



Using High Sensitivity Pressure Measurements for the Detection of Infrasound

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MOTIVATION

Dangerous weather causes billions in damages and kills thousands every year. Tornadoes, one kind of extremely dangerous weather formations, emit low frequency infrasound during their startup cycles, and high performance barometers have the capability to detect infrasound. Using the current method of signal filtering, the ambient wind noise often overpowers these signals. Because tornadoes tend to form in or near areas with high winds this severely limits the effectiveness of technique.



PURPOSE

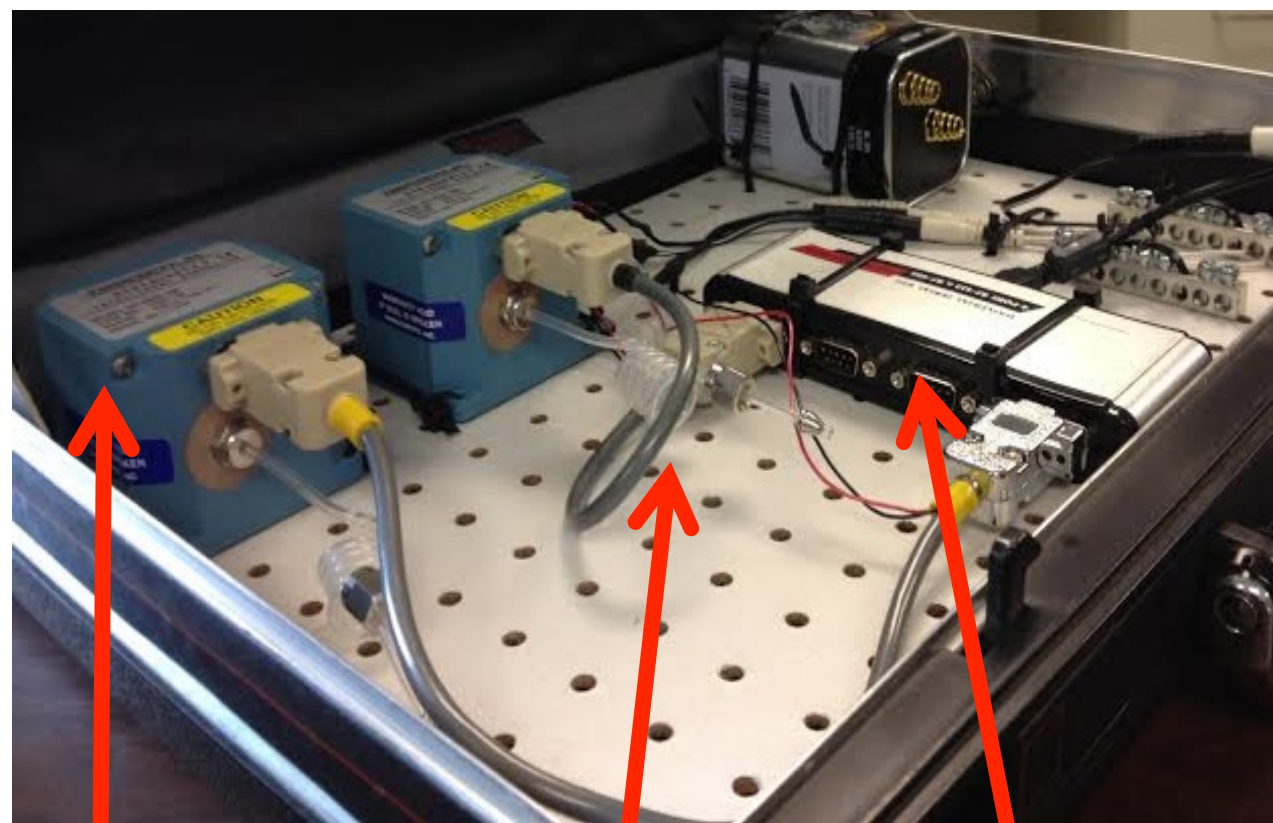
To learn about the nature of these infrasound signals while working towards the development of a small scale physical wind filter for use in the detection of infrasound signals in areas with high wind noise.

EQUIPMENT

To develop my understanding of infrasound signals and filtering methods I was given two Paroscientific 6000-16 B barometers and a Digiport filter.

