

#### Design Digital Non-Recursive FIR Filter by Using Exponential Window

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#### ABSTRACE

One of the most effective variables is the far-end stopband attenuation especially when the signal needed to be filtered has a great concentration of spectral energy. In a sub-band coding, the filter is intended to separate out various frequency bands for independent processing. When it is applied on speech, the far-end rejection of the energy in the stopband needs to be as higher as possible to make leakage of the energy from one band to another as lower as possible. Therefore, the designed filter should have special specifications which should provide better far-end stopband attenuation (amplitude of last ripple in stopband). Finding a digital filter that has a higher performance far-end stopband attenuation than Kaiser Window is very valuable when the FIR filter constructed by the use of Kaiser Window far-end stopband attenuation becomes better than the one constructed by the well-known adjustable windows, for instance, the special cases of Ultra-spherical windows, Dolph-Chebyshev and Saramaki.

In this paper, the design of digital non-recursive finite impulse response (FIR) filter by using Exponential window is proposed. Also, the construction of non-recursive digital FIR filter has been presented through applying Exponential window. After applying the Exponential window, it is found that the far-end stopband attenuation becomes better than the filter constructed by Kaiser window, and that is one of the advantages of filter building by using Exponential window over Kaiser window. The proposed scheme is simulated by MATLAB. All the simulation results show a good agreement with the proposed theory.

Keywords: Digital FIR Filter, Side-lobe Roll-off Ratio, Far-end Stopband Attenuation, Window Technique, Exponential Window

#### INTRODUCTION

A more comprehensive view of the truncation and smoothing operations is in terms of window functions (or windows for short). Windows are normally compared and classified into different types according to their spectral characteristics. Window functions have been widely used in various digital signal processing (DSP) applications such as signal analysis, signal estimation, digital filter design and speech processing [1][2].

Various windows have been proposed to achieve the desired solutions [3][4][2][5]. Cosine hyperbolic function is one of them [6]. The idea of this window is based on the Kaiser window, but it has an advantage since there is no expanding in the power series in the time domain representation. This window gives a better ripple ratio for wider main lobe width and larger side lobe roll-off ratio along with the ultra-spherical comparison. When its function is merged with the Hamming window, it produces a better performance in terms of the ripple ratio, better than a same margin of a Kaiser and Hamming windows. Another method to design ultra-spherical window functions in order to reach prescribed spectral characteristics can be found in [4]. This method is made of combining various techniques basically to measure the ultra-spherical window, independent parameters which are ripple ratio and main-lobe width or null-to-null width along with a user-defined side-lobe pattern can also be reached. A simple comparison has been made between the ultra-spherical and Kaiser Windows and the result of this comparison showed that there is a difference in the performance which depends on the required specifications [14].

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