UNIVERSITY OF LOUISIANA AT LAFAYETTE

MEASUREMENTS AND INSTRUMENTATION

MCHE 357

Lab 10

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Introduction

This lab consisted of using Labview to create a program which reads data from a strain gauge to measure the stress placed on an object. The program was used to measure the stress on a cantilever beam, as well as its natural frequency.

Theory

Labview can be used in conjunction with physical instruments in order to control a system or take data in from a system. Reading data from an instrument can be done by referring to the documentation of the instrument in order to map voltage readings to the desired measurement, while also considering the sensitivity of the instrument.

A strain gauge is a device used to measure stress placed on a material which changes resistance as its elongation changes. This changing resistance results in different voltages being outputted by the device which can then be mapped to stresses. The mean voltage outputted at different stresses is correlated to a stress with a gauge factor.

Procedure & Analysis

The program used in this lab would read the voltage outputted by the strain gauge and map it to a stress value by use of a gauge factor tabulated in the instrument's documentation. The system diagram and control panel for the Labview program can be seen in Figure 1 and Figure 2, respectively. The data mentioned throughout this section can be seen tabulated in Figure 3.

A cantilever beam was set up as shown in Figure 4. The gauge was first zeroed out to compensate for the voltage reading when no strain is placed on the gauge. The natural frequency of the cantilever beam was then measured by deflecting the beam and then releasing it, allowing it to oscillate for one second and recording the oscillation data. The frequency was estimated as 17 Hz by plotting the data, shown in Figure 5.

A known weight was then hung from the end of the beam to place a load on the beam as shown in Figure 6. The stress caused by this load was recorded. A second weight was then added to the first weight and the stress reading was recorded again. The process was then repeated for a third weight. Between adding weights, the weights were removed momentarily to zero out the gauge again since excessive deflection can change the resting voltage value of the gauge. The data can be seen tabulated by referring back to Figure 3, and the data is plotted in Figure 7. As is expected, the data for the readings is approximately linear as it should be when considering that moments due to a static, concentrated load are linearly proportional to the loading force.