Paroscientific 6000-16B Barometers

- Absolute pressure zeroed to within 8 Pascals
- .01 Pascal signal resolution
- Continuous Serial output



Barometer Housing

Pressure Port

Serial to USB Housing

Digiport filter accuracy

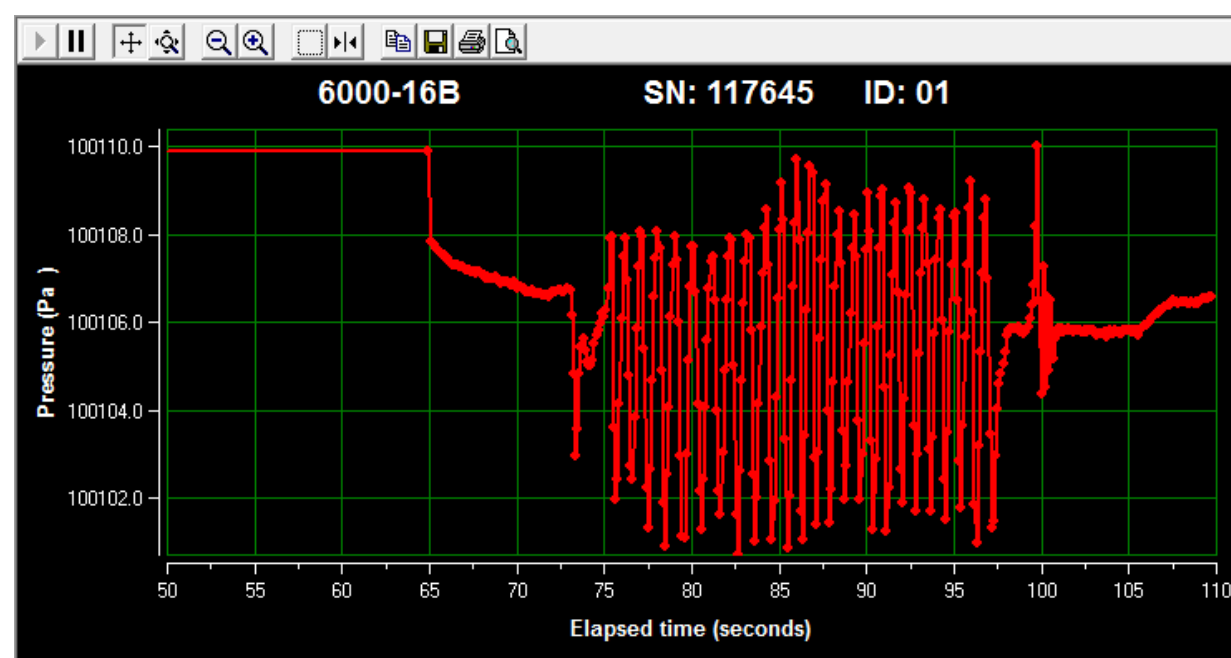
- 5 m/s 10 Pa
- 10 m/s 30 Pa
- 20 m/s 120 Pa



NOTABLE EXPERIMENTS

Small Pressure Change Detection

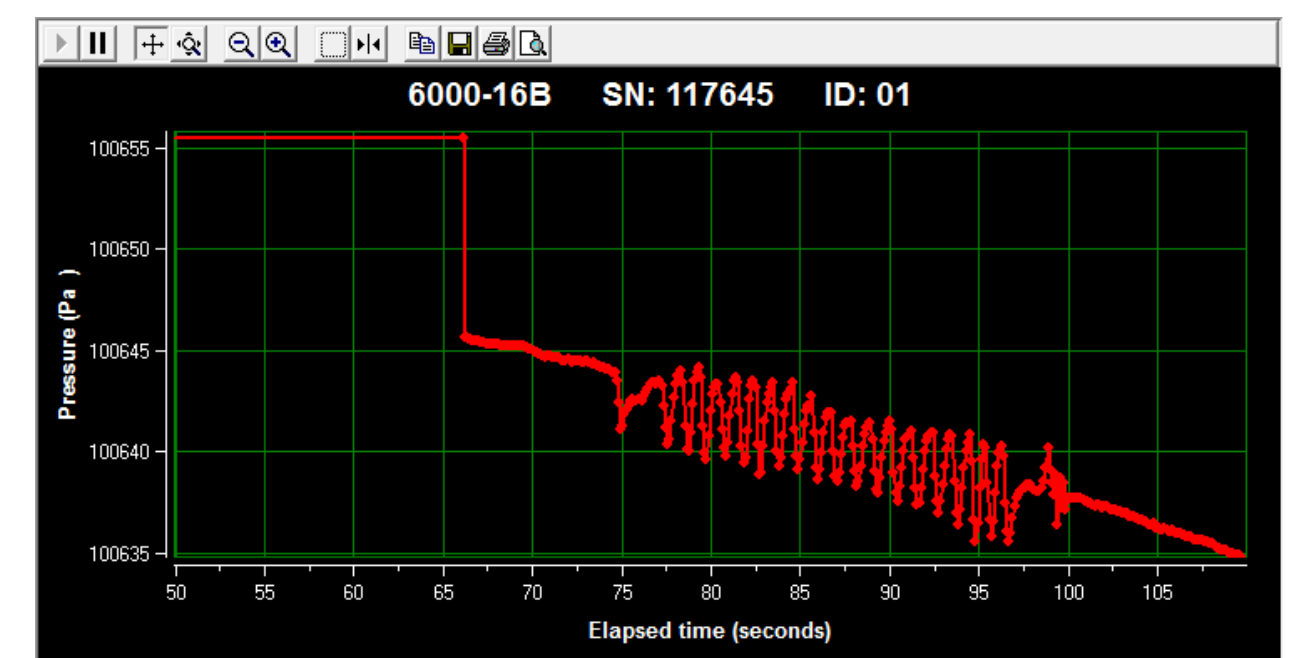
- Lab door was opened and closed approximately once per second.
- Barometers successfully detected Pascal level changes in static pressure
- Self written MATLAB signal analysis code functioned properly



