ELECTRONICS
LAB 9: LabVIEW and Data Acquisition

We will be using the iMac computers to test LabVIEW's data acquisition capabilities using an external data acquisition (DAQ) board NI USB-6009 which connects to your computer via a USB cable. The DAQ board provides many functions: a 14 bit A/D converter with programmable gain, a 12 bit D/A converter that generates outputs from 0 – 5 V, a 4 bit and an 8 bit digital I/O port, and counter/timer capability. In this lab, you will use the A/D and D/A using LabVIEW (7.1) programs that you write.

The files for today's lab are all VIs contained within the library file "USB DAQ6009 Phys220.llb" (llb stands for library) which is in the National Instruments -> LabVIEW 7.1 -> examples->USB-6009 folder within the Applications folder on your Mac. When you open this file, you will see a dialog box that allows you to choose a specific VI from the library.

1) Use the VI "USB-600x Interactive Control ORIG.vi" to do some basic testing of the analog functions of your USB DAQ device. Try connecting a known DC voltage to different pins (from pin 1 to 12). What is the difference between AI-RSE and AI-Differential? Test the analog output (AO) pins as well by connecting them to a meter or scope. Look at the block diagram for this VI (provided by National Instruments) and see how much you can interpret. Try using the debugging tools (like the lightbulb "Highlight Execution" button) to trace what happens as the VI runs.

2) Starting with a new VI, use the subVI "USB-600x Interactive Control AI/AO.vi" to construct a program that collects data one point at a time from one of the 4 differential measurement channels on the board. Your program should display the voltage on the screen as a graph and save it in a file on the computer. Use a function generator set at 0.5 Hz as the input. See how large a frequency can be measured with your program before you observe aliasing.

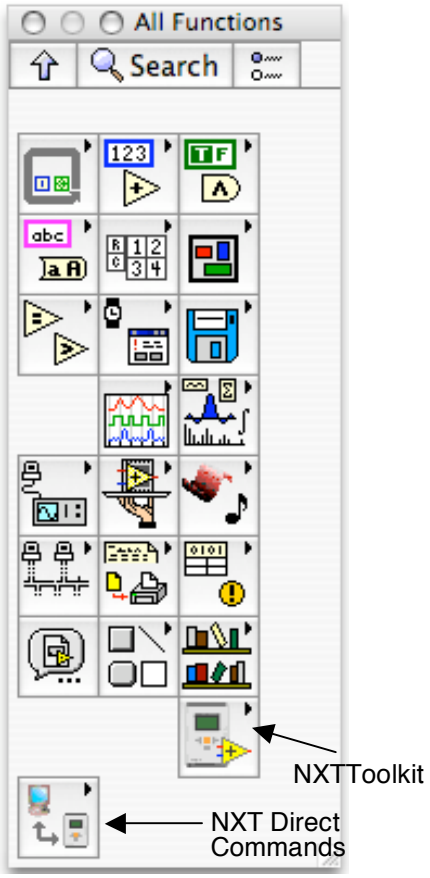
3) Use the existing program "USB-600x Interactive with plot" and see how large a frequency that can be measured. The program is set up to graph the differential input at pins 2 and 3. How is this program faster? Looking at the program, do you have any ideas to improve the speed further?

Print your programs and the corresponding front panels showing the results of the program. Also sketch the waveforms on the oscilloscope, and record other relevant information (like function generator settings).

Getting to know your Robot:

The NXT robots can be programmed and controlled in three different ways:

1) You can write standard LabVIEW code, compile it and download it to the NXT robot. The robot functions independently while it's running. To write this type of program, use only the functions and objects contained in the **NXT Toolkit** palette.
2) You can write a LabVIEW program that runs on the Mac, but communicates with the NXT robot while running, either via the USB or Bluetooth. To write this type of program, use the functions contained in the **NXT Direct Commands** palette.
3) You can write routines in LabVIEW 7.1 to be saved as "blocks" and imported into the simpler NXT software.



In this course, I expect that option #1 will be the most useful. To compile the VI that you write to an NXT, you must use **only** the functions and objects that are in the **NXT Toolkit** palette. That is, if you want to multiply two numbers, you must use the Multiply function from the **Numeric** sub-palette of the **NXT Toolkit** palette, NOT the one available under **All Functions**.

Tasks:

Use the NXT Terminal (Tools->NXT Module->NXT Terminal) to connect to your robot brick via USB. Rename your robot. You can also check its battery and amount of free space on its drive with the terminal.

Follow the directions in the LabVIEW NXT "Getting Started" Guide to create a VI to graph the sound level detected by the NXT sound sensor. (The Guide is posted on the lab website.)

Write a VI to run one of the NXT motors until you signal the program to stop. (You could send this signal by pushing the Touch Sensor button or by clapping your hands to signal the Sound Sensor.) Test the VI by running it on the NXT robot brick.