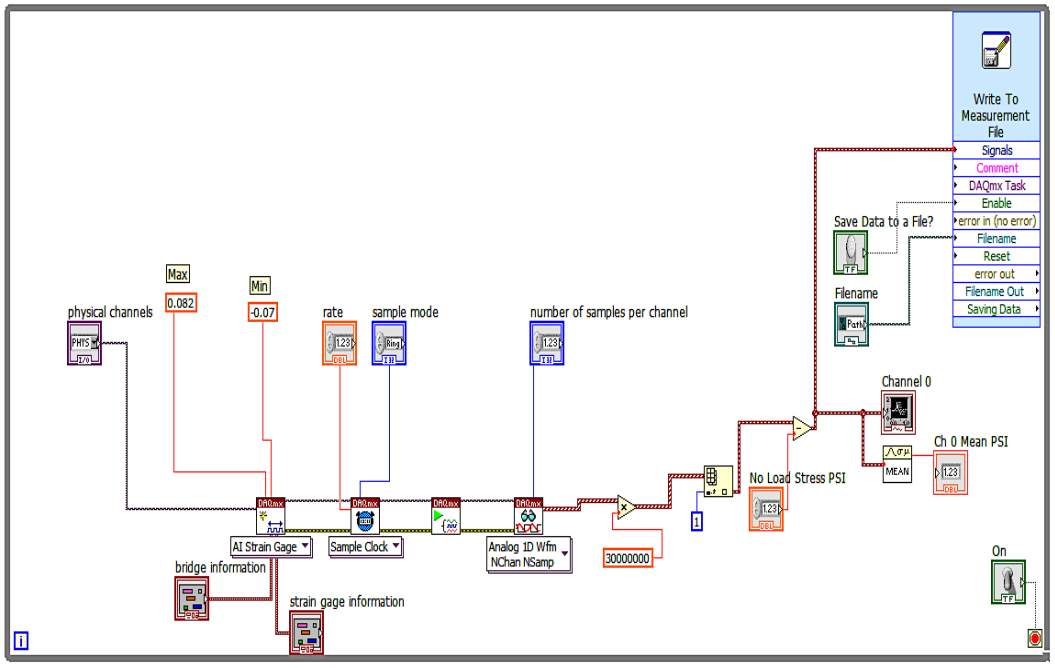

Figure 1: Labview Program System Diagram

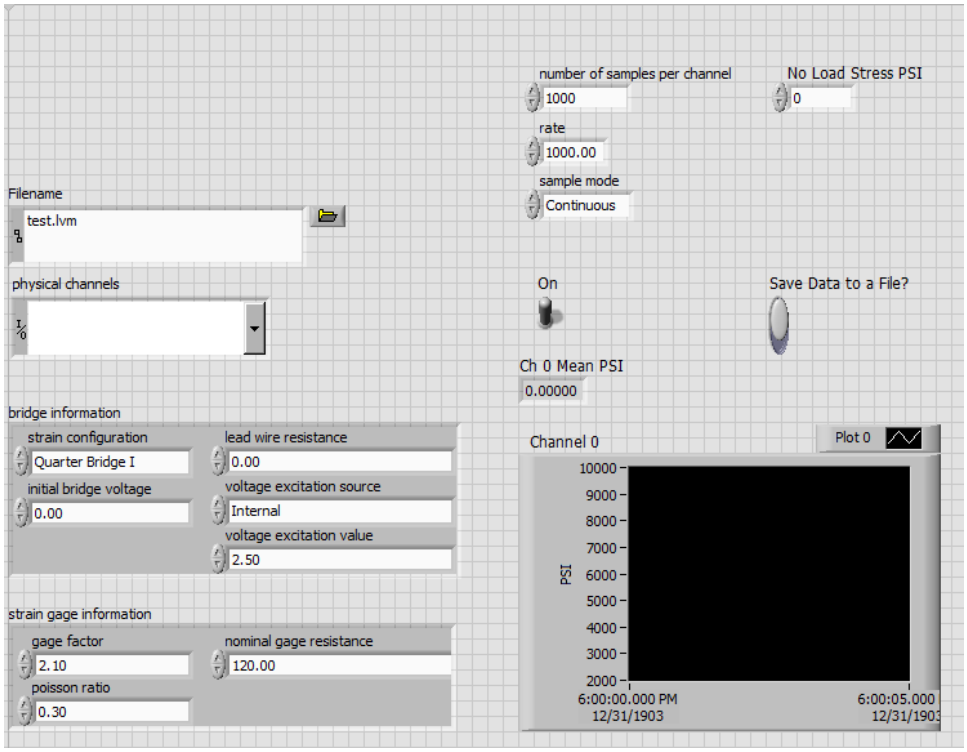

Figure 2: Labview Program System Control Panel

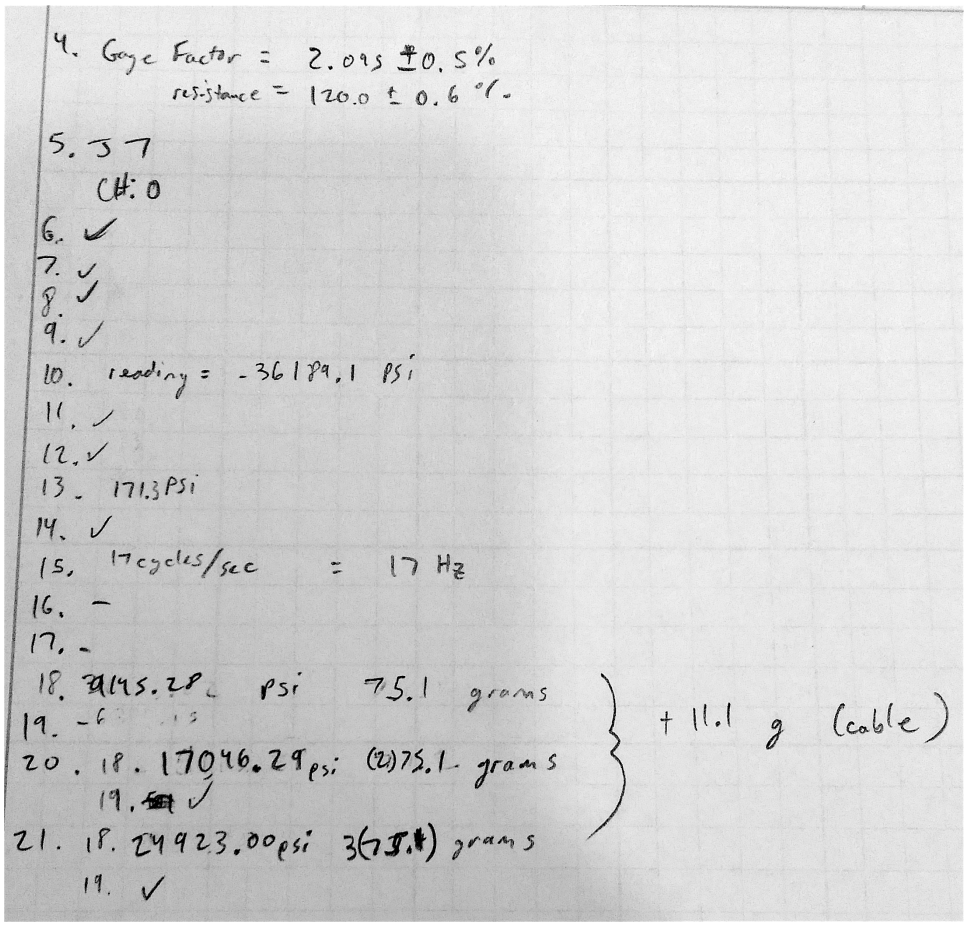

Figure 3: Lab Notes

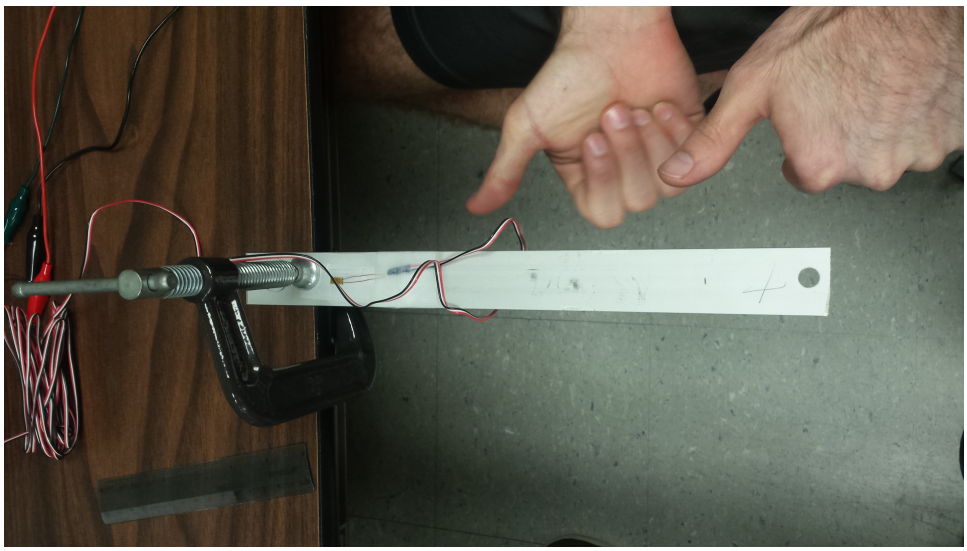

Figure 4: Cantilever Beam

