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学 位 論 文 の 概 要 及 び 要 旨

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題　　目　Noise and respiration component reduction for non-contact heart rate measurement based on Doppler radar

（ドップラーレーダを基にする非接触心拍検出のための雑音及び呼吸成分除去）

学位論文の概要及び要旨

This paper summarizes research conducted with the aim of improving heart rate measurement reducing respiration and noise using the Adaptive Notch filter (ANF) and Bispectrum method.

In recent years, with the onset of an aging society, monitoring of biological information has attracted attention. In addition, there is growing interest in monitoring biological information not only in humans but also in animals to detect diseases and changes in physical condition, and to check the physical condition after surgery.

An adaptive notch filter that is effective for estimating narrowband signals, the fundamental frequency due to heartbeat and respiration can be estimated without the limitation of frequency resolution. Using a respiration harmonic removal filter consisting of cascaded notch filters, it is possible to remove respiration harmonics that interfere with heartbeat components. The removal notch frequency of the respiratory harmonic removal filter is determined based on the fundamental frequency of breathing estimated by the adaptive notch filter and is adaptively controlled.

The bispectrum in reducing the influence to accurately estimate the heart rate. The bispectrum preserves phase information for describing quadratic nonlinear coupling between frequency components. In the bispectrum, the signal due to the heartbeat is distributed in the diagonal component, and the receiving noise is less likely to be distributed in the diagonal component. I observed the bispectrum usefulness for lowering reception noise and precisely estimating heart rate.

Also, the one-dimensional-based bispectrum approach measures heart rate without physical contact. Since high-order statistics and bispectrum have zero means for Gaussian noise, bispectrum can enhance the accuracy of heart rate estimates. However, the computational complexity is increased by the bispectrum. As a result, I presented the bispectrum in one dimension, sliced.

In the experiment, measurements are performed using a Doppler radar with a carrier frequency of 24GHz, and the optimal parameters for computer simulation are investigated. Experimental results with subjects in a resting state showed that the proposed Adaptive Notch Filter, one-dimension, and two-dimension methods were able to reduce the average RMSE of the measured value of the non-contact sensor. This method was able to improve the heart rate estimation accuracy, confirming the effectiveness of this method.