AE251a: Experiments in Aerospace Engineering

Lab – 5 Date: April 09, 2019

Save your work in your own directory

Purpose: Exposure to DAQ techniques

You may wish to ensure the following wiring on the DAQ Accessory. Connect the output of the sine wave generator to AI Channel 1 and the Square Wave to AI Channel 2. The room temperature sensor is internally connected to Channel 0.

The specification of the DAQ board installed in your computer is given below:

DAQ Board Specification	
Analog input	16 SE/8 Diff
Resolution	16-bits
Board range	±10V
Available gain settings	1, 2, 10, 50
Maximum sampling rate	250 KS/s

1. Given separately in the PDF file "EX1_MAX".
2. **Finite sample acquisition from multiple channels**
   a) Acquire only once.
   b) Acquire repeatedly.

   Use AI0 (temp), AI1 (sine wave), and AI2 (square wave) as your input signals. Also, implement the following for parts a) and b):

   i) Display all voltage data in a single graph
   ii) Display scaled temperature data in a separate graph
   iii) Display the power spectrum of sine wave data in a graph. Also, estimate the frequency.
   iv) Save the acquired data in a file
3. **Continuous sample acquisition from multiple channels**
   a) Acquire continuously and display
   b) Incorporate change in sampling rate during acquisition.

   Use AI0 (temp), AI1 (sine wave), and AI2 (square wave) as your analog input. Also, implement the following for parts a) and b):

   i) Display all voltage data in a single graph
   ii) Display scaled temperature data in a separate graph
   iii) Display the power spectrum of sine wave data in a graph. Also, estimate the frequency.
   iv) Save the acquired data in a file
4. Demonstration of Aliasing problem in DAQ

5. Build a VI that continuously acquires data from AI0, AI1, and AI2 at the rate of 5000 samples per second. Reads 500 samples at a time and displays in a graph. Also, saves the data along with other information such as sampling rate etc. selectively (as and when desired) by pressing a front panel Boolean button.

6. It is desired to build a VI in **Finite Sample Acquisition Mode** to monitor room temperature in the VI-Lab. For this, use built-in temperature sensor in BNC-2120 *signal accessory* box internally connected to "AI Chan 0" and the DAQ board specified above. Incorporate the following functionalities in your temperature monitoring VI:

   - Read 1 second of data at a time at the rate of 1200 samples/second and display in a waveform graph. Also, display the average temperature of this 1 second data in ^{o}F in a separate waveform chart and save the average temperature data in a text file. The sensitivity of the temperature sensor is 10mV/^{o}C.
   - If the temperature (1 second average) exceeds 28^{o}C, display a message "TURN ON AC" in a string. This message must disappear if the temperature is less than 28^{o}C.
   - Finally stop the temperature monitoring VI after acquiring 50 averaged temperature data points.
   - In your VI above, what is the smallest change in the temperature you will be able to measure? You can type your answer in the block diagram using text tool.

7. It is desired to build a VI in **finite sample acquisition mode** to acquire sine wave data. For this, connect sine wave signal to AI Chan 0 in the BNC-2120 signal accessory box. Incorporate following functionalities in your VI:

   - Read 0.3sec of data at a time at the rate of 5000 samples/sec and display in a waveform graph.
   - Save two records of data into a datalog file. The data record is a cluster containing sampling rate (DBL) and sine wave data (1D array of DBL). Data saved in the first record must have sine wave amplitude of about ±1V and frequency 200Hz ±5Hz; whereas, in the second record the amplitude should be about ±2V and frequency 350Hz ±10Hz.

8. Build a VI to read the data from the file you have just created in problem-7.

   - Display the sine wave data for both the records in two separate waveform graphs whose x-axis is time.
   - Analyze the data to verify whether the specified conditions on amplitude and frequency are satisfied or not.

9. Digital I/O

   a) Control a digital line of digital port 0 using Boolean and Numeric
   b) Control all the digital lines of digital port 0 using Boolean and Numeric
   c) Read the status of the digital lines
   d) Turn ON and OFF only one digital line of port 0 every 500ms.
   e) Turn ON one digital line every 200ms in a sequence starting for line 0 and repeat this until the VI is stopped.
   f) Turn ON every other digital line of Port 0 starting from line 1 every 200ms until the VI is stopped.