“Measurement, Analysis and Synthesis of Infra Sound”

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Infra sound refers to sound waves below the range of human hearing (20 to 20000 Hz). Infra sound comes from a number of natural phenomena including weather changes, thunder, and ocean waves.
Common man-made sources include heating and ventilation systems, industrial machinery, moving vehicle cabins (airplanes, trains, cars), and energy generation (wind turbines, gas plants). While low frequency noise and infra sound are known to impact human health, there are no standards for infra sound exposure. In most cases, low frequency sound is simply ignored. Sound level readings are typically in “dBA”, decibels A-weighted. A-weighting is based on (averaged) curves of human hearing sensitivity, which fall off sharply at low frequencies. Low frequency noise and infra sound, in particular, are largely unstudied.
My research to date has focused on wind turbines. For this project I will broaden my research to multiple sources of infra sound, thereby increasing the potential for multiple research partners, interest from multiple groups and industries, sources of funding, etc. This broadening of scope will also have a multiplier effect on establishing data bases and measurement standards, which are now lacking and which our University can have a significant role in helping to establish.

The specific aim of this project is to:

1. Record infra sound from man- made and natural sources.
2. Characterize the signals.
3. Reproduce the complete sound, both audible and infra sound, under controlled (Laboratory) conditions.

All data will be made available to the research community.

Infra sound recording and measurement.

I have constructed a measurement system consisting of G.R.A.S. 40AZ infra sound microphones (0.5 to 20000 Hz), an Infiltec INFRA20 micro barometer (0.05 to 20 Hz) and a Honeywell silicon pressure sensor (0-15 psi). Combining these signals will provide the full sound spectrum (from 0 to 20000 Hz). Signals are captured with National Instruments data acquisition hardware using Labview software. A number of sources have already been recorded.

Characterization of infra sound.

Current work is based on the narrow band Fourier transform of the signal. Results for Wind turbines are reported in [1]. These techniques will be extended to consider a variety of other infra sound sources.

Synthesis of infra sound.

To generate infra sound I will use an infra sound transducer device [2]. This device and associated amplifier-control unit, is designed to develop infra sound pressures within a controlled space, based on an arbitrary analog signal input.
The full power frequency response of the system is from ~0.2 Hz to ~ 40 Hz. A pressure sensor feedback module will also be assessed. This sensor can provide a method of closed loop pressure control of the control space or alternatively, analog pressure signals may be provided as feedback from user supplied infra sound microphone or pressure sensing system (+100 mV /Pa signal recommended). The goal of this stage will be to ensure that the device performs within its specifications so as to provide a dependable base for further research.

Student opportunities.

One student per term for three terms, starting fall 2015. I plan to hire undergraduate students via part time and/or Co-op positions. Students will develop software and hardware, take measurements, and perform analysis.

References.

1. J. Vanderkooy and R. Mann. “Measuring Wind Turbine Coherent Infrasound”. Wind Turbine Noise 2015, INCE/EUROPE, April 20-23, 2015. Glasgow, Scotland

2. Research Infrasound Source (RIS-10). Kevin Allan Dooley Inc.