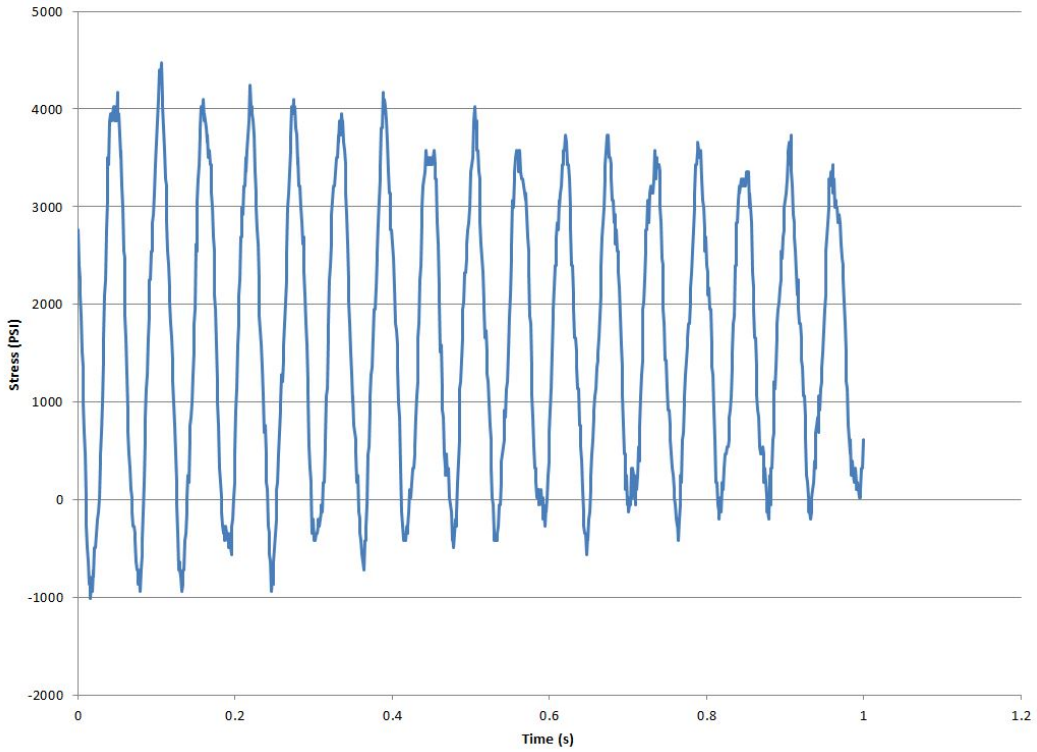

Figure 5: Oscillation Data Plot

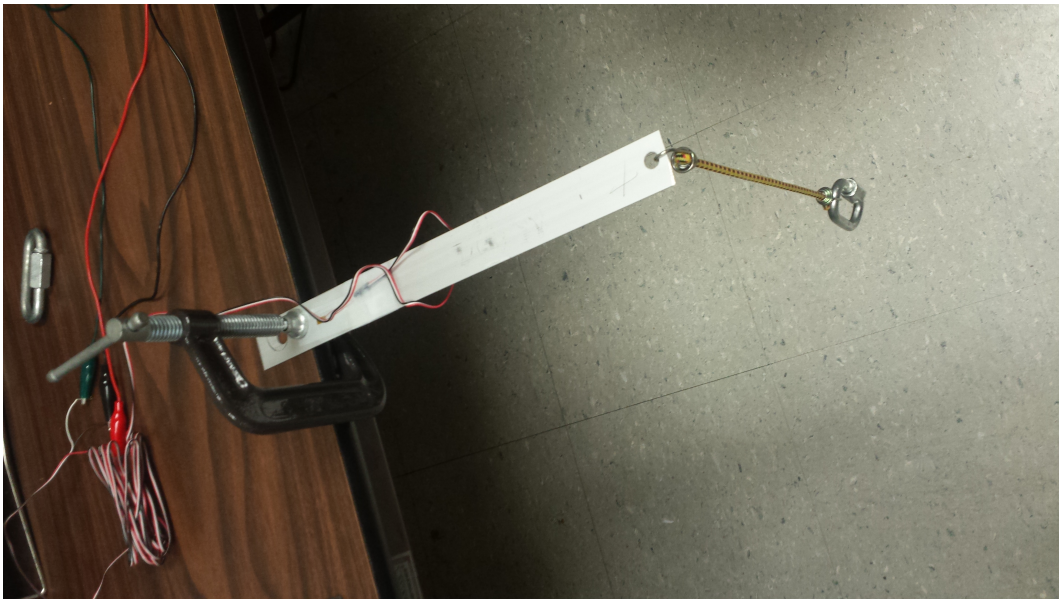

Figure 6: Hanging Weight End-Load

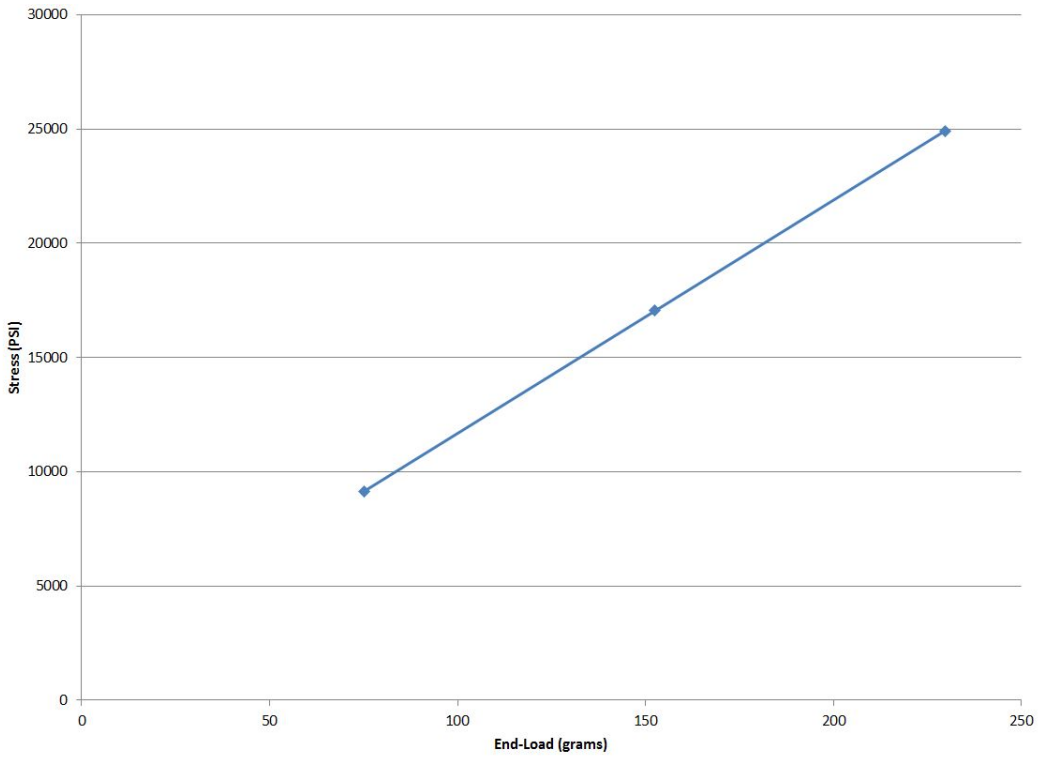

Figure 7: Hanging Weight End-Load Data Plot

Conclusion

The exercises conducted in this lab demonstrated using a Labview program to acquire data. It was shown that reading data from sensors is typically done by mapping the voltage reading from the sensor to a measurement value by using documentation on the specific sensor being used. This is how most measurement systems work, and it is important that students are exposed to using these sensors as they will likely use them in their careers in the industry. Exhibiting this method by measuring something mechanical engineering students are familiar with helps them appreciate the importance of accurate instrumentation in order to acquire accurate data for their work.