**Identify clearly the exact subject of the experiment.**

Todays experiment will focus on the characterization and mitigation of signal noise.

**Give readers the necessary context and background required to understand your results and analysis method.**

Noise is the result of the often unintentional coupling between signals (Ott, pg. 22)

Noise is quantified using a metric called the **signal-to-noise ratio (SNR)**. This can be computed using either the amplitude of the signal, or the peak-to-peak signal. Often SNR is measured in decibles (dB).

There are two types of signal noise, electrical and magnetic.

Electrical noise is caused by any wire acting as an antenna.

Electrical noise can come from power cables, other equipment, or radio signals (Otto, pg. 1)

Magnetic noise can be caused by nearby motors and transformers.

Methods of reducing interference involve (Ott, pg. 26)

1. Shielding
2. Grounding
3. Balancing
4. Filtering
5. Isolation
6. Separation and orientation
7. Circuit impedance level control
8. Cable design
9. Cancellation techniques.

Noise can be reduced by using shorter wires, shielding, twisting wires, or implementing a differential amplifier.

Shorter wires reduce the effectiveness of the unintentional antenna.

Shielding adds an additional grounded antenna that works to intercept interfering radio energy and drain it to ground. Shielding can take the form of a foil or metal braid raped around the wire, and in some cases is as simple as a single bare wire that makes loops long the length of the signal wire.

The effectiveness of a shield against electrical interference can be measured (Ott pg. 165)

Twisting wires is the first technique attempting to specifically limit the effects of magnetic interference. As the flux lines of a magnetic field move into the area of a loop of wire, a current is produce in that wire according the right hand rule. Tightly twisiting the signal wires is an attempt to reduce the loop area, and proportionally reduce the interference. Additioanlly, the direction of the area is reversed with each twist, so any noise in one loop is canceled out by the next.

Finally, a differential amplifier is a way to eliminate the effects of noise without directly attenuating the noise. Interference is expected to affect all signal wires in a cable the same way and by a similar amount. A differential amplifier takes the signal as the difference between the signal and ground wire voltages. In this way, if the voltage in the signal and ground wires is raised equally due to noise, the signal measured at the output of the differential amplifier will not change. This is called **common mode noise rejection**.

An additional source of noise can arise from poor grounding techniques. If large currents are being dumped into the ground plane in one portion of the circuit, any resistances in the ground plane will cause the voltage of the ground plane in that portion of the circuit to rise. In this way, the ground become different between the source of a signal, and where it is received. Often, this can be mitigated using what is called a **mecca ground**. A single point in the circuit where all ground connections are wired together.

**Provide motivation and importance/applications.**

A transducer is a device that converts a physical quantity such a pressure to an electrical signal. Often this signal is an analog voltage or current proportional the quantity being measured by the transducer.

Transducers are subsequently connected to a data acquisition unit (DAQ) that converts the electrical signal into a form the computer can record and understand.

When noise is enough to prevent normal sensor operation it is called **interference** (Otto, pg. 4).

**Present a list of objectives that are expected to be accomplished at the end of the experiment.**

This report has three goals.

Practice the techniques of singe variable statistics.

Understand and characterize sources of noise in measurement.

Understand and implement common noise reduction techniques.