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Impact of Building Vibrations on Vibrocardiographic Signal Collection

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RESEARCH OBJECTIVE

In order to obtain cleaner vibrocardiographic (VCG) signals, the vibrations of the building must be found and filtered. This study will use several methods to determine how vibrations of structures impact VCG collection.

BACKGROUND

According to the Centers for Disease Control and Prevention, heart disease is the number one cause of death in the United States, killing approximatley 614,348 people a year ("Leading Causes of Death," 2016). VCG signals, or the vibrations produced by the heart, can provide useful clinical information which may lead to develop new diagnostic methods. However, due to the sensitive equipment used to collect accurate results, any amount of outside noise or vibrations will taint the data collected and provide inaccurate results. Thus, the building vibrations and those of the surrounding areas where the VCG signals are being collected can potentially impact the end results of the diagnosis (Taebi A, Mansy HA, 2016).

Figure 1: Visual of VCG Signals

Building vibrations are a common occurrence and caused by various agents. From the outside, construction and traffic vibrations travel through the soil and into the building. These vibrations are mostly notable in high traffic and heavy construction areas. Other causes of building vibrations are the ones from the inside of the building. Walking, talking, closing doors, using of elevators, air conditioning, and fluid plumbing systems all contribute substantially to these vibrations ("Building vibration," n.d.). This study will investigate the effect of structural vibrations on VCG collection and determine whether they significantly alter the end result.

METHODS

In order to see if the building vibrations impact VCG recordings, an experiment must be run:

~~First, use an accelerometer to collect the vibrations on each floor of the building and the VCG signal of a subject on four different days.

~~Next, use the, "Data Analysis: Fourier Frontier" tool on Excel to convert this data into frequency domain.

~~Graph the results and take note of dominate frequencies.

~~If VCG and building vibration frequency domain graphs share dominate frequencies, we can assume that building vibration effected the collected VCG signals.

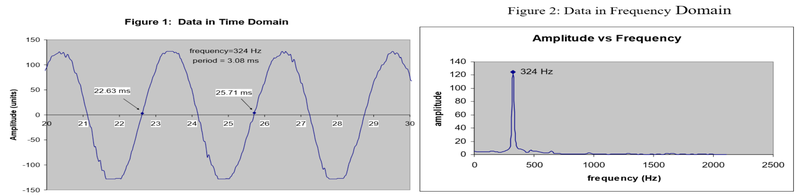


Figure 2: Data in Time Domain vs Data in Frequency Domain Comparison (Citation: 3)

RESULTS

After completing the experiement, I noticed that the VCG signals produced two dominate frequencies. These frequencies occur at 9.14 ± 0.644 and 19.77 ± 3.001 . In regards to the building vibrations, various dominate frequencies were produced, however, the only ones which could potentially impact the VCG signals were 24.583 ± 0.180 and 22.188 . Thus, it is possible that the building vibrations affect the second dominate VCG frequency. Now that this is concluded, a researcher collecting VCG signals in the lab should simultaniously record the building vibrations, and then deduct the building vibrations from the VCG signal. This will clean up the VCG signal and make it more accurate.

Figure 3: Building Vibration Results in Frequency Domain

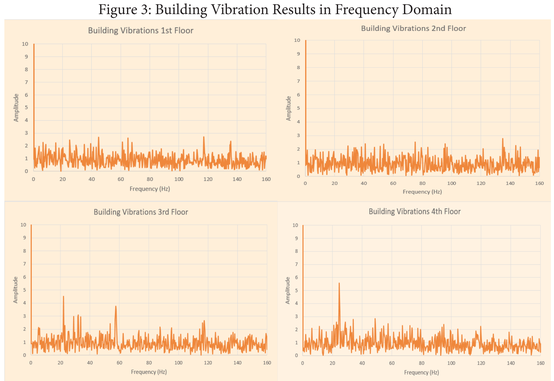
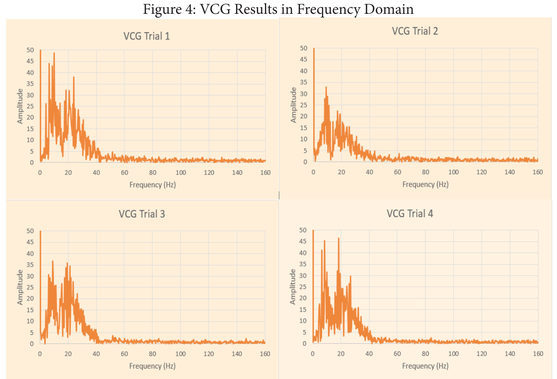


Figure 4: VCG Results in Frequency Domain



BUDGET

$0.00

Every thing required for this project, such as an accelerometer and a computer with Excel, is provided by the Biomedical Acoustics Research Lab and any computer lab in UCF, respectivley.

TIMELINE

January 2017
Collect building vibration data

Febuary 2017
Collect VCG data

March 2017
Analyze collected data and make conclusion

April 2017
Present data

REFERENCES

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