Technology Licensing Opportunity

UNIVERSITY OF SASKATCHEWAN

SPARSE REPRESENTATION AND COMPRESSED SENSING IN SEISMOCARDIOGRAM (SCG) SYSTEMS

Invention:

This invention provides an efficient framework to represent, acquire, and recover signals in seismocardiogram (SCG) systems, based on the theory of compressed sensing. The target market applications include mainly the health care industry, with possible extensions to security and biometric systems. Currently, the competing technology is the electrocardiogram (ECG). However, the SCG has been shown to provide a wider range of disease detection capabilities compared to the ECG.

The seismocardiogram (SCG) measures the acceleration generated by the mechanical contraction and relaxation activities of the heart. It has been demonstrated to facilitate accurate identification of various coronary artery diseases. However, applications involving SCG are severely hampered by the large amount of data to be processed, preventing real-time monitoring and detection of diseases. This challenge is exacerbated in the case of tri-axial SCG, with the increase in data collected. Addressing this challenge, sparse representation and compressed sensing (CS) represent a promising framework to potentially capture and represent signals significantly below the Nyquist rate. To this end, this invention explores the possibility of using CS with SCG systems, by proposing suitable signal processing algorithms, and evaluating these methods with experimental data. The obtained results demonstrate significant reduction in bandwidth, while maintaining accurate signal recovery.

Applications:

Preliminary research has proved that the following cardiac states can also be detected by seismocardiogram in its early stages as compared to electrocardiogram.

1. Coronary Artery disease
2. Sports Medical (serial testing, systolic performance, diastolic performance, mitral valve prolapse, hypertrophic cardiomyopathy)
3. Ischemic Heart Diseases (IHD)
4. Sinus Arrhythmia: Tachycardia, bradycardia
5. Nonsinus Arrhythmia: ventricular & atrial flutter/fibrillation Hypertension

Advantages over existing Technology:

In this work, a Compressed Sensing-based scheme is proposed to efficiently reduce the bandwidth necessary to process tri-axial SCG signals. The obtained results show that it is possible to achieve at least a 1/3-compression ratio, while still maintaining accurate recovery (quantified by a worst-case PSNR=36.9852 dB, based on preliminary experimental data collected for a group of 10 subjects). Furthermore, the scheme does not require stringent preprocessing. In fact, the segmentation can be performed coarsely, by a windowing scheme that takes into account a complete heartbeat. These properties should facilitate practical implementations of the proposed scheme in a wide range of application scenarios involving SCG signals.

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