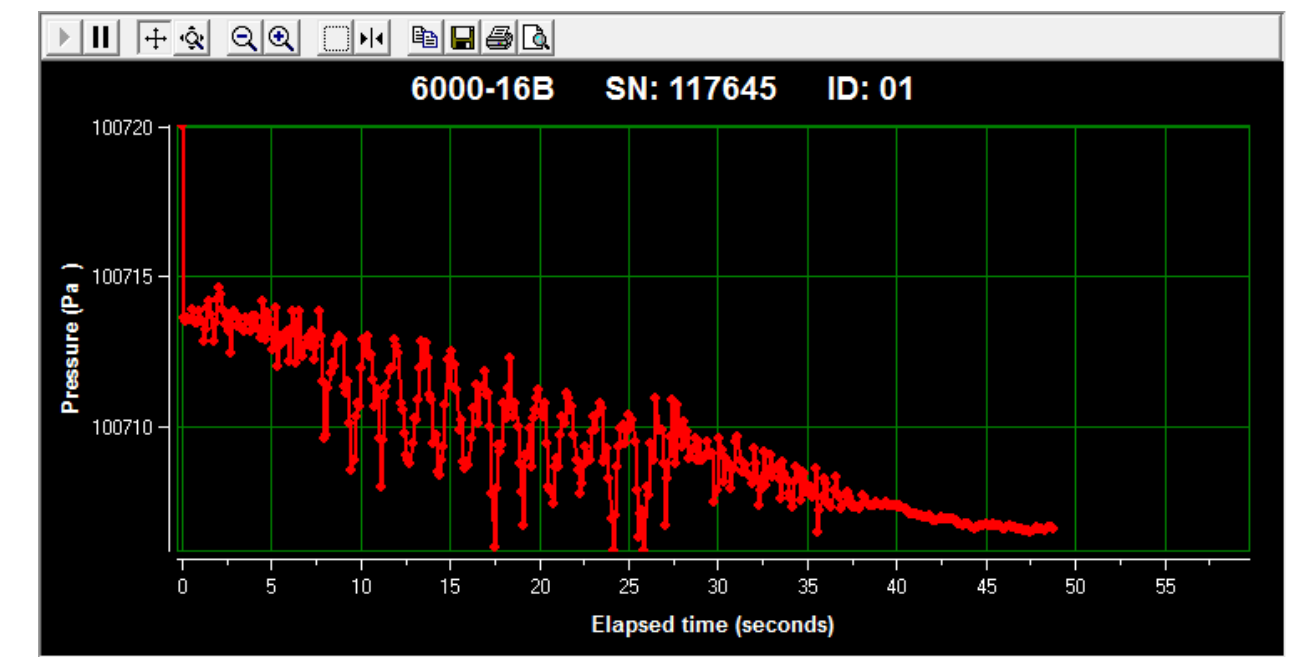
Pressure vs. Time: Door Closing

Digiport Effectiveness Testing

- The Digiport decreased the magnitude of the signal while simultaneously decreasing wind noise, as expected.
- Several self made filters failed to achieve a higher reduction in wind noise when compared to the Digiport.



