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Performance Analysis of Filter Bank Multicarrier Based on Massive MIMO Systems

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ABSTRACT: This paper introduces the Filter bank Multicarrier technique to overcome the disadvantage of Orthogonal Frequency Division Multiplexing (OFDM) technique like Carrier Frequency Offset (CFO), Time and Frequency Synchronization in application of Massive MIMO systems. By using Filter Bank Multicarrier technique in Massive MIMO applications reduces the complexity and doesn't need cyclic prefix (CP). In this proposed work, the high spectral efficiency was achieved by using the filter bank technique. The absence of cyclic prefix in FBMC increases the bandwidth efficiency.n this proposed work, the signal to Interference Noise ratio (SINR) and the signal to interference ratio (SIR) was increased. By increasing the number of antennas for multiple users leads to efficient data transmission. Self-equalization, a property of FBMC in massive MIMO that is introduced in this paper, has the impact of reducing complexity. In this proposed work, self equalization parameter was obtained. Finally, the resultant output evaluate the high spectral efficiency.

KEYWORDS: Massive MIMO, Filter bank Multicarrier Modulation, Carrier Frequency Offset.

I.INTRODUCTION

In signal processing, Filter Bank multicarrier technology is a subclass for multicarrier systems. The basic principle of (FBMC) is dividing the frequency spectrum into more number of narrow subchannels [3]. The subbands in the receivers isdownsampled and their low frequency are resampled at a low rate. By upsampling the bandpasssubbands, the same result can be achieved. In recent years multicarrier is adopted in many systems such as (LTE,WAN).To overcome the disadvantage of Orthogonal Frequency Division Multiplexing [1], Filterbank technique is employed.

The system connected with multiple number of antennas and large-scale number of antenna systems is also considered here. By increasing the number of antennas leads for efficient data transmisssion. Massive MIMO is also known as large scale antenna systems. By comparing the previous results mathematically, analyzing the signal to Interference Noise ratio(SINR) using Matched Filter(MF) and Minimum mean Square Error(MMSE) technique is calculated. This paper analyzed the fundamental problem of self equalization in multicell systems. Further, a new multicell of (MMSE) and (MF) based precoding method can solve the problem.

The main advantage of FBMC is the signal strength gets increased.Another benefit in FBMC is carrier aggregation that is for transmission (non-contiguous band of spectrum) is used. In each of the subcarrier band that is assigned to a confined range and it nullifies the interference from other bands. A new innovation of finding in this paper is known as massive MIMO systems, by linearly combining the components of the signals through different channels that can smoothen the channel distortion[9][10]. Hence FBMC is a potential candidate plays a major role in massive MIMO applications.

Modulation technique is Quadrature Amplitude Modulation (QAM) and cosine modulated multitone (CMT). QAM is both analog and digital modulation scheme. It gives two analog message signal or digital bit streams,by modulating its amplitude of both carrier waves using some digital modulation scheme or amplitude modulation scheme or analog modulation scheme.QAM is one of the modulating technique which can combine two amplitude modulated signals into a one channel,hence it double the bandwidth effectively.In some special wireless application systems, QAM Modulation method is used along with the Pulse Ampltiude Modulation (PCM) on digital systems.

Simulation-based results have demonstrated that addressed solutions clearly outperform previous MIMO FBMC schemes in terms of SINR. The objective of this paper is to analyze the numerical and simulation results of Signal to Interference Ratio performance of QAM Filterbank for Matched Filter (MF) and Minimum Mean Square Error

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(MMSE) detectors. To observe the Signal to Interference Ratio performance when the number of antennas are increased Filter (MF) and Minimum Mean Square Error (MMSE) detectors was analysed.

II.SYSTEM MODEL AND ASSUMPTIONS

The system model of ‘n’ no. of antennas with equalizer output $X_k(n)$ is expressed as,

$$\xi = E\,[(|X_k(n)|^s - R)^2] \qquad (1)$$

where $X_k(n)$ is equalizer output, k is No. of subcarrier channel ,q be ainteger(usually set equal to 2) and n is a No of antennas.

$$R = \frac{E\,[|t|2^{q}]}{E\,[|t|^{q}]} \quad (2)$$

Let, t will be a No. of symbols using in PAM and E refers to Expectations.y_l=(t(l)+ j p(l)) m_l (3)
By considering $p_l=[p_l(0),\ldots\ldots\ldots p_l(n-1)]$,q(l) is the contribution of ISI and ICI and t(l) be a Transmit symbol.

