Frequency-domain Heart Rate Variability Analysis Performed by Digital Filters

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Short-term heart rate variability (HRV) analysis based on spectral methods has been widely applied to assessment of autonomic nervous system activities for many physiological and mental disorders. Recently, homecare devices designed for heart monitoring have attempted to include HRV analysis function. These homecare devices based on some microprocessors with low computational power might encounter difficulty in implementing HRV spectral analysis for real-time applications. Therefore simple and less computation consuming methods to calculate frequency domain HRV indicators are needed. In this study, time-domain digital filters are proposed to solve this problem. The low-frequency (LF, 0.04-0.15 Hz) band and high-frequency (0.15-0.4 Hz) band signals of HRV are filtered from original 256 beats HRV signal. The variances of these two signals were considered as the equivalence of LF and HF powers derived from standard Fourier-based spectra respectively. Some finite and infinite impulse response (FIR and IIR) filters were tested to show their feasibility and find the optimal filter. The results showed that the time-domain filter with simple modification can generate comparable LF and HF power of HRV. The FIR filter-based method just uses the convolution operator thus it can simplify the design and deployment of short-term HRV analysis in homecare devices and make the real-time applications easier.