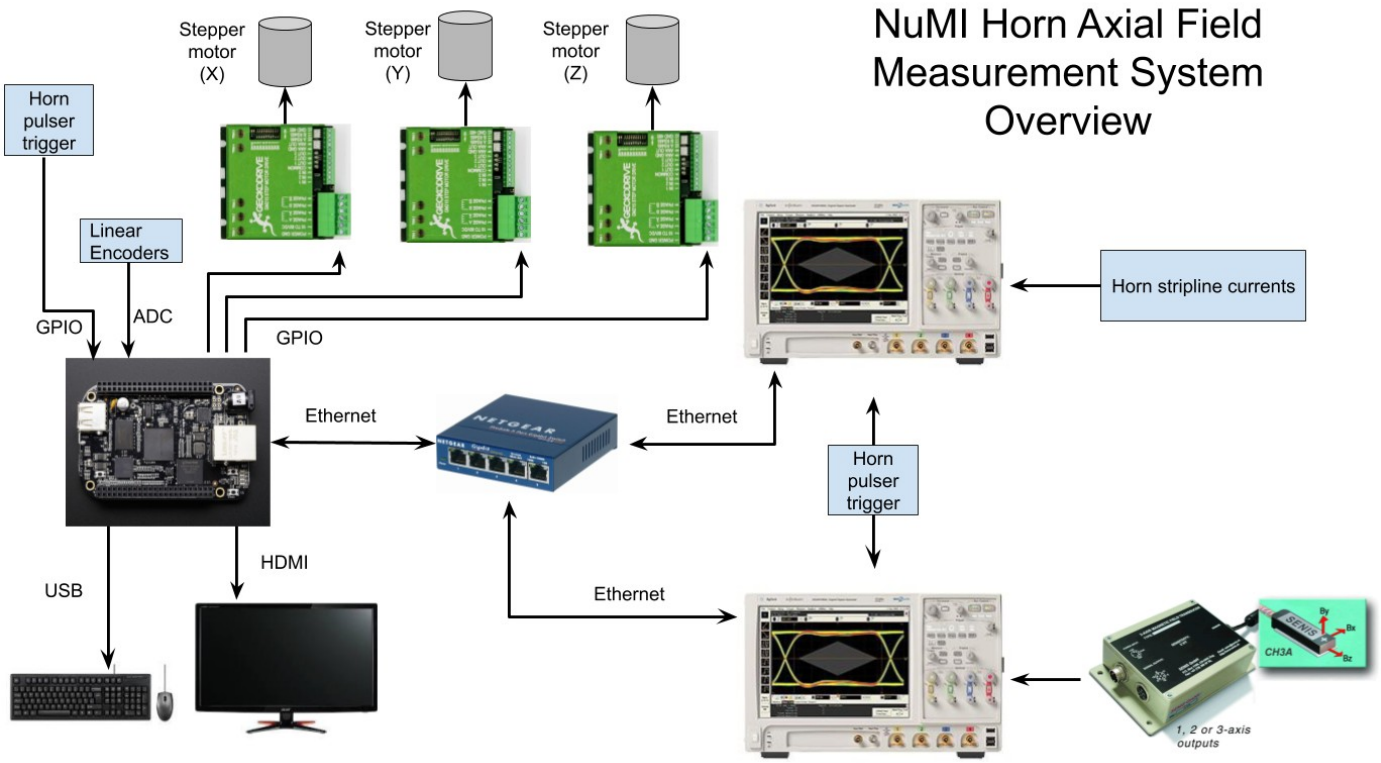
Motivation

This is a brief description of a specific problem we found with the new DAQ for the horn field-mapping system, and why we had to use the old LabView DAQ.

