Development of a Closed Loop FMCW Radar Device to Extract Biometric Data for Security and Irregularity Detection

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NOTE - Data Compilation is still being done - will have useful results to display in coming weeks

***Abstract*—* WILL ADD WHEN PAPER IS FINISHED ***

***Index Terms*—* WILL ADD WHEN PAPER IS FINISHED ***

I. Introduction

*explain issues with current sensing methods (cost, usability, length of use)

II. Problem Statement

This project aims to develop an accurate and optimal algorithm to extract and store biometric data from a Frequency Modulated Continuous Wave radar within an easily-used device for data privacy and early irregularity detection.

A. Maintaining the Integrity of the Specifications

III. Related Work

* ADDED FROM EARLIER REVIEW, WILL FORMAT WHEN PROJECT SCOPE IS CAPPED *

Source 1 - Time Frequency Analysis of Wavelet and Fourier Transform (Jarlton Wirsing) [November 18th, 2020]

This source details the fundamentals of the wavelet transform as an alternative transform method to the Fourier and the Fast Fourier Transform for signal processing and decomposition. The Fourier transform is limited to a global scale, and the lack of ability to account for local features. In response to this, the windowed Fourier transform was created, which applies a window function of a short period to a signal and applies the transform only to that window. This, in turn, is limited by local features that are larger or shorter than the applied window function and the lack of time resolution scaling between high and low frequencies. The wavelet transform scales in time and frequency, and because of this, beats out the limitations of the Fourier transform in these areas. The wavelet transform scales the bandwidth of the applied filter inversely to the frequency, allowing it to better account for signals of differing frequency. Many biometric signals are less consistent than ideal, like heart rate. Heart and respiratory rates are non-constant and can vary in frequency based on circumstance and other component signal pollution. Considering the wavelet transform for signal decomposition could allow for a more accurate assessment of biometric data. The wavelet transform does have an implementation in MATLAB, so there could be tests done to verify the accuracy and speed of the wavelet transform in comparison to different Fourier transform methods for biometric data acquisition.

Source 2 - Compression and Encryption of ECG Signal Using Wavelet and Chaotically Huffman Code in Telemedicine Application (Mahsa Raeiatibanadbooki, Saeed Rahati Quchani, MmohammadMahdi KhalilZade, Kambiz Bahaadinbeigy) [January 16th, 2016]

This source develops encryption and wavelet compression methods to secure, transmit, and store ECG data for physicians' access. Many of the signal processing methods are similar to those of Source 1 in the previous literature review, such as noise removal and phase restriction, but it is significant to reference a source that compression and encrypts biometric data with minimal losses across larger distances than necessary for the current project, especially considering the use of wavelet transform for reasons discussed in Source 1.

IV. Methodology

* WILL REFORMAT WHEN PROJECT SCOPE IS CAPPED *

Simulated radar has 3 subjects with individual position, velocity, and angle-of-attack data The radar has a configurable antenna array where the number or RX and TX antennas, as well as the distance between the antennas, can be adjusted

- Currently working on processing simulated chirp data - After a base algorithm that can properly decompose the signal is developed, further testing to optimize processing speed and accuracy based on signal decomposition methods can be conducted - Separate tests on Fourier vs. Wavelet transforms - Potential use of Quantum Fast Fourier Transform (QFFT) - Data will need to be encrypted/transmitted/stored, so testing on best encryption and compression methods to ensure security and persistence of necessary features will need to be done

National Science Foundation, Professor

V. Experimental Results and Evaluation

* WILL ADD WHEN I GET DATA *

VI. FINDINGS AND DISCUSSION

* WILL ADD WHEN I GET DATA THAT ISN'T JUST SIMULATION *

VII. CONCLUSION FUTURE WORK

* WILL ADD WHEN I GET DATA *

References

*WILL ADD ALL WHEN PROJECT SCOPE IS CAPPEDG. Eason, B. Noble, and I. N. Sneddon, "On certain integrals of Lipschitz-Hankel type involving products of Bessel functions," Phil. Trans. Roy. Soc. London, vol. A247, pp. 529–551, April 1955. J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73. I. S. Jacobs and C. P. Bean, "Fine particles, thin films and exchange anisotropy," in Magnetism, vol. III, G. T. Rado and H. Suhl, Eds. New York: Academic, 1963, pp. 271–350. K. Elissa, "Title of paper if known," unpublished. R. Nicole, "Title of paper with only first word capitalized," J. Name Stand. Abbrev., in press. Y. Yorozu, M. Hirano, K. Oka, and Y. Tagawa, "Electron spectroscopy studies on magneto-optical media and plastic substrate interface," IEEE Transl. J. Magn. Japan, vol. 2, pp. 740–741, August 1987 [Digests 9th Annual Conf. Magnetics Japan, p. 301, 1982]. M. Young, The Technical Writer's Handbook. Mill Valley, CA: University Science, 1989.