

EE 211 Lecture 4

T. H. Ortmeyer

Spring 2006

This week's labs

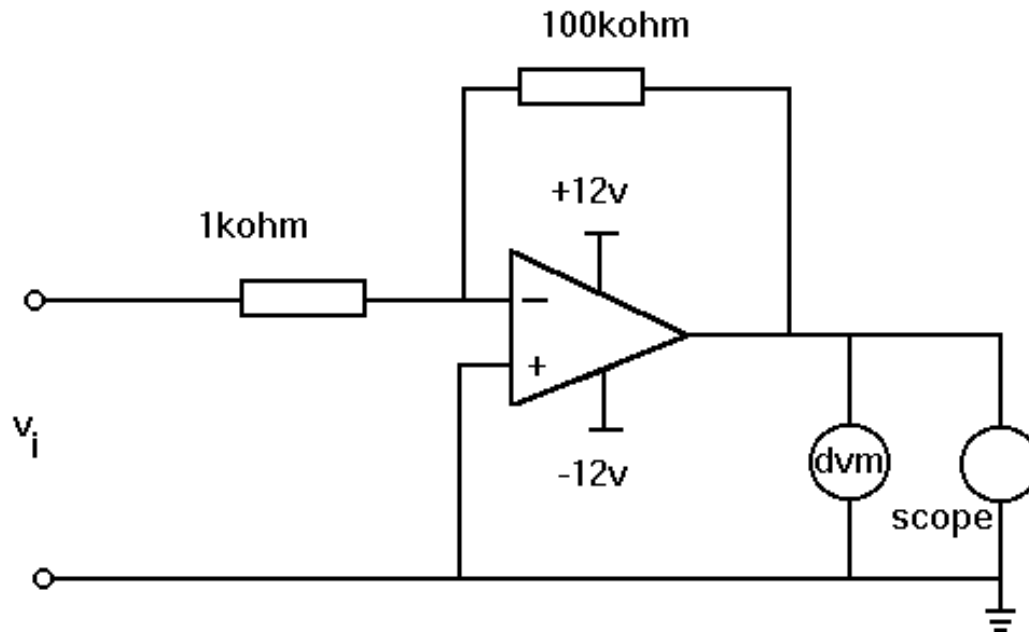
- Grounding Lab
- Labview Tutorial

Grounding Lab

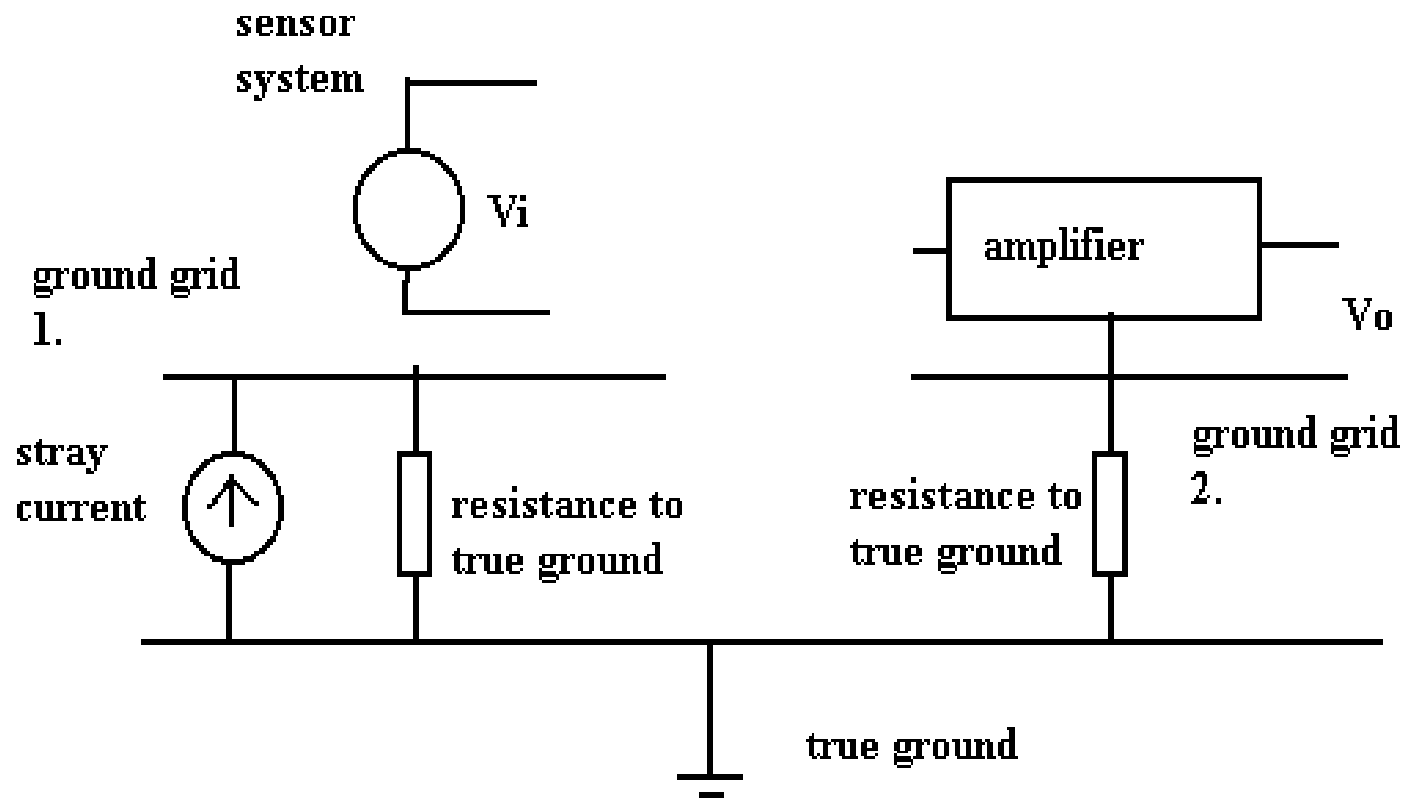
- The purpose of this laboratory experiment is to demonstrate the potential problems that can arise due to poor grounding.
- We will amplify millivolt signals from sensors to the 10 volt range, using op amps operating in the linear region.

