Triggering Device for Acoustical Monitoring of Lightning

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Abstract

Acoustic research of thunderstorms in the Magdalena Mountains of New Mexico is currently being performed by Langmuir Laboratories. Continuous recording of audio-range information results in large quantities of data which must be stored and processed. The purpose of this project is to design, fabricate, and test a triggering system that will detect lightning events allowing for recording of data only when thunder is present. Two triggering systems, one analog and one digital, will be implemented. Each system will create a pulse in the event of lightning. These pulses may be used to start audio data storage in the currently implemented data logger system.

Background

New Mexico Tech's Lightning Mapping Array (LMA) measures lightning propagation.

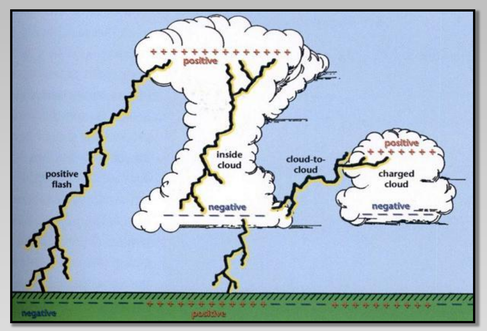

Figure 1. Lightning Types Detected at LMA

Audio data is constantly collected – even with no thunder/lightning

Data storage capacity is prohibitive to length of testing period.

Objective

Research, design, and test a triggering device to optimize an existing audio recording system.

Triggering system should facilitate data storage only in the case of a lightning event.

Implement post-processing software to extract valid thunder data from continuously recorded data.

Design Specifications

The triggering system should meet and maintain the following system requirements:

- Cost < $1000
- Powered by 12V DC @ 100mA
- Electrically isolated from data logger system
- Able to detect positive and negative lightning events

References

Figure 1 Courtesy of:
http://www.crondallweather.co.uk/lightning.html#.UWHzPJNlnW8

Design Approach

A slow antenna detects electric field on Earth's surface. Large changes in surface fields indicate lightning events. Selected two feasible design options for detection of lightning field changes.

Design 1 – Analog Threshold Detector

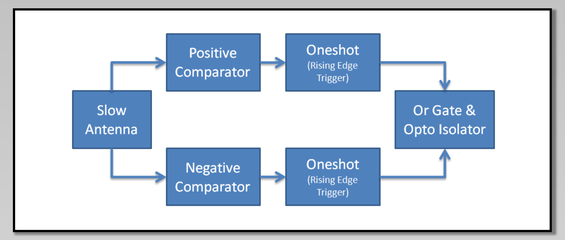

Figure 2. Analog Threshold Detector Block Diagram

Design 2 – Digital Consecutive Voltage Differential Detector

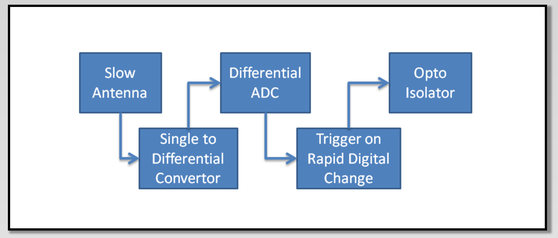

Figure 3. Digital Consecutive Voltage Differential Detector Block Diagram

Both produce a positive square pulse output at data logger logic levels in the event of a lightning discharge.

Design Team

Lightning Triggering Design Team (from left):
Matthew Scharmer, Kalyn Jones, Ryan Steinbach

Results

Analog Triggering System

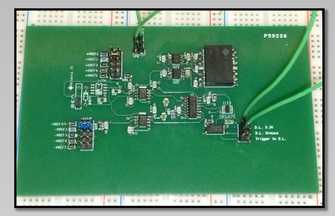

Figure 4. System PCB

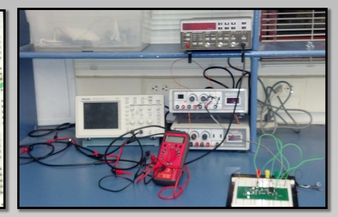

Figure 5. Testing Lab

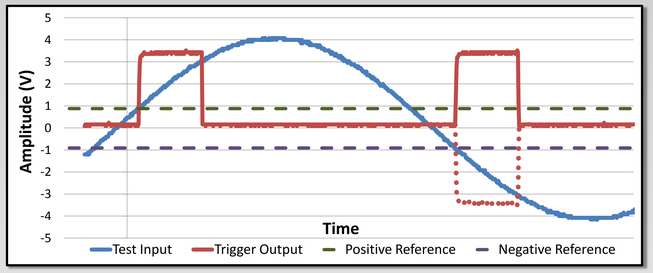

Figure 6. Positive Pulse Generation at Threshold Crossing

Analog triggering system creates 1.0 millisecond positive trigger pulse when input exceeds the positive and negative thresholds.

Project Status

Tasks Completed

- Analog system design, integration and testing
- Post-processing software prototype

Future Work

- Digital system design, integration, and testing
- Field testing
- Post-processing implementation and testing

Prototype Cost

- Design/testing Cost - $340.69
- Cost to rebuild prototype - $160.17

Acknowledgements

Dr. Rene Arechiga – Customer
Dr. William Rison – Faculty Advisor