$$Y = \sum_{i=0}^{L-1} yi + V \quad (4)$$

Let V must be Channel noise vector,y be user data input with *l* channels.Equation (4) may be re-arranged as,

$$\hat{y} = A[\tfrac{t}{s}] + V \qquad (5)$$

Let us considered $\hat{X}= [y_R^T y_I^T]^T$,$\hat{V}=[V_R^T \; V_I^T]^T$,$\hat{p}_l = [p_{l,R}^T p_{l,I}^T]^T$, t= [t(0),t(1)……………t(L-1)], s=[s(0),s(2)……………s(L-1)],R=Real part and I=Imaginary part.The matched filter detector is used to estimate the vector ‘t’.

$$t_{MF}=D^{-1}\,\Gamma A^T\hat{y} \qquad (6)$$

Here D is considered as $\mathrm{diag}\{\|p_0\|^2, \ldots\ldots, \|\hat{p}_{L-1}\|^2\}$. Using equation(6), Final SINR equation for matched filter is expressed as,

$$SINR_{MF}(l) = \frac{\left\|\tilde{h}_l\right\|^4}{\sum_{i=0}^{K-1}\left(\left|\tilde{h}_l^T\tilde{h}_i\right|^2 + \left|\tilde{h}_l^T\breve{h}_i\right|^2\right) + \sigma_v^2\left\|\tilde{h}_l\right\|^2}$$

Final SINR equation for Minimum mean square error technique,

$$SINR_{MMSE}(l) = \frac{\left|w_l^T\tilde{h}_l\right|^2}{\sum_{i=0}^{K-1}\left|w_l^T\tilde{h}_i\right|^2 + \sum_{i=0}^{K-1}\left|w_l^T\breve{h}_i\right|^2 + \sigma_v^2\left\|w_l\right\|^2}$$

III.FBMC

In digital signal processing, array of the filter bank is of band-pass filters that divides the input signal into multiple components, each signal carrying a single frequency sub-band for the original signal. Important application of a filter bank is a graphic equalizer, it can attenuate the components differently and again it combine them into some modified version of that original signal. The process of decomposition is performed by filter bank is called analysis (analysis of the signal interms of their components in each sub-band); the analysis of its output is referred to a subband signal with multiple subbands have filters in the filter bank. The process of reconstruction of signals is called synthesis, reconstruction of a complete signal in analysis and synthesis filter bank. Thereconstruction of a complete signal resulting from the filtering process.

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Here the number of antennas are increased and its denoted by the factor (N). By doing so the efficieny for the multiple users is high.The spectral efficieny was efficiently increased. Minimum Mean Square Error (MMSE) technique is used to analysis the numerical results. Below Figure 1 and Figure 2 is the comparative simulated results of OFDM (vs) FBMC [2][3]. Thus it can clearly explain about the signal shape of each carrier.

IV. RESULT AND DISCUSSION

The FBMC was explained in section II is simulated using MATLAB software. In this part, the various study of design schemes or methods for FBMC technique which enhances the flexibility,when adopting the MIMO technology.The major bottleneck in Filter bank based massive MIMO is Inter symbol Inteference (ISI) signals that are mitigated by using some efficient decoding or modulation scheme like cosine Modualtion Tone (CMT) or Quadrature amplitude Modulation (QAM) will improve the MIMO techniques more compatiable. Finally, the resultant output shows that FBMC-MIMO could be a best alternative rather than OFDM-MIMO. .

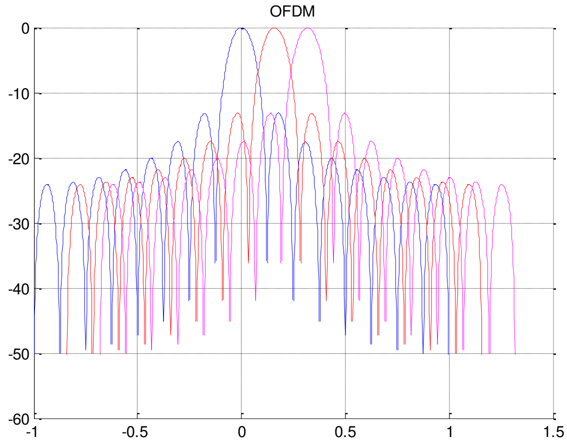

Figure 1. Comparative simulated results of OFDM

The above figure is the simulated results of OFDM using signal to interference noise ratio (SINR).The SINR for number of antennas used here is N=126. And thus the resultant signal produces some drawbacks because of the signal shape broaden in each carrier. To avoid those problems in OFDM,FBMC is used.

