COSINE MODULATED FILTER-BANK TRANSMULTIPLEXER USING KAISER WINDOW

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ABSTRACT

This paper presents the design of near perfect reconstruction (NPR) cosine modulated filter-bank (CMFB) transmultiplexer using Kaiser Window approach. Cosine modulation is used to design the synthesis an analysis sections of the transmultiplexer. The prototype filter is designed by using high side-lobe fall off rate (SLFOR) Kaiser window functions. A bisection optimization algorithm has been used, and without optimization algorithm used. The use of optimization algorithm is reduce the effect of ISI (inter symbol interference) and ICI (inter carrier interference).

Keywords -OFDM, ICI, ISI, Kaiser Window SLFOR

I. INTRODUCTION

Orthogonal frequency division multiplexing (OFDM) and discrete multitone transmission (DMT) are the widely use technologies in multicarrier communication. Both use IFFT or DFT for the modulation and demodulation of signals. Due to multipath fading over wireless communication, the consecutive OFDM symbols overlap at the receiver and gives rise to ISI and ICI. To minimize the ISI in OFDM system the guard band is used, which may loss of spectral efficiency. The DFT based modulation filter has side lobes of -13 dB. It provides better stop band performance with less complexity. The main contribution of this paper can summarize as below:
1. The fixed Kaiser Window functions have certain limitations in selecting input parameters. Therefore, popular variable window functions with high side lobe falloff rate (SLFOR) are used for the design of prototype filters.
2. A iteration method and without optimization is discussed.
II. CONVOLUTION CODES

Convolution codes are specified on the basis of three parameters \( (n, k, L) \), where \( n \), \( k \), \( L \) are length of the codeword, number of input bits and constraint length respectively. The constraint length \( L \), defines the past number of input bits in the memory register that affect the output code word. The rate of Convolution code is defined as the ratio of number of output bits to the input bits and is denoted by ‘\( r \)’. Therefore code rate \( r = k/n \). [2]

III. DFT MULTICARRIER TRANSMISSION TECHNIQUE

To generate OFDM successfully the orthogonality principle between the carriers must be maintained. For this reason, OFDM is generated by first choosing the spectrum required, based on the input data, and modulation scheme used. Each carrier to be produced is assigned some data to transmit. The required amplitude and phase of the carrier is then calculated based on the modulation scheme (typically differential BPSK, QPSK, or QAM). The required spectrum is then converted back to its time domain signal using an Inverse Fourier Transform. In most applications, an Inverse Fast Fourier Transform (IFFT) is used. The IFFT performs the transformation very efficiently, and provides a simple way of ensuring the carrier signals produced are orthogonal.

The Fast Fourier Transform (FFT) transforms a cyclic time domain signal into its equivalent frequency spectrum. The IFFT performs the reverse process, transforming a spectrum (amplitude and phase of each component) into a time domain signal. An IFFT converts a number of complex data points, into the time domain signal of the same number of points. Each data point in frequency spectrum used for an FFT or IFFT is called a bin. The orthogonal carriers required for the OFDM signal can be easily generated by setting the amplitude and phase of each frequency bin, then performing the IFFT. Since each bin of an IFFT corresponds to the amplitude and phase of a set of orthogonal sinusoids, the reverse process guarantees that the carriers generated are orthogonal. Figure 1 below shows the block diagram of basic OFDM transmitter and receiver. The signal generated is at base-band and so to generate an RF signal the signal must be filtered and mixed to the desired transmission frequency.

![Fig.1 Block Diagram of OFDM Transmitter and Receiver](image)

IV. TRANSMULTIPLEXER SYSTEM:

The \( M \)-channel maximally decimated transmultiplexer is shown in Fig.2. Basically it is a TDM-FDM-TDM converter. It consists of synthesis block at transmitter end and precedes the analysis block at receiver end. At the transmitter end, \( M \)-input signals are first interpolated by
the factor of $M$ and synthesized into one composite signal using synthesis filter bank, $F_k(z)$ for $k = 0, 1, \ldots, M - 1$. Conversely, at the receiver end, the composite signal is split out into $M$-output signals with the help of the analysis filter bank $H_k(z)$ and then decimated by a factor of $M$. The equation of the transmultiplexer is given as:

$$\hat{X}_k(Z) = \sum_{m=0}^{M-1} S_{km}(Z) X_m(Z)$$  \hspace{1cm} (1)

$$\hat{X}(z) = s(z)x(z)$$  \hspace{1cm} (2)

If, $s(z)$ is diagonal then it is free from cross talk.

$$\hat{X}_k(z) = S_{kk}(z)x_k(z)$$  \hspace{1cm} (3)

**V. SIMULATION RESULT**

**Fig. 2** M-channel transmultiplexer

**Fig.3:** With optimization algorithm using Kaiser Window approach
Without optimization the cosine modulated filter bank results are:

For M=8:

For M=16:

VI. CONCLUSION

In this paper, the performance of TMUX-OFDM systems and cosine modulated filter bank systems is discussed. The cosine modulated transmultiplexer using Kaiser Window approach is give better result as Blackman window. The optimization algorithm gives less error as compared to without optimization.

REFERENCES