Strain Gage Lab

ETSC 242

Fall 2018

Purpose

To explore the characteristics of implementing a Strain Gage into a LabVIEW data acquisition system. Students will design a system that acquires an amplified voltage from a Wheatstone quarter-bridge circuit. The voltage will then be converted into strain, then determined whether the strain gage is under compression or tension. Once completed, students gain an understanding of the complete instrumentation process for strain gage application, circuit design and data acquisition.

Goals

- Develop a LabVIEW VI that will acquire voltage from your amplified quarter-bridge circuit
- Understand the need for amplification to a wheatstone bridge sensor system
- Use the conversion formula to convert the voltage into strain
- Develop conditional statements to display to the user (front panel) whether the strain gage is under compression, tension or no strain at all (Hint: In Range)

Procedure

<u>Hardware setup</u>

1. Build a wheatstone bridge with (2) 120Ω resistors, (1) 200Ω potentiometer, and the strain gage that you have applied to a piece of metal. Hint: refer to diagram drawn on whiteboard in the lab
2. Using the benchtop power supply and multimeter, dial in the potentiometer to make your bridge "balanced"
3. Wire the <u>output</u> of the wheatsone bridge into the <u>input</u> Instrumentation amplifier. Details for wiring the instrumentation amplifier can be found on its datasheet.
4. Wire the <u>output</u> of the amplifier to an analog <u>input</u> channel on the 9205 module.
5. Remember that a common ground needs to be implemented throughout the system.

<u>Software procedure</u>

6. Start a new LabVIEW project and create a new VI within the project.
7. Set up the DAQ assistant in the VI to acquire a voltage from the 9205 with the following settings:
    a. Range -3 to 3
    b. RSE Terminal Configuration
    c. Continuous Samples
    d. 100 Samples to Read at 1kHz

8. Use the Formula Express VI to convert the voltage into strain.
    a. Here's our equation from the strain gage tutorial

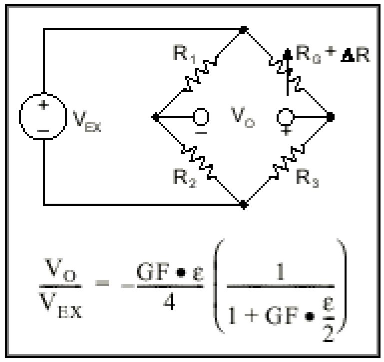


Figure 4. Quarter-Bridge Circuit

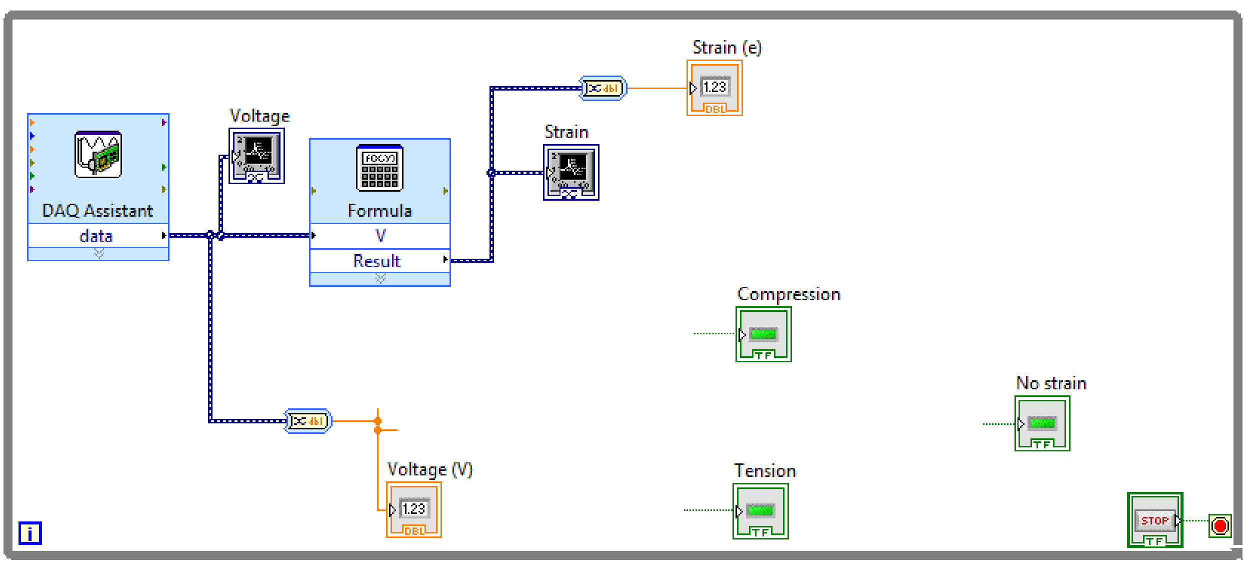
    b. Notice that the equation variable is ε which is strain…so we need to solve for ε in order for the equation to be a function of voltage (V).
    c. Here's the equation from above with our strain gage factor "GF" of 2.05 inserted:

$$V = -\left(\frac{2.05 * \varepsilon}{4}\right) * \left(\frac{1}{1 + 2.05 * \left(\frac{\varepsilon}{2}\right)}\right)$$