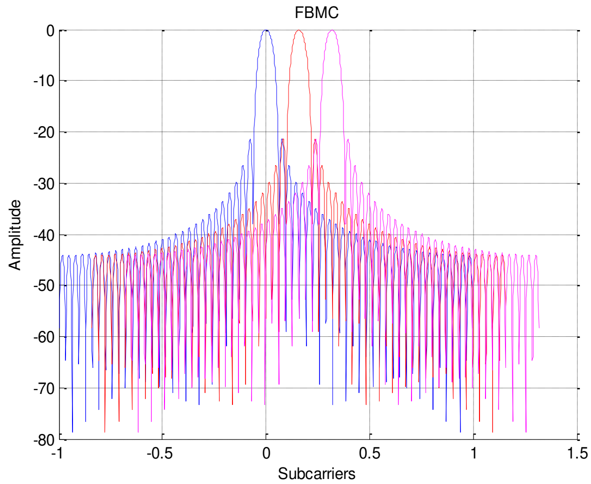

Figure 2. Comparative results of FBMC

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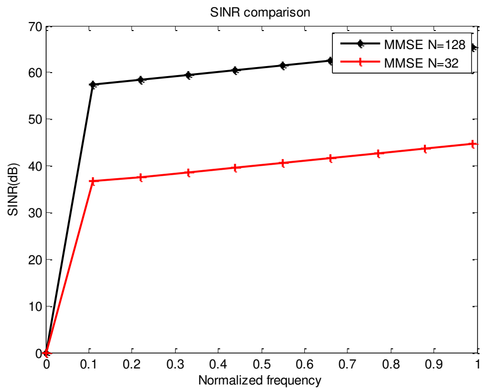

Figure 3 Numerical Results of SINR

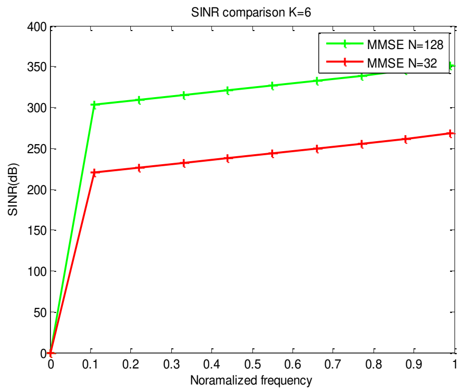

Figure 4 Numerical Results of SINR for K=6

The above figure 1 is the simulated result of FBMC using (SINR).The disadvantages occurred in OFDM has been overcame by FBMC. The above figure 2 is the numerical results of the SINR using minimum mean square error (MMSE). By increasing the number of antennas for N=126 and N=32 for single users is Signal to Interference Noise ratio (SINR) technique. It is to be noted that efficiency is high and it is plotted as graph. The figure 4 presents the numerical results of the SINR using MMSE technique. The number of antennas increased for N=32, N=126 and K=6. Finally the efficiency was increased and it is plotted as graph.Figure 6 represents the numerical result of the proposed work (self equalization) parameter is estimated using Bit Error rate(BER).

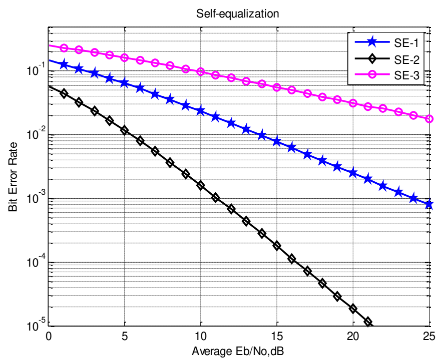

Figure 6 Numerical results of self-equalization

V.CONCLUSION

In this paper,the filter bank multicarrier technology is replaced instead of OFDM in massive MIMO applications.The simulated and numerical results of signal to Interference Noise ratio (SINR) of Quadrature amplitude Modulation filterbank for Minimum Mean Square Error (MMSE) was estimated. It shows that the number of antennas were increased, the SINR also gets increased. Quadrature Amplitude Modulation (QAM) technique was proposed for the filter bank multicarrier based massive MIMO systems.And some important parameters such as self -equalization was analysed.

