Engr325 **Lab #6** **Winter, 2020**

Measuring Acceleration

Name _____

Partner (s)_____ **Grade** _____/10

Introduction

The goal of this lab is to explore the usefulness of the FFT to measure vibration waveforms picked up by placing an accelerometer on the handle of a wooden softball bat. When a softball is hit with a bat, it may cause significant vibration in the hands of the hitter. In extreme cases, it causes pain. Hitters observe that vibration and pain level depend on where the ball hits the bat. There is a "sweet" spot where vibration is minimal.

Objectives

- Further your learning about data acquisition using A/D converters;
- Use the Fourier transform to find the frequency content of a composite signal;
- Understand how the use of accelerometers can help measure vibration magnitude.

Equipment Provided

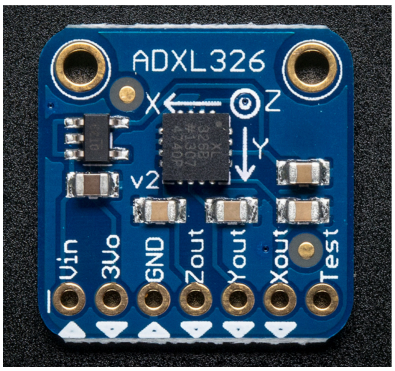
- Baseball bat, cantilever beam, and clamp;
- Tape, rubber bands, and a "striking" device;
- Accelerometer board and connection cables;
- Oscilloscope, signal generator, and computer with ADC and connection board.

References

- Instrumentation text book;
- Course web page including lecture notes, Matlab scripts, and a research paper on baseball bat vibration.

Procedure

- Use a C-clamp to clamp a cantilever rod to the top of the work-station cabinet. Hang the bat vertically from the rod using rubber bands with the handle-end up.
- Plug the 4-foot ribbon cable into the accelerator board. Attach the accelerometer board to the side of the bat, about where a hitter would place their hands. Use the Z-axis output from the accelerometer board so you are measuring transverse vibration (perpendicular to the length of the bat).
- Using the short single-wire connection cables provided, make the necessary connections between the end of the ribbon cable and the A/D connection board. Use an ohmmeter to determine which signal from the A/D board is connected to which pin on the other end of the 4-foot long ribbon cable. The signals from the accelerometer board that need to be connected are:
  - **Vin** – connect to Vcc on A/D board.
  - **GND** – connect to G0 **and** the GND pin next to the Vcc pin on the A/D board.
  - The y-axis analog output voltage – connect to the S0 pin on the A/D board.



- Monitor accelerometer output with an oscilloscope and capture it with the A/D converter.
- Tap the bat at various intervals and measure the magnitude of the vibration.
- Determine the components of the frequency of vibration and a method to decide which point on the bat has the "least" vibration.
- Determine the "resonant" frequency of the bat. Compare to the numbers cited in the paper posted on the course web page under "Lab6".

Note

- The accelerometer board will output voltage in the range of 0.0 – 3.3 V, where 0.00 volts corresponds to -16g's and 3.3 volts corresponds to +16g's. Thus, 0g should read about 1.65 V.

To Turn In

Each person needs to staple the following items to this handout and turn them in:

- Time-domain and frequency-domain plots for the case of least vibration;
- Summary of methods and results, elaborating on what you learned.