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Mathematical implementation of hybrid fast fourier transform and discrete wavelet transform for developing graphical user interface using visual basic for signal processing applications

Abstract

In recent years, the application of discrete wavelet transform (DWT) on biosignal processing has made a significant impact on developing several applications. However, the existing user-friendly software based on graphical user interfaces (GUI) does not allow the freedom of saving the wavelet coefficients in .txt or .xls format and to analyze the frequency spectrum of wavelet coefficients at any desired wavelet decomposition level. This work describes the development of mathematical models for the implementation of DWT in a GUI environment. This proposed software based on GUI is developed under the visual basic (VB) platform. As a preliminary tool, the end user can perform "j" level of decomposition on a given input signal using the three most popular wavelet functions-Daubechies, Symlet, and Coiflet over "n" order. The end user can save the output of wavelet coefficients either in .txt or .xls file format for any further investigations. In addition, the users can gain insight into the most dominating frequency component of any given wavelet decomposition level through fast Fourier transform (FFT). This feature is highly essential in signal processing applications for the in-depth analysis on input signal components. Hence, this GUI has the hybrid features of FFT with DWT to derive the frequency spectrum of any level of wavelet coefficient. The novel feature of this software becomes more evident for any signal processing application. The proposed software is tested with three physiological signal-electroencephalogram (EEG), electrocardiogram (ECG), and electromyogram (EMG)-samples. Two statistical features such as mean and energy of wavelet coefficient are used as a performance measure for validating the proposed software over conventional software. The results of proposed software is compared and analyzed with MATLAB wavelet toolbox for performance verification. As a result, the proposed software gives the same results as the conventional toolbox and allows more freedom to the end user to investigate the input signal.

Keywords — Discrete wavelet transform (DWT), graphical user interface (GUI), fast Fourier transform (FFT)