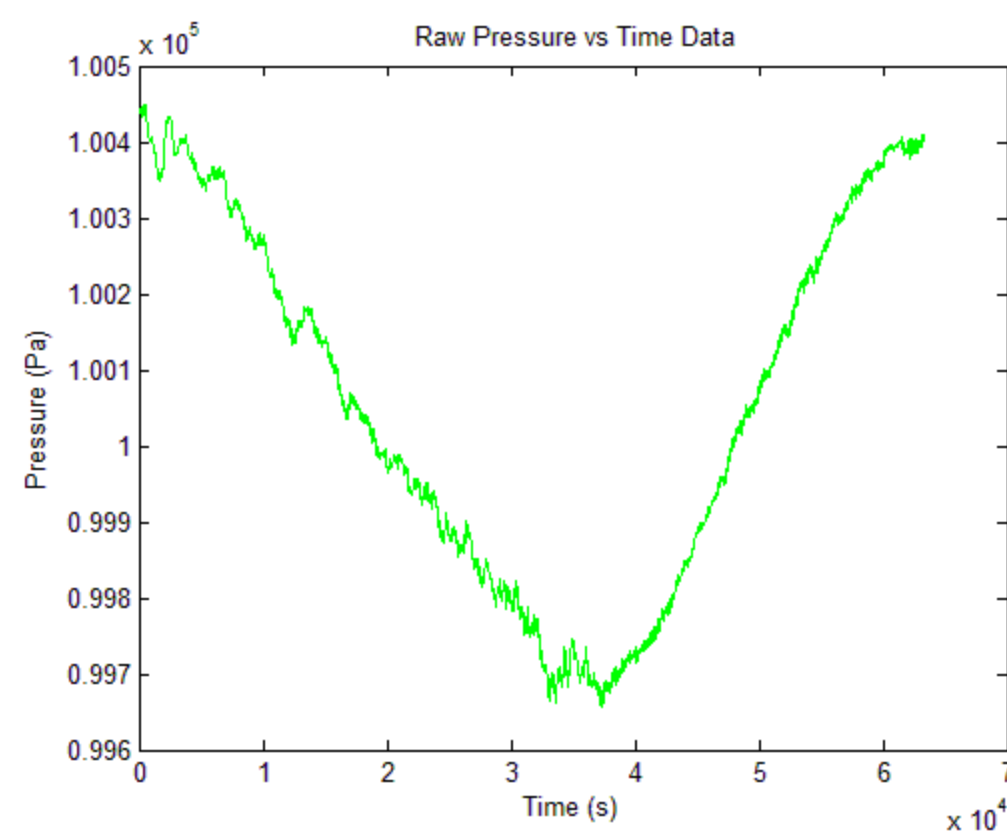
Pressure vs. Time: DIGIPOINT connected to hose with 12" Fan (High)



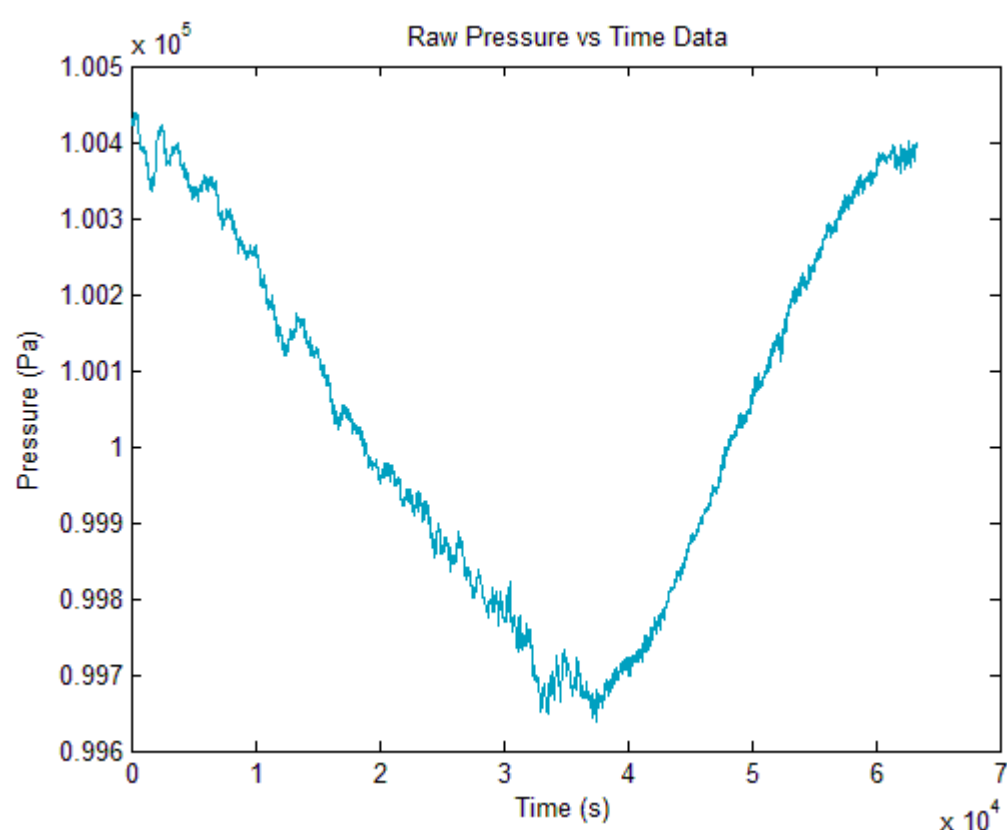
Pressure vs. Time: Open hose with 12" Fan (High)

