LabVIEW Basics

Peter Avitabile, Jeffrey Hodgkins
Mechanical Engineering Department
University of Massachusetts Lowell
LabVIEW

LabVIEW is a data acquisition software package commonly used with hardware acquisition boards.

LabVIEW has many features for data acquisition and processing of either measured data or simulated signals.
LabVIEW – Start Up

LabVIEW will be explored using some simple signals
LabVIEW - Start Up

LabVIEW will be explored using some simple signals

NEW - template selector

or click on arrow for either

NEW, blank vi, or recently accessed
LabVIEW - Blank vi

Two windows appear -

‘Block Diagram’ & ‘Front Panel’
LabVIEW - Front Panel

Right mouse click to open important 'Controls' palette

These include graphical controls, knobs, sliders, text boxes, LEDs, switches, and other specialty items.

NOTE: Sub-categories may be available for each layer.
Right mouse click to open important ‘Functions’ palette

These include acquisition tools, signal analysis, output devices, programming tools, arithmetic operators, and other processing tools

NOTE: Sub-categories may be available for each layer
LabVIEW - HELP - Exists in several forms

HELP -> Show Context HELP

Window reports general use characteristics for each icon the mouse passes over
LabVIEW - HELP - Exists in several forms

WINDOWS -> Show Tools Palette

Extremely useful panel for assigning a specific tool function to the mouse.
LabVIEW - HELP - Exists in several forms

HELP ->

VI, function & how to

Find examples
LabVIEW - Tutorial (Getting Started)

Tutorial Name: ‘Generate, Analyze, and Display’
LabVIEW - Starting Front Panel

Front Panel has a display for output
LabVIEW - Starting Block Diagram

Block Diagram illustrates how system is assembled.

This template is intended for use with the Getting Started manual.

1. Configure the Simulate Signal Express VI by double-clicking it.
2. Configure the Amplitude and Level Measurements Express VI by double-clicking it.

Note that you can also add many more kinds of analysis by using the Express VIs in the Signal Analysis palette.
LabVIEW - Tutorial (Getting Started)

Relationship between Block Diagram and Front Panel

This template is intended for use with the Getting Started manual.

1. Configure the Simulate Signal Express VI by double-clicking it.
2. Configure the Amplitude and Level Measurements Express VI by double-clicking it.

Note that you can also add many more kinds of analysis by using the Express VI in the Signal Analysis palette.
A sine signal is generated using Simulate Signal.

Double click for properties.

Sine at 10 Hz with 1 volt peak and offset at 0.25
Sampling 1024 samples per second and 512 samples
Signals can be interrogated

Amplitude
Level Measurement

Double click for properties

Measurements of DC, RMS, peak, etc can be obtained
LabVIEW – Amplitude and Level Measurements

Operators

These have selectable elements based on desired parameters of interest

Indicators

Are used to export output to the front panel

Many tools available
LabVIEW – Amplitude and Level Measurements

As items are added to each of the Functions, Indicators and Controls, these selected items will appear in the Front Panel and/or Block Diagram.

These need to be wired into the diagram and initial parameters identified.
LabVIEW – Amplitude and Level Measurements

**Controls**

These have selectable elements used for changing parameters of interest

You can change the data range of the control by right-clicking on control and selecting ‘Properties’. Adjust ‘Data Range’ and ‘Scale’ tabs.

Many tools available

**Operators**

These have selectable elements based on desired parameters of interest
LabVIEW - Amplitude and Level Measurements

Add several features such as

Input Box for DC offset of sine wave
Dial for Frequency Controls
Slider for Amplitude
LabVIEW - Amplitude and Level Measurements

Select another output parameter such as DC
Notice RMS is already hooked up but DC needs to be attached to some output device
LabVIEW – Amplitude and Level Measurements

Create a dial to change frequency.

Expand the simulate signal VI by clicking and dragging the gray arrow on the bottom of the icon.

Create control
LabVIEW - Amplitude and Level Measurements

Create a dial to change frequency.

To change to a dial, right-click on control and:

Can change range, scale, precision, etc. by right-clicking on dial, and selecting properties.
LabVIEW - Amplitude and Level Measurements

Create a slider to change amplitude.

Follow the previous steps for creating a dial, only this time do it for the amplitude property of the simulate signal VI.

Also select 'Pointer Slide' instead of 'Dial'

Can change range, scale, precision, etc. by right-clicking on slider, and selecting properties.
Now the time signal can be converted to the frequency domain using the 'Spectral Measurements Block'.

It can be found in:
LabVIEW - FFT Express VI

A parameter window will appear once VI is placed on wire diagram. Here you can set desired output formats, windows, averages, etc.
LabVIEW - FFT Express VI

Wire in the signal to be analyzed, and wire out graph indicators to display amplitude and phase.

From Simulate Signal
LabVIEW - FFT Express VI

The resulting front panel display is:
LabVIEW - Task to be performed

Start a new VI and generate a sine wave with both amplitude and frequency input controls - take the FFT of the sine wave (select the sine wave to satisfy the periodicity requirements of the Fourier Transform)

Generate harmonics of that sine wave to ultimately form a representation of a square wave in both the time and frequency domain

Create a square wave that represents the true time and frequency of the signal for comparison

(Here are a few extra things you’ll need to know)
LabVIEW – Extras – While Loop

In order to have a program that will continue running and stop when a 'stop button' is pressed, a while loop can be used.

Note: Unless in emergency situations, never use the 'abort button'. Always program in a 'stop button'.
LabVIEW - Extras - Summing Signals

In order to sum signals together:

- Make sure each signal has the same number of samples
- Limited to only adding to signals together at a time

‘Add Block’
In order to run multiple signals through a VI (FFT, Waveform Graph...) signals must be run through a merge block.

The block can be resized to allow for more than two signals.
LabVIEW – Task to be performed

Generate a low pass filter (1\textsuperscript{st} order Butterworth) and apply it to your square wave approximation. You may want to investigate higher order filters as well.

Select a cutoff frequency (that is variable via a control) to filter the higher frequencies of the summed Fourier series of sine waves.

Modify the low pass filter to make it a band pass filter for viewing tight bands around each sine wave that makes up the terms of the Fourier series. Note the effects of the filter on both the time and frequency signals.

(Here are a few extra things you’ll need to know)
Filtering of input signals can be done by using the ‘Filter Block’ found in:
LabVIEW – Extras – Filter block

A parameter window will appear once VI is placed on wire diagram. Here you can set desired filter type, cutoff frequencies, topologies, etc.