Introduction to Sensors, Measurement and Instrumentation

Lab 3: Strain Gauge Scale

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February 21, 2023

Calibration Curve Plot

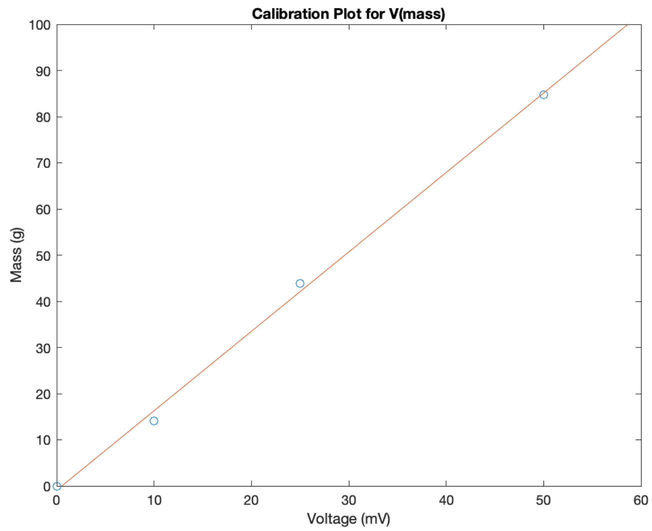

Figure 1: Calibration Curve (Voltage(mV) vs Mass(g)) -A 5V DC input was used in a Wheatstone bridge consisting of a strain gauge and connected to an instrumentation amplifier "AD623" for measuring the variation of voltage with mass.

% Error in Scale

We know that, $\%error = |\frac{x_{measured} - x_{known}}{x_{known}}|$

Here, $x_{measured} = 42$ g and $x_{known} = 43.8$ g

Therefore, $\%error = 4.1\%$

Scale Sensitivity

The scale sensitivity for for a 20 mV change in $V_{out} = \frac{dV_{output}}{dmass_{input}}$

Therefore, scale sensitivity $= \frac{40mV - 20mV}{70g - 35g} = 0.57mV/g$

The mass required to get a change of 20 mV is approximately equal to 35g.

Analysis of electrical resistance change of the strain gauge

The circuit we have is a Wheatstone bridge consisting of a strain gauge. The nominal resistance of the strain gauge when no load is applied is 120Ω. The resistors used are $120\Omega \pm 1\%$ on one side, whereas on the other side, the strain gauge, 115Ω resistor is combined with a potentiometer (10Ω) which is acceptable and the bridge gets balanced manually.

As the circuit is a voltage divider, the absolute voltage on each midpoint is 2.5 V on both sides. When the circuit is balanced, the $\Delta V_{meas} = 0$.

When a load of 35 g is applied to the strain gauge, it results in a change of $\Delta V_{meas} = 20$ mV as the voltage difference is linearly affected with mass. The strain of the gauge is linearly related with mass, and consequently the strain is linear with ΔV_{meas}. Therefore, we can encapsulate this relation in the transfer equation:

$$\frac{\Delta R_{gauge}}{R} = \frac{1}{G} * \frac{\Delta V_{meas}}{V}$$

where ΔR_{gauge} is the change in electrical resistance of the strain gauge.

Therefore, $\Delta R_{gauge} = 120\Omega * \frac{1}{501} * \frac{20mV}{2.5V}$

$\Delta R_{gauge} \approx 0.0024\Omega$