Windowing and Leakage LabVIEW GUI Exercise

INTRODUCTION

This document provides suggested exercises for the Windowing and Leakage GUI with the purpose of furthering the users understanding of the subject.

WINDOWING AND LEAKAGE GUI EXERCISE

Fig. 1. shows the appearance of the GUI when it is first opened. Initially the frequency is 100Hz and no windows are applied.
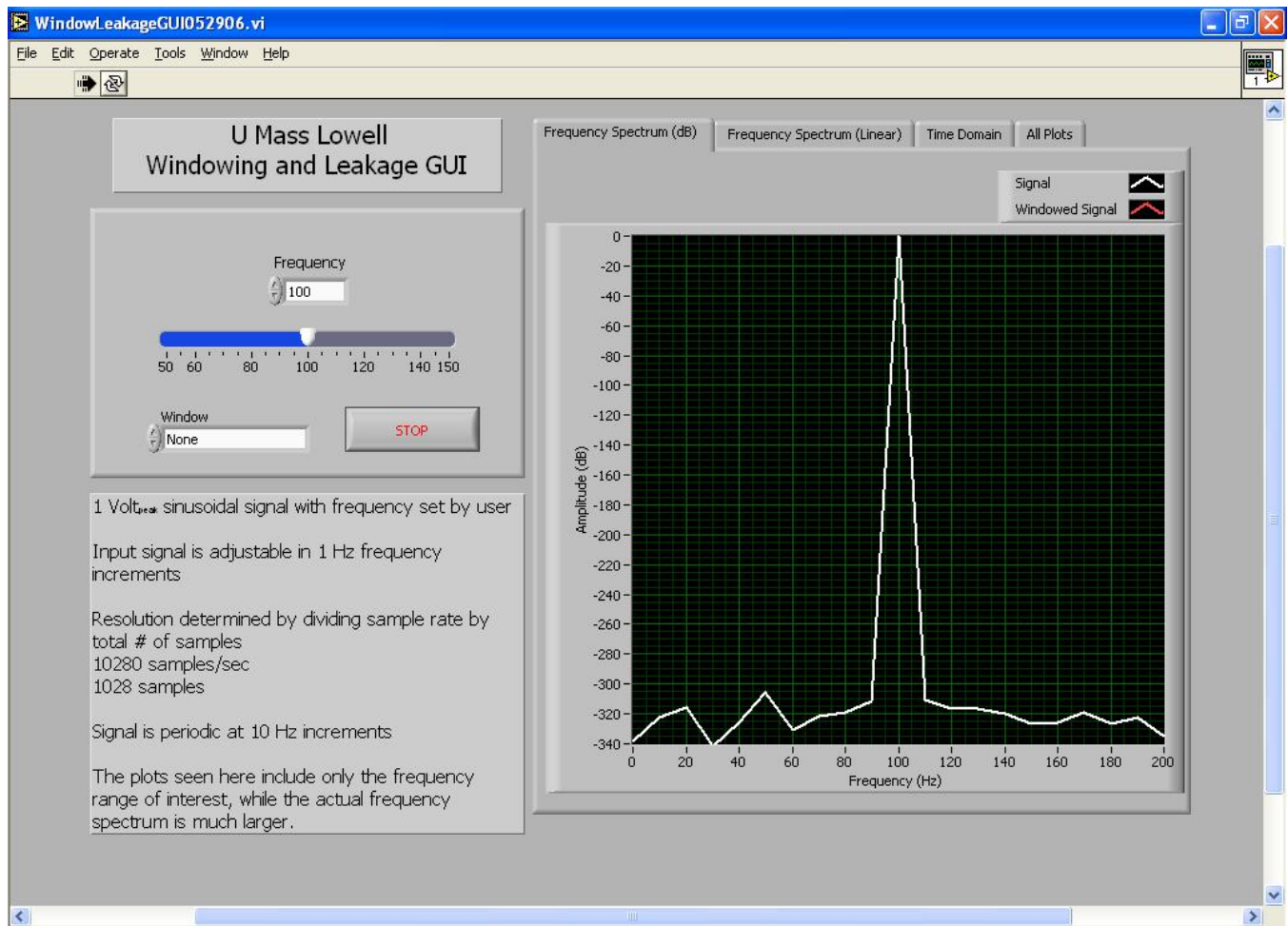

Fig. 1. Windows and Leakage GUI

This GUI takes a 1 V_{peak} sinusoidal input and applies an FFT to represent the signal in the frequency domain.

Vary the input frequency and observe the effect of input frequency on the representation of the signal's amplitude and frequency content. Notice that the signal is periodic in 10 Hz increments. Set the

frequency to 95Hz and apply a Hanning window. Observe how the window helps preserve the amplitude of the signal. Notice the difference in information representation by switching between the decibel and linear plots.

Go to the time domain plot and observe how the window physically alters the time domain sample before the FFT is performed. Adjust the frequency so that it is periodic (for example 100 Hz) and notice how the sample is periodic in the time domain i.e. the sine wave starts and ends at the same point in the cycle. Also notice how a window weights the start and end of the sample heavily to zero while at the same time increasing the amplitude of the signal in the center so that the average amplitude of the signal is unchanged, however the signal appears more periodic because the start and end of the sample are heavily weighted to zero.

Apply a flat top window and return the frequency to 95 Hz. Select the all plots window and scroll between the flat top and hanning window. Observe how the flat top window preserves amplitude content better than the hanning window but produces reduced frequency resolution.

Be sure to notice the differences between a linear and decibel representation of frequency content i.e. notice that -100 dB and -300dB are both essential zero in the linear frequency domain plot.

Explore the other windows and scroll through the frequencies. Observing the plots to understand how time domain and frequency domain information are related.

There are several salient features in this GUI that the user should develop an understanding of. Windows help preserve information when converting a signal from the time domain to the frequency domain with an FFT if the signal is not periodic. The user should understand the differences between a linear and decibel representation of information. Using the all plots feature, the user should make the connection between time domain information, windowing, and frequency domain representation. The user should also leave with an understanding of the uses of the Flat top and Hanning windows because these are the two most commonly used windows when sampling a constant signal. Other windows are more useful for sampling other types of information but are beyond the scope of this GUI.