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Introduction to Sensors, Instrumentation, and Measurement

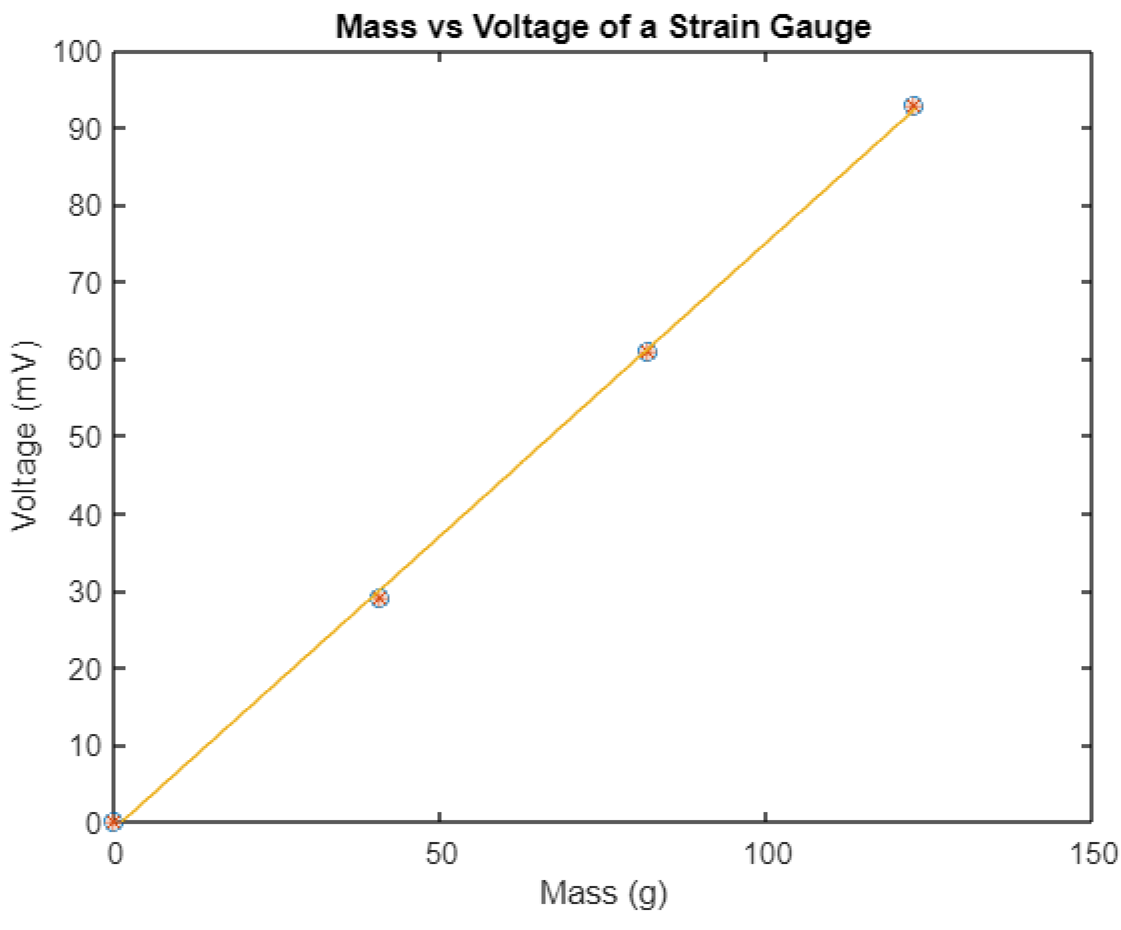
02/08/2024

Lab Three: Strain Gauge

Purpose: Create a "scale" using a cantilever with a strain gauge, calibrate it and measure a weight.

Results:

1.) Calibration plot for Strain Gauge (Mass vs. Voltage)



*Measurement of a 120 strain gauge within a wheatstone bridge. Input voltage is 5V, strain gauge is connected to a thin aluminum bar. The change in voltage output is amplified 501x by a AD623 chip. The line of best fit is: Voltage (mV) = 0.7591 * Mass (g) - 0.8037*

2.) % Error of Calibration Curve

Calibration curve line of best fit: Voltage (mV) = 0.7591 * Mass (g) - 0.8037

Theoretical output voltage for a 27.6 gram object:

*Voltage (mV) = 0.7591 * (27.6 grams) - 0.8037*
Voltage (mV) = 20.147 mV

Measured output voltage for a 27.6 gram object:

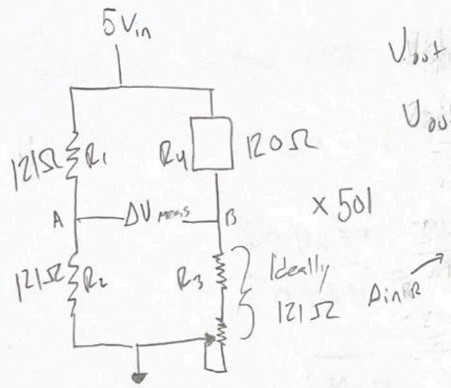
Voltage = ~19 mV

% Error:

*% Error = ((Measured - Known) / Known) * 100*
*% Error = ((20.147 mV - 19 mV)/19mV) * 100*
% Error = 6.0368%

3.)

Associated Change in resistance for a 20 mV change:



$$V_{out} = V_{ref} + G(V_+ - V_-)$$

$$V_{out} = 2.5V + 20mV$$

$$V_{out} = 2.48V$$

$$\frac{\delta R}{R} = \frac{V_{in}}{V_{out}} - 2$$

$$\frac{\Delta R}{120\Omega} = \frac{5V}{2.48V} - 2$$

$$\frac{\Delta R}{120\Omega} = -0.0161$$

$$\boxed{\Delta R = \pm 1.93\ \Omega}$$

I was able to calculate the change in resistance for a Vout of 20 mV to be 1.93 ohms using the formulas *Vout = Vref + G(V+ − V-)* and *ΔR/R = (Vin/Vout) - 2*. Both are formulas relating specifically to strain gauges and or wheatstone circuits.

Mass required for a change of 20 mV.

$$\text{Voltage (mV)} = 0.7591 \times \text{Mass (g)} - 0.8037$$

$$20 = 0.7591 \times \text{Mass (g)} - 0.8037$$

$$\frac{20.8037}{0.7591} = \text{Mass (g)}$$

$$\boxed{\text{Mass} = 27.41 \text{ grams}}$$

I was able to calculate the mass required for a change in 20 mV using my calibration curve equation *Voltage (mV) = 0.7591 * (27.6 grams) - 0.8037.*