The “vanilla” amplifier– with a good ground

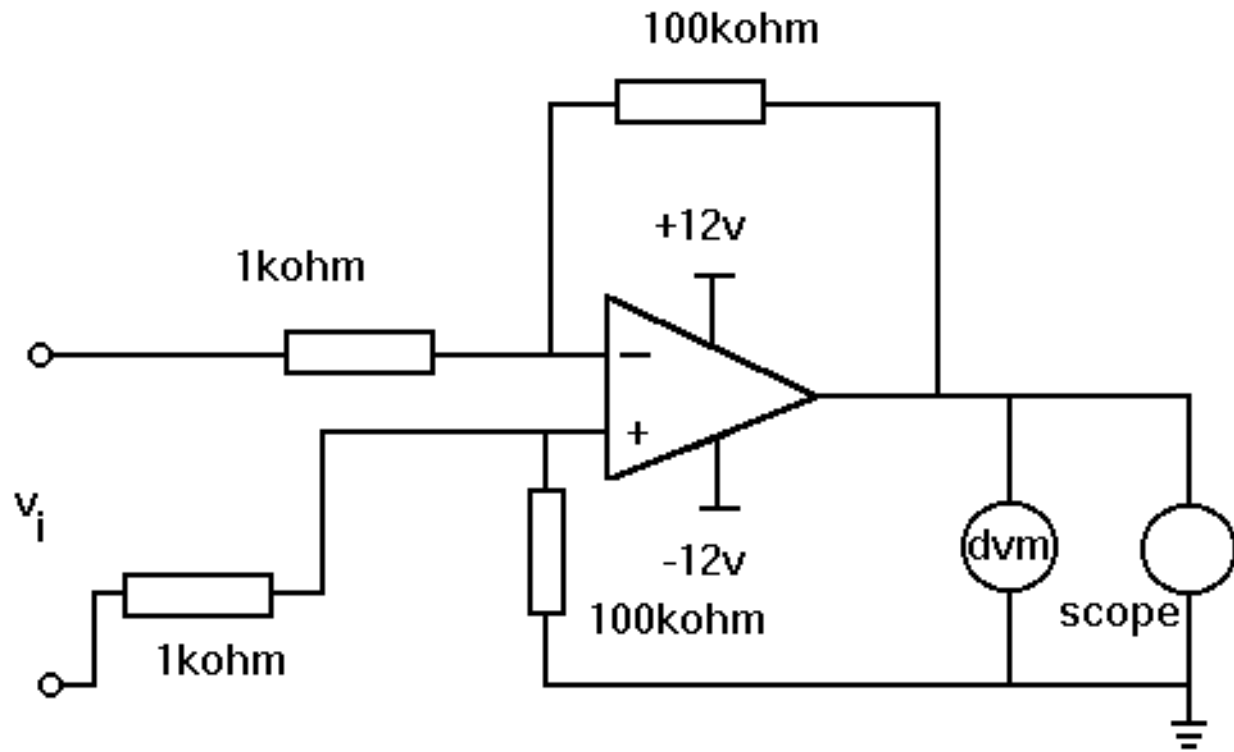
$$Gain = (-) \frac{R_{feedback}}{R_{in}}$$