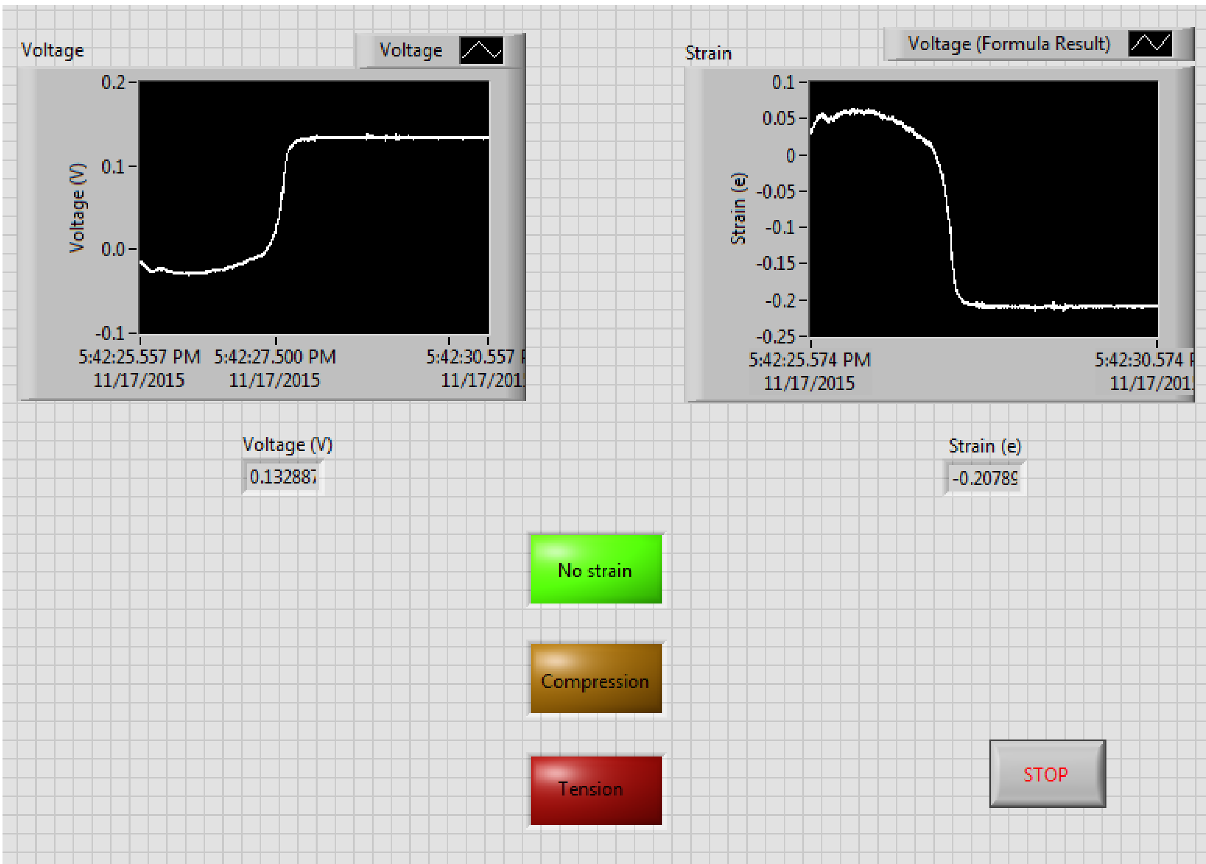
    d. Now solving for ε gives us the following:

$$\varepsilon = -\frac{0.97561 * V}{V + 0.5}$$

9. Begin building a block diagram that look like the following image. I have removed the problem solving components of the diagram that you will find a solution for. Note: all strain gages will have some variance in values, so other's values may not be the same as yours.



10. Refer to the Front Panel image below. Create your own front panel that looks similar, then see if you can program the block diagram to make the VI function as specified.
    a. Label your charts and indicators accordingly, ex. Strain (e) and Voltage (V)
    b. Create the code necessary to turn the indicators "on" when the gage is under compression, tension or no strain at all respectively.
    c. Change the colors of the indicators so that they are not all the same.



11. <u>Show your functioning system to the instructor</u>
12. <u>Submit your completed VI to CANVAS</u>
13. <u>BONUS! 5 points extra credit: Implement a way to compensate for the input voltage offset</u>