Numerical Differentiation and Integration MATLAB EXE GUI

INTRODUCTION

This GUI allows the user to explore numerical integration and differentiation and how it is affected by corrupting factors present in the data.

The sample signal used is a damped sine wave as shown in Fig. 1.

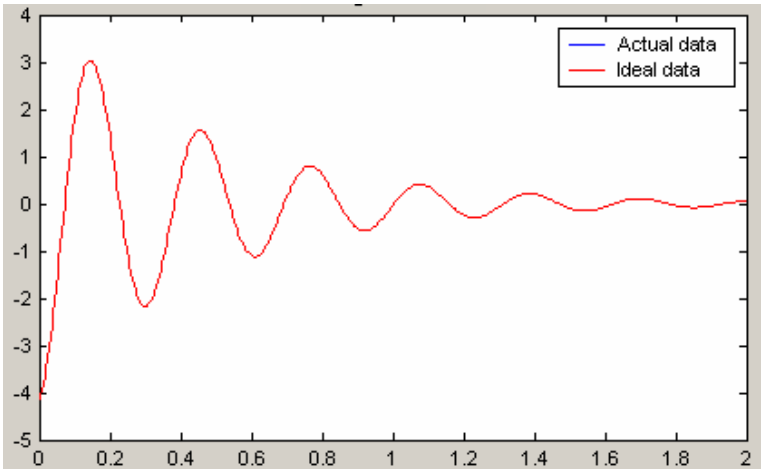

Fig. 1. Damped sine wave.

This is a common result that could be obtained from a simple dynamic test. To this signal, various factors such as bias, drift, random noise, and sinusoidal noise can be added using the GUI. This modified signal can then be integrated and differentiated, and the result compared to the "ideal" result.

FILES NEEDED TO RUN INTEGRATION-DIFFERENTIATION GUI

int_diff.exe
int_diff_data.xls
int_diff.ctf

With the MATLAB Runtime Engine installed, click on int_diff.exe and the GUI will run.

RUNNING THE GUI

With the correct working directory selected in MATLAB, type 'int_diff' at the command prompt to start the GUI. When initially opened, the GUI will appear as shown in Fig. 2.

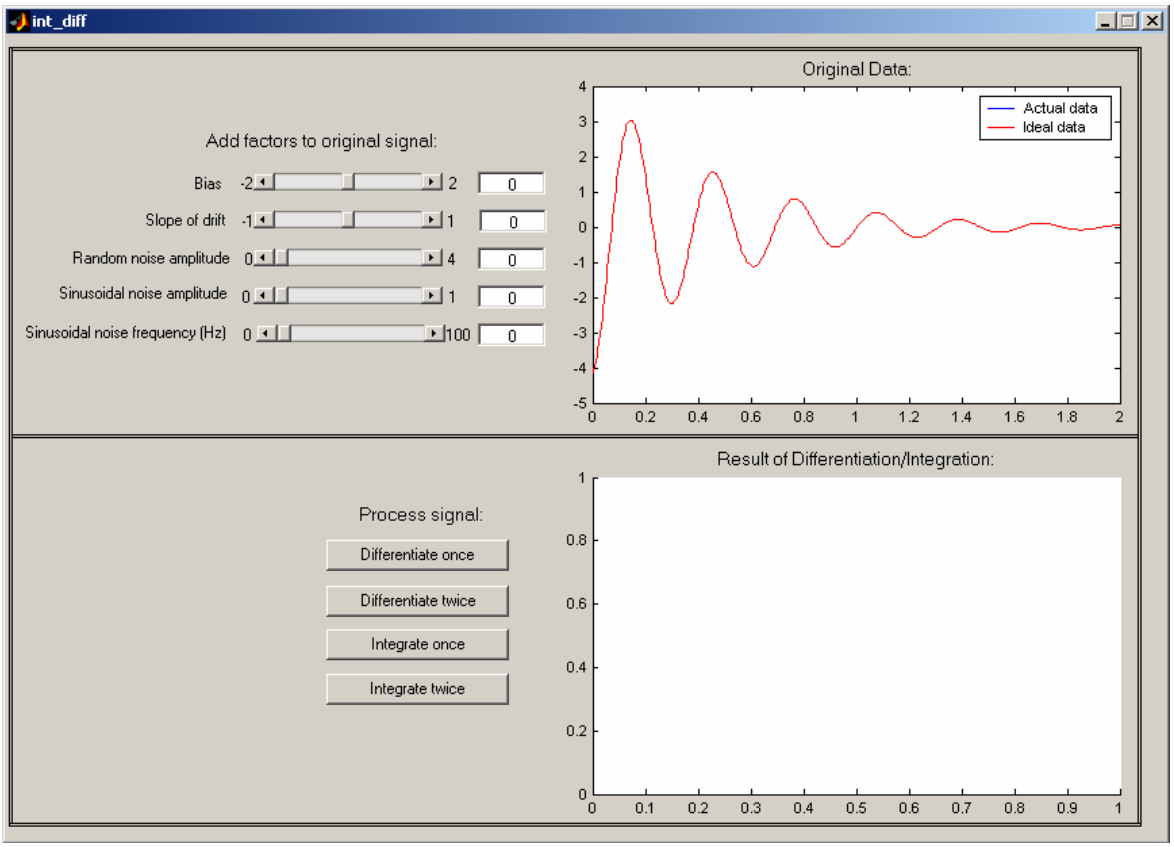

Fig. 2. Integration-differentiation GUI.