The same amp with a poor ground



Differential amp– the better solution



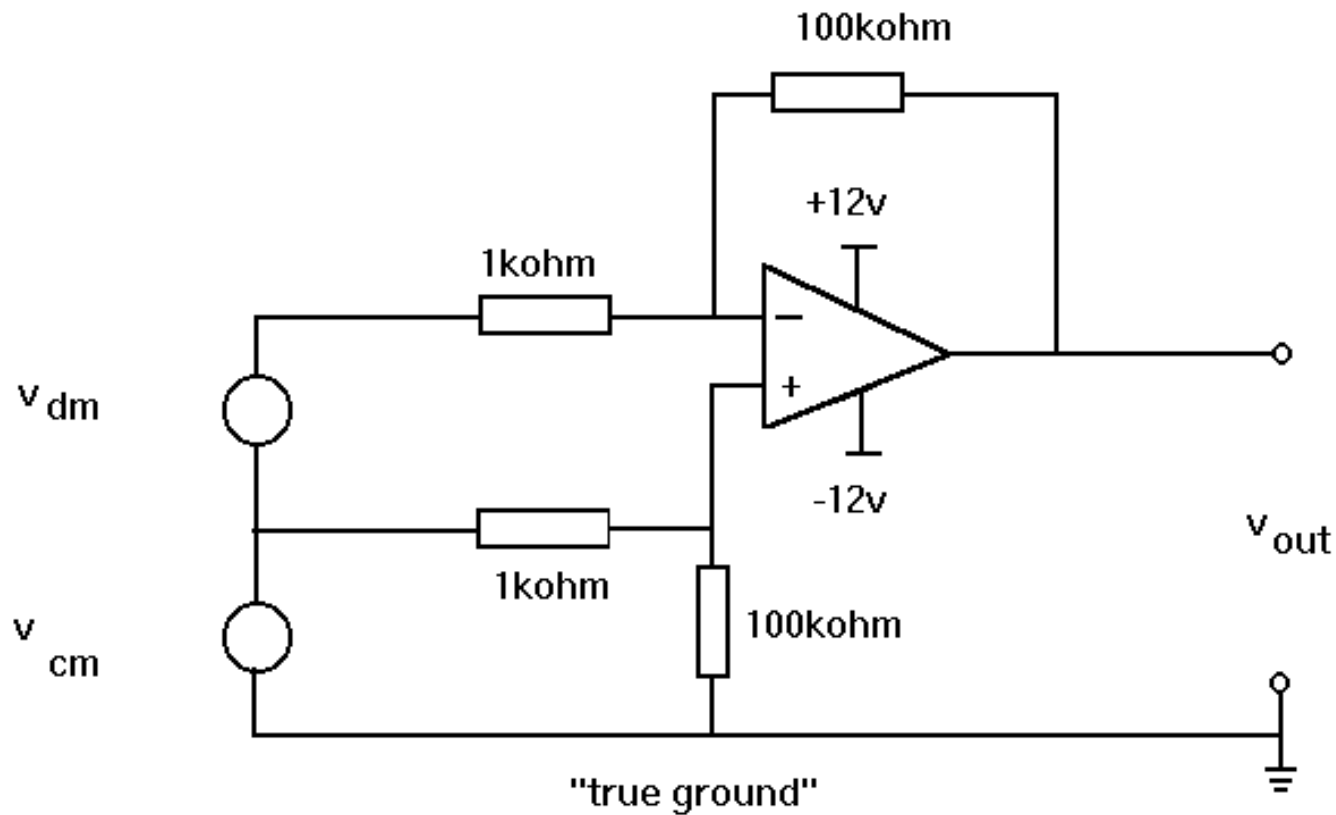
Differential amp

- Connect both sides of the sensor to the differential amplifier inputs.
- Ground the sensor as needed for safety.

Definitions

- Differential mode– the difference between the two leads of a signal.
- Common mode– the level that the signal floats above ground.

