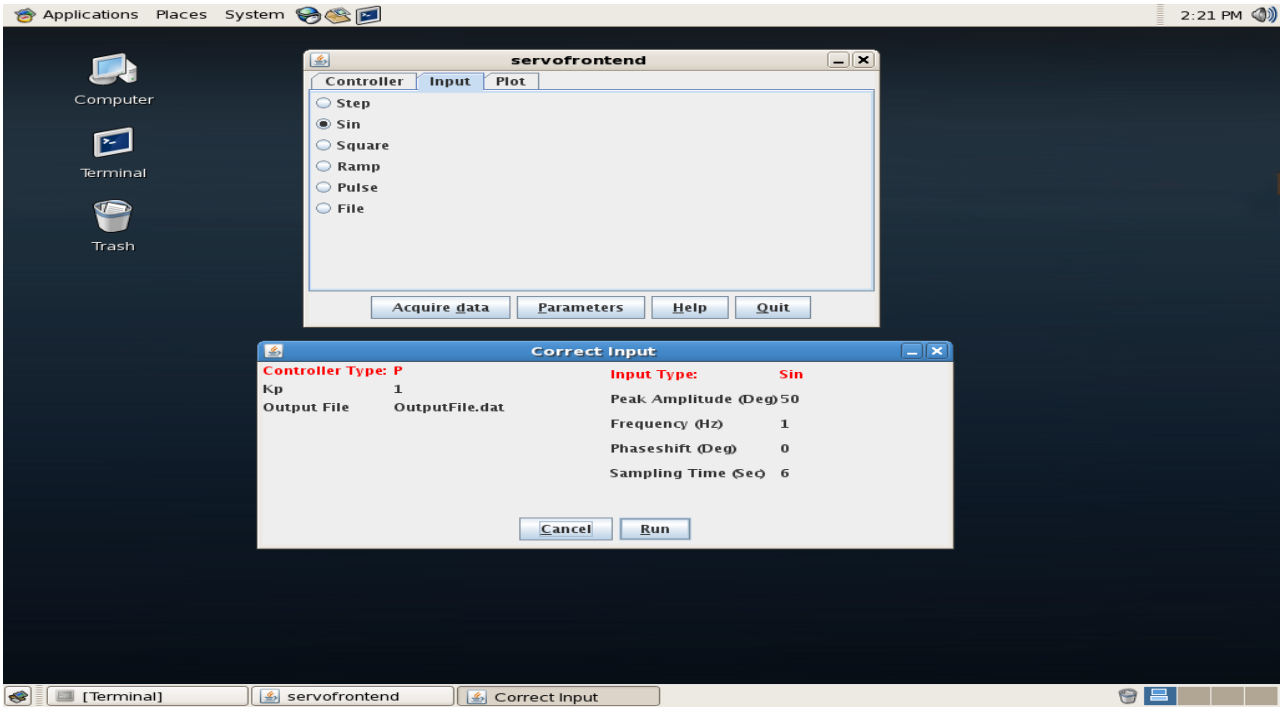

Figure 7: Simulation Parameters

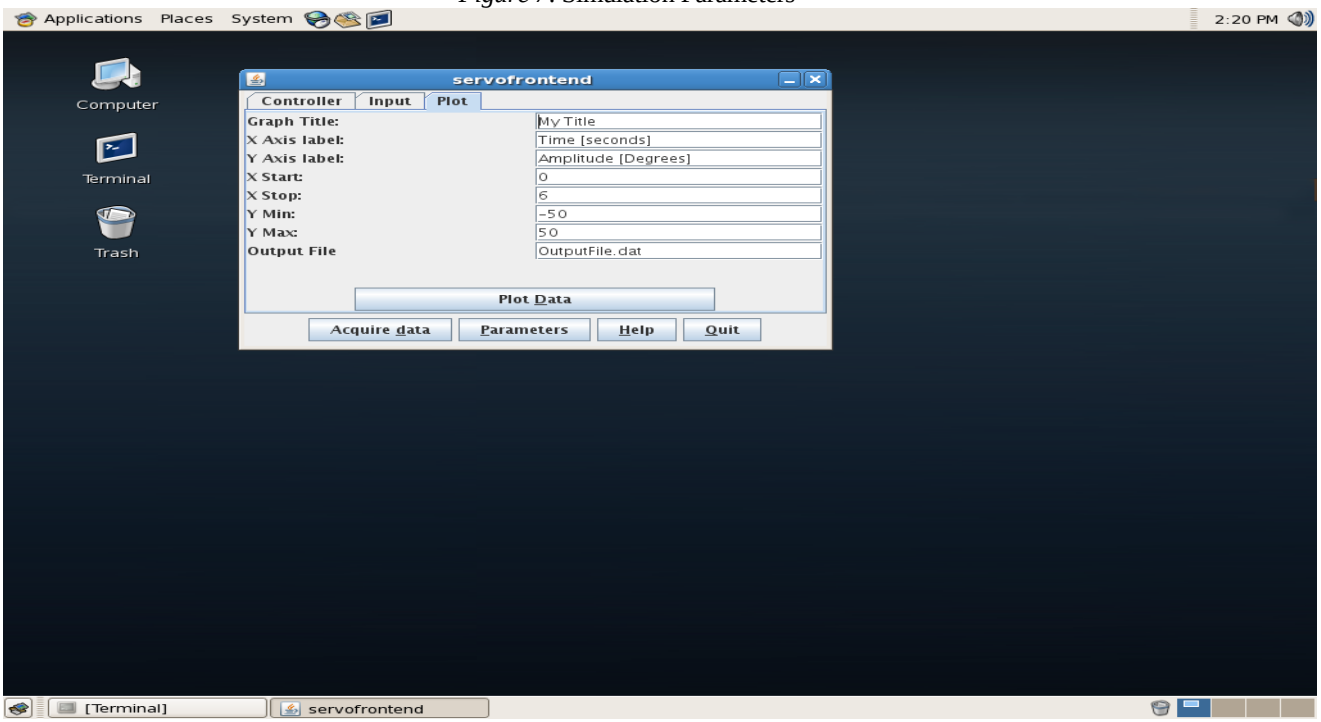

