GIZMo for DUNE at LBNF

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Introduction
This Ground Impedance Monitor system monitors the integrity of the single point grounding configuration required for low noise operations of the far side DUNE detector.

Motivation for GIZMo
Building Ground is noisy and hence the detector needs a virtual single point ground node that is isolated from the building ground in order to eliminate the noise.

Method
The DUNE detector is connected to building ground for safety purposes using saturable inductors. This is the only desired connection to building ground. Any additional ground connections could create current loops and be a source of noise. The GIZMo injects a small AC current to the detector and measures current in the saturable inductor to estimate the impedance between the single point ground node and building ground.

Fig 1 Operation of LArTPC
Fig 2 GIZMo Circuit
Fig 3 Quadrature Demodulation
Fig 4 Calibration Curve for Resistive Component
Fig 5 Calibration Curve for Reactive Component
Fig 6 Implementation in Zed Board

The excitation waveform is stored in one FPGA block RAM, which is injected to the circuit using DAC. The current through inductor is measured with CT and is digitized using ADC module. Inductor current is demodulated into quadrature relative to the stimulating current. Now, the magnitude ratio between currents can be used to estimate resistive component of the unwanted impedance.

Similarly, the reactive component can be estimated using the phase difference between the current signals.

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