Differential and common mode input voltages



Common Mode Rejection

$$CMRR = \frac{\textit{Differential Mode Gain}}{\textit{Common Mode Gain}}$$

PreLab Assignment

- Determine the gain equation for the differential amplifier.
- Review the definition of Common Mode and Differential Mode gains, as well as Common Mode Rejection Ratio

#8– LabView Tutorial

- Run the Labview tutorial
- Explore sampled signals

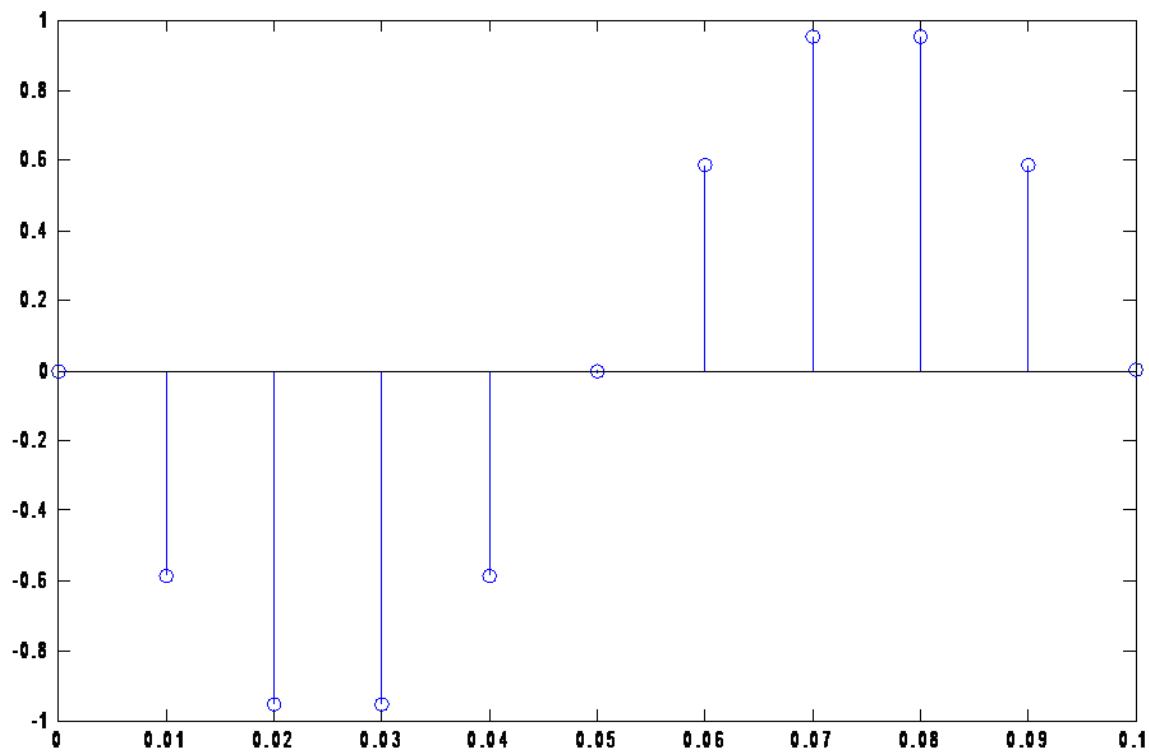
Labview– Graphical Programming Language

- It is intended to make the PC look like an instrument.
- It has two view-
 - Panel, which represents the front of the instrument
 - Block diagram, which represents the circuitry of the instrument

Elements of LabView

- Command and indicating elements are placed on the panel
- Functional elements are placed on the block diagram, and connected with a wiring tool.
- LabView Express is intended to streamline certain common functions.

Digitizing a signal



Digitized Math

- Averaging--

$$V_{dc} = \frac{1}{T} \int_{t=0}^T v(t) dt \text{ becomes}$$

$$V_{dc} = \frac{1}{N} \sum_{n=1}^N v_n$$

RMS'ing

$$V_{rms} = \sqrt{\frac{1}{T} \int_{t=0}^T v^2(t) dt} \quad \text{becomes}$$

$$V_{rms} = \sqrt{\frac{1}{N} \sum_{n=1}^N v_n^2}$$

What if your sampling interval is not T?

- Error!!!!
- We explore this error at low frequencies

Finally,

- We configure Labview to measure real signals from an A/D converter rather than the simulated signals.

Prelab

- Preview the on-line presentation

<http://www.ni.com/swf/presentation/us/lv7/>