The controls in the left portion of the top window, shown in Fig. 3, allow various corrupting factors to be added to the original signal.

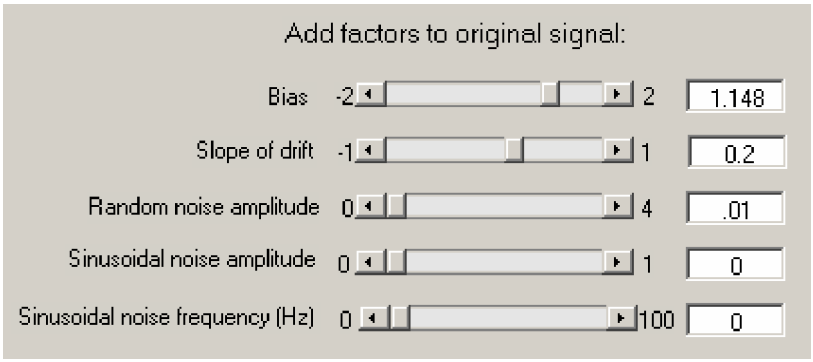

Fig. 3. Controls to add “problems” to the original signal.

The factors which may be added are bias, drift (select the slope), random noise (select amplitude), and sinusoidal noise (select amplitude and frequency). The original “ideal” signal will continue to be seen in red in the top plot, while the "corrupted" data is shown in blue.

PROCESSING THE DATA

In the bottom section of the GUI, buttons can be pressed to differentiate and integrate the signals from the top window, as shown in Fig. 4.

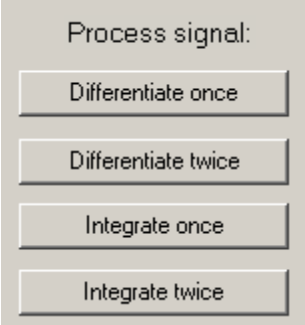

Fig. 4. Buttons to process data.

The data is differentiated using forward differentiation, or integrated using the trapezoidal rule, and the results for the ideal and corrupted signal are shown on the bottom plot. Again, the result from the ideal signal is in red and the modified signal in blue. Fig. 5 shows an example of this being done—a small amount of random noise has been added to the signal, and the lower plot shows the result when this signal is differentiated twice.

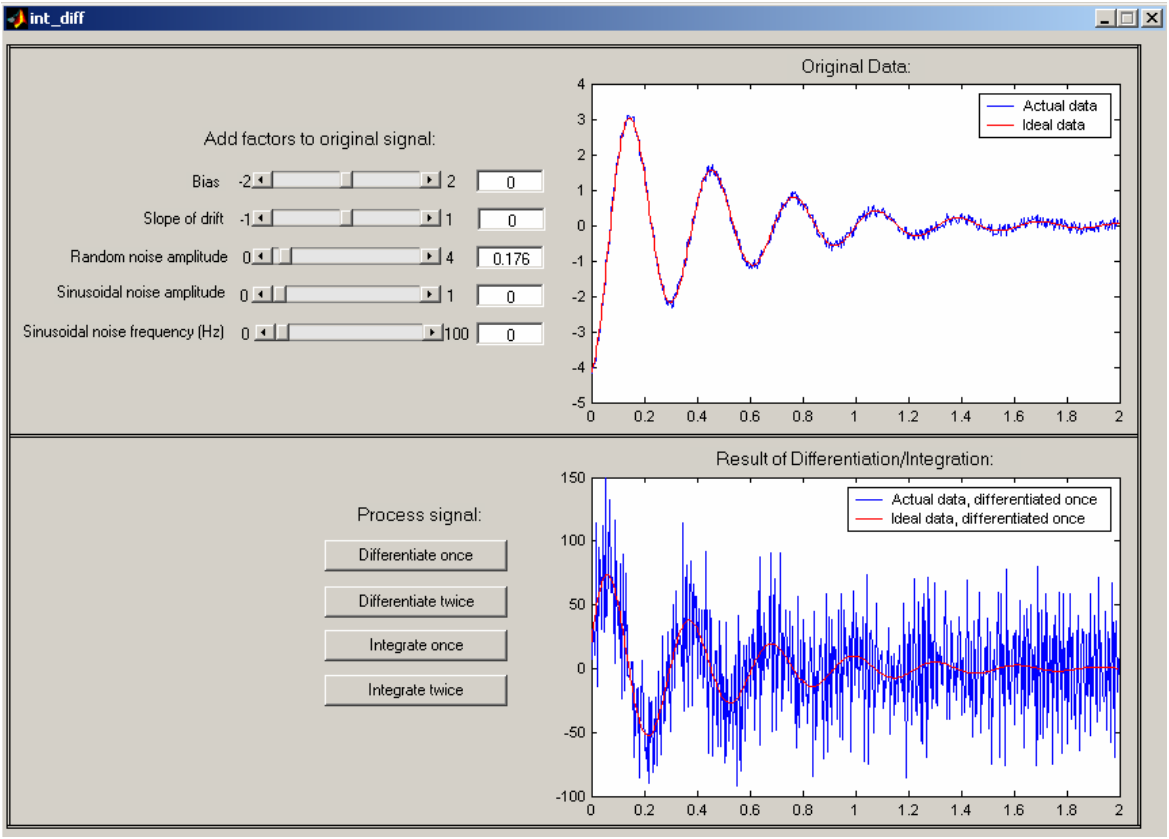

Fig. 5. Differentiating a signal with random noise added.

Note that the integrations and differentiations in all cases are performed on the original signal, rather than the result from the previous operation.