**Speed of Sound Lab**

ME360 – Engineering Experimentation

Spring 2021

**Purpose:**

The goal of this experiment is to approximate the speed of sound in air at different temperatures. To do so, we will be conducting “quasi”-impulse response measurements simultaneously at two on-axis microphones.

**Equipment:**

1. Teensy (x1)
2. Breadboard (x1)
3. Micro USB Cable (x1)
4. Electret microphone (x2)
5. Thermistor (x1)
6. 10 k resistor (x3) ([4-band Resistor color chart](https://www.digikey.com/en/resources/conversion-calculators/conversion-calculator-resistor-color-code))
7. Jumper Cables (~10)
8. Ruler
9. Tape
10. Multimeter and leads (for debugging circuit)

**Software:**

Download and Install Arduino IDE: [Arduino Download Link](https://www.arduino.cc/en/software)

Download and Install Teensyduino: [Teensy Download Link](https://www.pjrc.com/teensy/td_download.html)

Download and Install Python 3.7 (or later) from <https://www.python.org/>

Download Teensy code and GUI from <https://github.com/mgiglia92/ME360_code>

**Procedure:**

*Set-up*

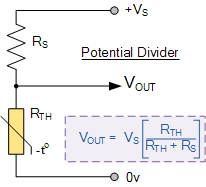
1. Place Teensy on to the breadboard.
   1. Orient Teensy such that the 5V and Ground (G) pins will be on row 1 of the breadboard.
   2. Now forget that the 5V pin exists (NEVER route 5V into the Teensy)
2. Connect 3.3 V to the power line and G to the ground line of the breadboard.
3. Wire both electret microphones using the following circuit diagram:

Diagram, schematic

Description automatically generated

Try to place the microphones as far apart on the breadboard as possible.

1. Wire the Thermistor using the following circuit diagram:



V\_out should go to A3 (pin 17).

1. On a flat surface, place the microphones horizontally in front of you approximately a foot apart (Prof. Lawless currently has his 6 inches apart).
2. Open “.\ME360\_code\arduino\_code\sketches\speed\_sound\_test\speed\_sound\_test.ino” in the Arduino IDE and upload the code on to the Teensy.
3. Open a console or IDE and change the directory to “.\ME360\_code\python\_code”.
4. Install the required python modules by typing “pip install -r requirements.txt” into the console.
5. Run the data acquisition (DAQ) GUI by running “python DAQ\_v3.py”
6. Change the COM port on the GUI to be the one currently being used by your Teensy.
7. Press Open Serial to open the connection to your Teensy.
8. Click the Settings button.
   1. Change the sample rate, fs, to 44100 Hz.
   2. Change the number of samples, N, to 44100 Hz. (How many seconds will our measurement be?)

*Protocol:*

1. Press the “Record Data” button on the GUI.
2. While the Teensy is recording, snap your fingers or clap your hands to create an impulsive sound.
   1. Position your fingers or hands to be on-axis of the microphones.
3. Press the “Send Data” button on the GUI to send the data from the Teensy to the Python GUI.
4. Plot the data with the GUI.
   1. Make sure that you can clearly see impulses in both of your microphone measurements.
5. Save the data. Data will be saved into the “.\ME360\_code\python\_code\data” folder as an excel file.
6. Repeat at different temperatures.