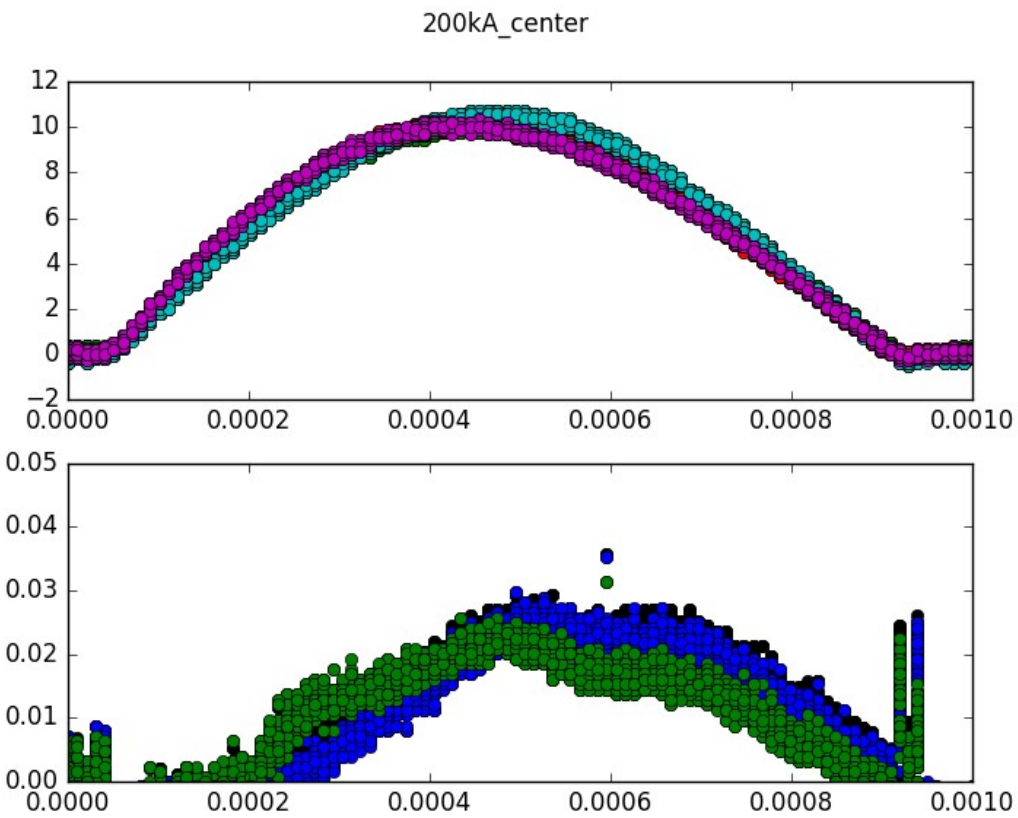
A solution for this issue is straightforward, but could not be implemented in time to finish the scan. This is why we used the LabView DAQ for this measurement.

Data acquisition system overview



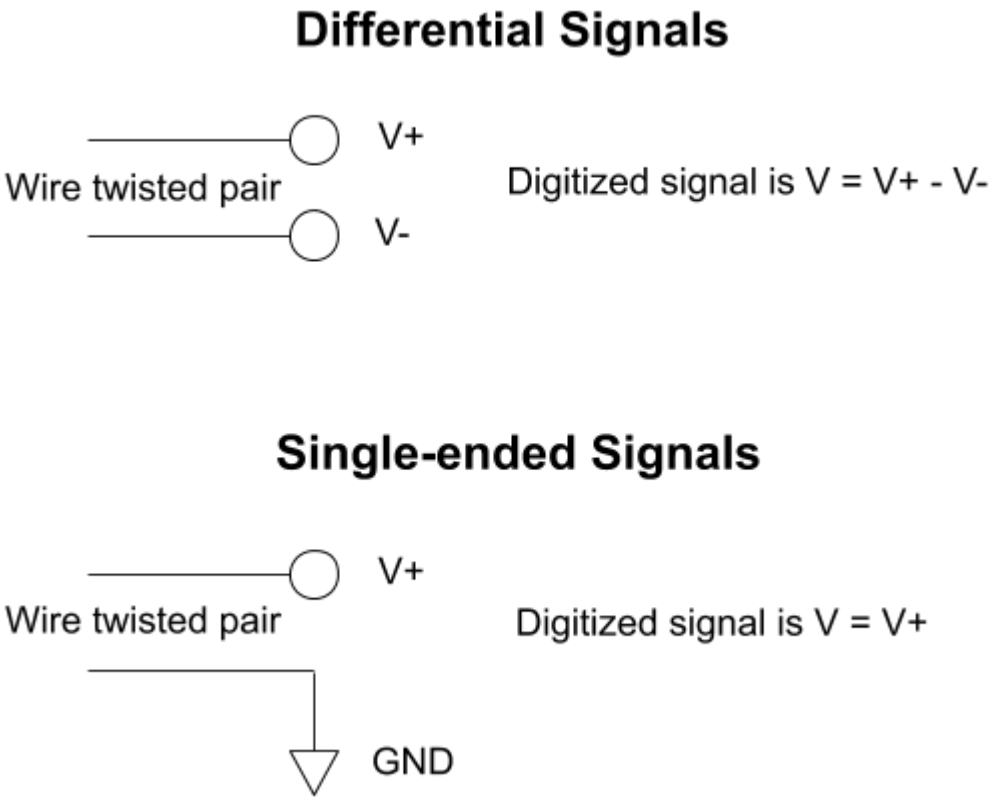
Strip-line current and hall probe signals are digitized by oscilloscopes to satisfy the 100 points-per-pulse sampling requirement. Data from the scopes is then pulled down via a local Ethernet network to the main CPU for collocation and synchronization with the motor control and position readings.