Winter Storm Data Collection

- High resolution pressure data collected overnight during a storm
- Data collected simultaneously from inside and outside.
- Both Barometers attached to Digiports



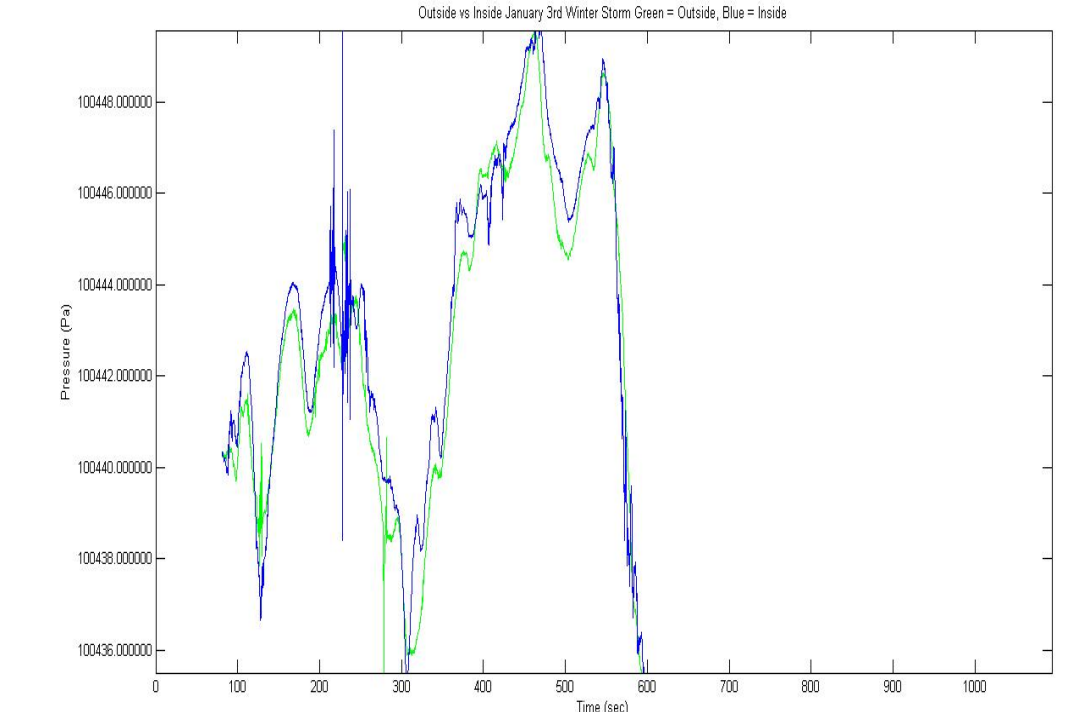
Pressure vs Time: Outside data (With Digiport)



Pressure vs Time: Inside Data (With Digiport)

Local Pressure Fluctuations

- Observed and documented slow variations in pressure having amplitude deviations as high as 10-30 Pa over periods of ~30 seconds.
- Pressure fluctuations indoors and outdoors track each other closely, ruling out HVAC as the cause.



Pressure vs. Time: Superimposed Zoom of Winter storm data

RESULTS

- Unable to create a wind filter that was able to achieve the accuracy necessary for infrasound detection at the projected wind speeds.
- Discovered interesting pressure fluctuations on the 10-30 Pa scale or what information can be pulled from them.
- It is unknown if the lack of any infrasound signal is due to problems with the detection methodology or the absence of a signal to detect.

FUTURE WORK

The longer (30-40 second) pressure fluctuations are not well understood or documented yet and should be looked into more seriously.

ACKNOWLEDGEMENTS

Special thanks to: Dr. David McLaughlin, Dr. David Pepyne and Caitlin McLain for their assistance and support!