REFERENCES

[1] Farhang-Boroujeny B.,"OFDM versus Filter Bank Multicarrier", IEEE Signal Processing magazine, vol.28, pp.92-112, May 2011.
[2] M. Bellanger,"Filter banks and OFDM/OQAM for high throughput wireless LAN", 3rd International Symposium on Communications, Control and Signal Processing. ISCCSP 2008, pp 758-761, Malta, Mar 2008.
[3] P. Siohan, C. Siclet, and N. Lacaille, "Analysis and design of OFDM/OQAM systems based on filter bank theory", IEEE Transactions on Signal Processing, vol. 50, no. 5, pp. 1170-1183, May 2002.

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[4] M. Bellanger, ”Specification and design of a prototype filter for filter bank based multicarrier transmission,” in Proc. IEEE Int. Conf. Acoustics, Speech, and Signal Processing, Salt Lake City, USA, pp. 2417-2420, May 2001.

[5] S.TenBrink,“Convergencebehavior of iteratively decoded parallel concatenated codes” IEEE Trans. Commun., vol. 49, no. 10, pp.1727–1737, 2001.

[6] H.Holma, S. Heikkinen, O.A. Lehtinen, and A. Toskala, “Interference considerations for the time division duplex mode of the UMTS terrestrial radio access” IEEE J. Sel. Areas Commun., vol. 18, no. 8,pp. 1386–1393, 2000.

[7] X.Li and J. Ritcey, “Bit-interleaved coded modulation with iterative decoding”,IEEECommun. Lett., vol. 1, no. 6, pp. 169–171, 1997.

[8] T. Zemen, M. Loncar, J.Wehinger, C. Mecklenbrauker, and R.Muller, “Improved channel estimation for iterative receivers” inProc. IEEE Global Telecommun.Conf. (IEEE GLOBECOM), 2003, vol. 1, pp.257–261.

[9] M. Bellanger, ”Specification and design of a prototype filter for filter bank based multicarrier transmission,” in Proc. IEEE Int. Conf. Acoustics, Speech, and Signal Processing, Salt Lake City, USA, pp. 2references

[10] T.L.Marzetta, “Noncooperative cellular wireless with unlimited numbers of base station antennas” IEEE Trans. Wireless Commun., vol. 9, no. 11, pp. 3590–3600, 2010.

[11] F.Fernandes, A. Ashikhmin, and T. Marzetta, “Inter-cell interference in noncooperative TDD large scale antenna systems” IEEE J. Sel. Areas Commun., vol. 31, no. 2, pp. 192–201, 2013

[12] H. Yin, D. Gesbert, M. Filippou, and Y. Liu, “A coordinated approach to channel estimation in large-scale multiple-antenna systems” IEEE J. Sel. Areas Commun., vol. 31, no. 2, pp. 264–273, 2013

[13] T. Marzetta, and S. Vishwanath, “Pilot contamination and precoding in multi-cell TDD systems,” J. Jose, A.Ashikhmin, IEEE Trans. Wireless Commun., vol. 10, no. 8, pp. 2640–2651, 2011.

[14] H. Q. Ngo and E. Larsson, “Evd-based channel estimation in multicell multiuser MIMO systems with very large antenna arrays” in Proc.IEEE Int. Conf. Acoust.,Speech, Signal Process. (ICASSP), 2012, pp.3249–3252.