Anomalous field signal



- Example data from new DAQ system shows stripline load monitor signals (top plot) and hall probe receiver voltages (lower plot) in time.
- Apparent “hump” in hall probe plot never changed significantly with probe position, even when probe moved longitudinally far from the horn and striplines.
- “Hump” in field signal does change with horn current.
- Determined that this was not legitimate magnetic field signal after comparing data from old LabView DAQ
- Decided to use LabView DAQ to finish the scan

The cause of the problem



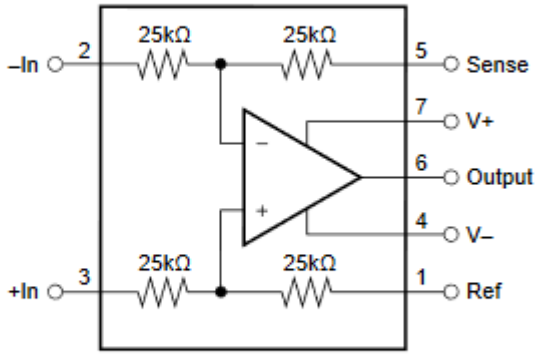
- The LabView DAQ is a differential digitizer, which means it digitizes the difference in potential between the pairs of wires for each hall probe plane.
- Differential signals take advantage of “common mode rejection”, where any external electromagnetic noise that is common to both wires is canceld out by taking the potential difference.
- Oscilloscopes always ground one wire (i.e. the shield of the BNC conncetor), so it treats signals as single-ended, making us more susceptible to the noise of the horn pulsing.

The solution

DESCRIPTION

The INA105 is a monolithic Gain = 1 differential amplifier consisting of a precision op amp and on-chip metal film resistors. The resistors are laser trimmed for accurate gain and high common-mode rejection. Excellent TCR tracking of the resistors maintains gain accuracy and common-mode rejection over temperature.

The differential amplifier is the foundation of many commonly used circuits. The INA105 provides this precision circuit function without using an expensive precision resistor network. The INA105 is available in 8-pin plastic DIP, SO-8 surface-mount and TO-99 metal packages.



- Solution is to treat the signal as differential up until the scope, then use a special circuit to convert the differential voltage to a single-ended voltage without grounding the V- wire.
- This preserves the common-mode rejection capability of the twisted-pair cable but lets us use an oscilloscope.
- Many circuit solutions to do this; simplest is using a purpose-made Op-amp chip shown above.
- Easy to make a simple box with three of these to convert X, Y, and Z hall probe differential signals for oscilloscope digitization.
- Note, V+ and V- refer to chip power. -In and +In are the input differential voltages, and the Output/Ref pair is connected to the center pin and shield of the BNC scope connector respectively.