ABSTRACT

Optical sensors that use photons as sensing elements are increasingly becoming important and relevant in the field of non-invasive diagnostics. The reason is that they have a simple construction, easy to use and relatively inexpensive in comparison with tools such as EEG, MRI and FMRI that can be use for research purposes without much investment. Among the various optical sensors available, the Photoplethysmography (PPG) sensors that are capable of measuring the blood volumetric changes in the subcutaneous vessels in conjunction with sensitive temperature sensors that enables the monitoring of breathing activity are used in the present study. Detailed analysis of the frequency spectrum of the PPG signal shows a peak around 0.12 Hz other than the two principle frequency components namely – the cardiac peak appearing at around 1 Hz corresponding to 60 pulsations a minute (\(f_h\)) and the respiratory appearing at around 0.25 Hz corresponding to 15 inspiration/expiration cycles per minute (\(f_b\)). The amplification/prominence of the low frequency rhythms also called the relaxation rhythm that appears around 0.12Hz (\(f_l\)) in conjunction the respiratory peak during deep breathing is reported in the present work.

Next step in evaluating the raw signal is the application of Fast Fourier Transform (FFT). For filtration of the raw data, application of Fast Fourier Transform (FFT) / Power Spectral Density (PSD) and plotting graphs, the Diadem 7.0 program is used. FFT gives a graph that clearly portrays the power distribution of the signal over the entire frequency spectrum. As the FFT of the PPG signal contains numerous peaks, Power spectral density which nothing but the square of FFT has been used to evade confusion. Usually the cardiac peak is the most dominant peak in the power
spectrum of any normal PPG recording. A relatively weaker peak will be detectable at the breathing frequency. Other than these two peaks, a peak may be detected varying over a wide range 0.14 and less, depending on the mental and physical condition of the subject under study. Though several explanations are given for the appearance of this low frequency component, the origin is still debatable.

*Keywords: Photoplethysmography, cardiac, respiratory, power density spectrum and low frequency rhythm.*