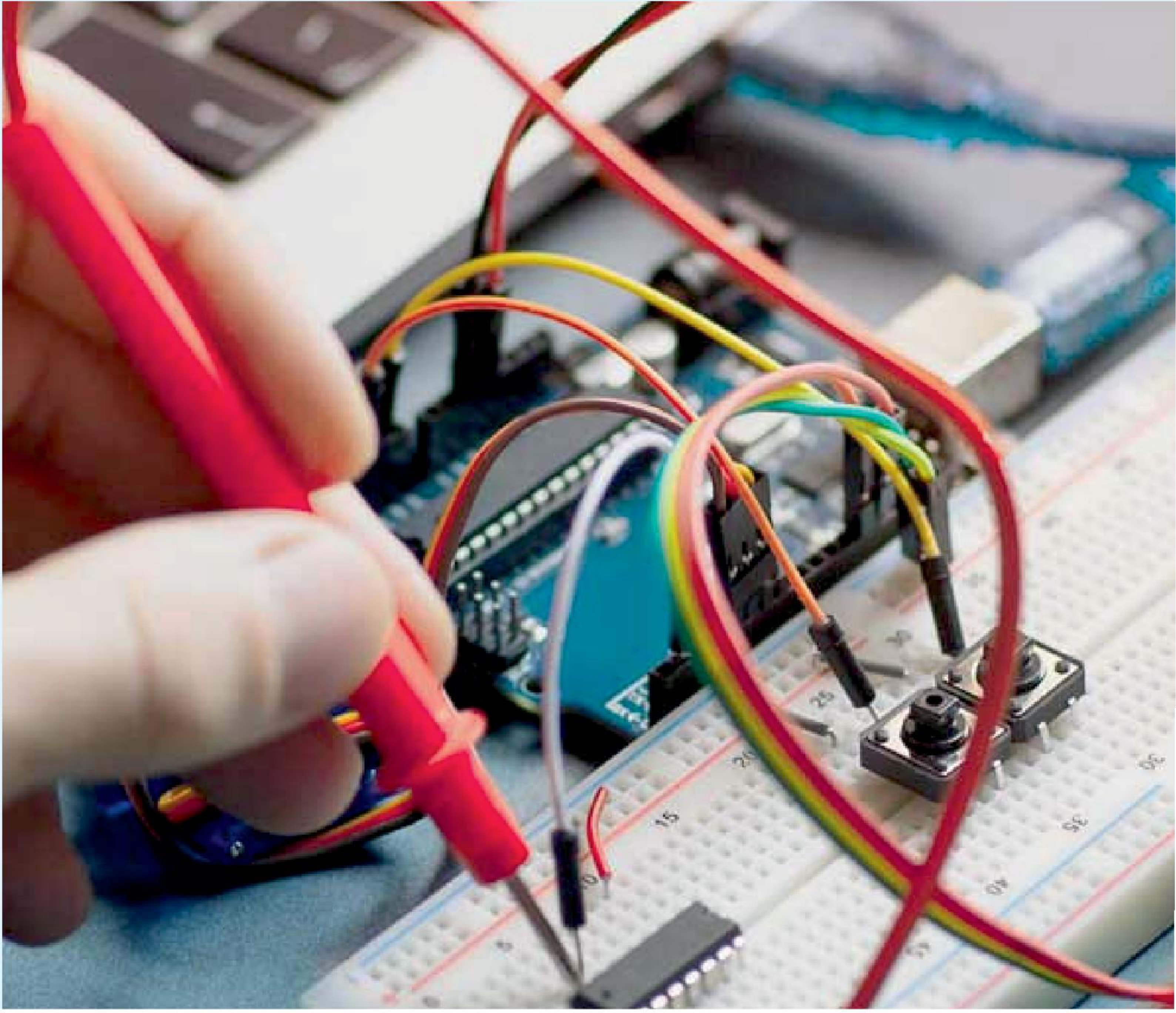
[15] J. Hoydis, S. ten Brink, and M. Debbah, “Massive mimo in the ul/dl of cellular networks: How many antennas do we need?” IEEE J. Sel. Areas Communication., vol. 31, no. 2, pp. 160–171, 2013.

[16] H. Ngo, E. Larsson, and T. Marzetta, “The multicell multiuser mimo uplink with very large antenna arrays and a finite dimensional channel” IEEE Trans. Commun., vol. 61, no. 6, pp. 2350–2361, 2013

[17] H. Schoeneich and P. A. Hoeher, “Iterative pilot-layer aided channel estimation with emphasis on interleave-division multiple access systems” EURASIP J. Appl. Signal Process., vol. 2006.

[18] H. Ngo, E. Larsson, and T. Marzetta, “The multicell multiuser mimo uplink with very large antenna arrays and a finite dimensional channel” IEEE Trans. Commun., vol. 61, no. 6, pp. 2350–2361, 2013.

[19] J.Hoydis,C.hoek, T.wild, S.ten Brick, “Channel measurements for large antenna arrays”,International symposium on wireless Communication Systems, pp.811-815, 2012417-2420, May 2001.



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