Figure 8: Options of Plot Tab

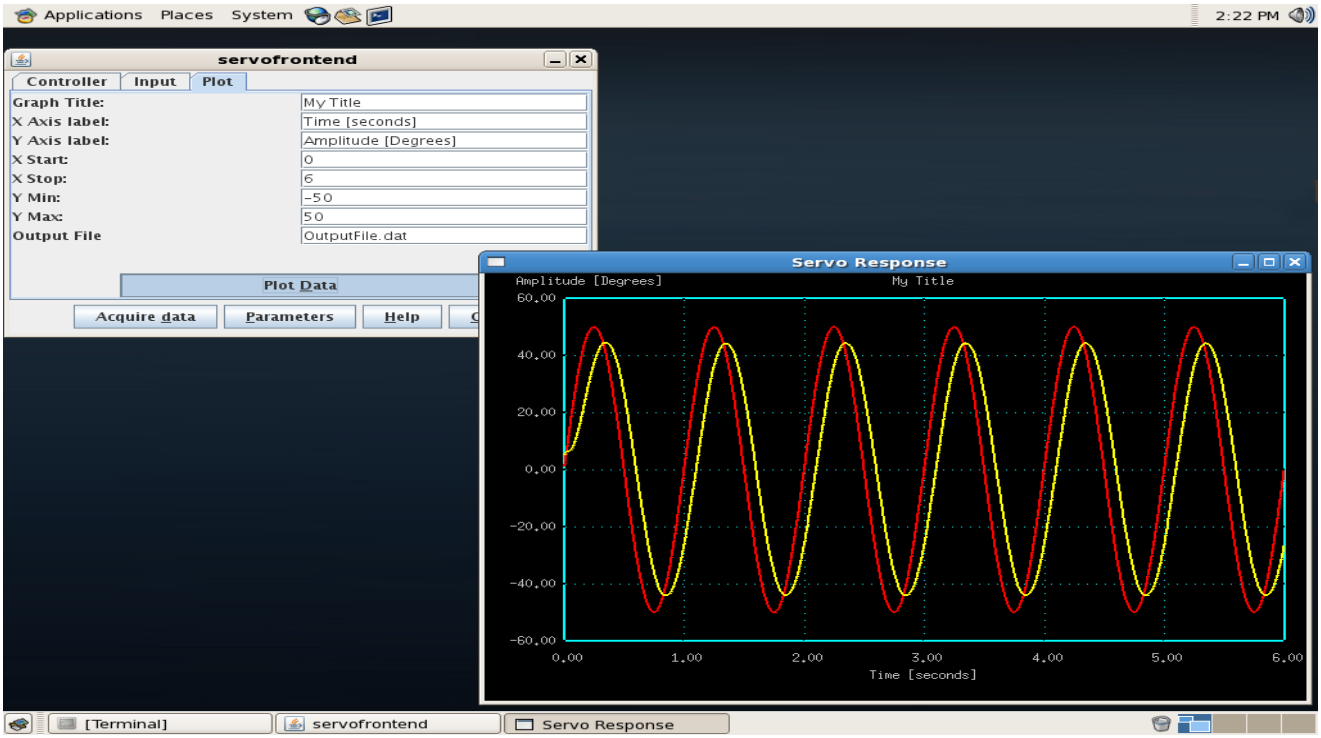

Figure 9: Example of Data Display