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Filter Optimization MIMO Signal Processing Techniques based on SDM Transmissions for 5G Technologies

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ABSTRACT: -In this paper, we portray ongoing advancement in space-division multiplexed (SDM) transmission, and our proposition and showing of thick space-division multiplexing (DSDM), which offers the likelihood of ultra-high limit SDM transmission frameworks with high spatial thickness and spatial channel tally of more than 30 for each fiber. We present the SDM transmission grid, which cross files the different kinds of multi-center multi-mode transmissions as indicated by the sort of light engendering in optical strands and how the spatial diverts are taken care of in the system. For every classification in the framework, we present the most recent advances in transmission ponders, and assess their transmission execution by phantom and spatial efficiencies.

KEYWORDS: - Filter Bank Multicarrier (FBMC), Filter Bank, MIMO System, 5G Technology

I. INTRODUCTION

To accommodate the interest for future energy efficient fiber-optic correspondence frameworks with very high limit, space division multiplexing (SDM) transmission advances utilizing multicore (MC) as well as multimode filaments (MMFs) have been seriously created in ongoing years. Explicit outcomes incorporate SDM transmission with Pb/s-class limit over MCF [1]–[3], and MC-MMFs [4], [5]. SDM transmissions can be arranged into two systems: non-coupled and coupled transmission. Transmission over an MCF is a non-coupled transmission system in which impedance spilled from different centers is all around stifled by methods for fiber as well as framework plan. In this system, minimal sign preparing adjustment would be required regarding transmission over a conventional SMF. The coupled transmission, on the other hand, requests the utilization of multi-input multi-yield (MIMO) signal preparing to counter the coupling between spatial channels, particularly for transmission separates in overabundance of the connection length [6]. All through this work we allude to a SDM transmission that utilizes MIMO sign preparing as a MIMO-SDM transmission.

MIMO-SDM transmission attributes are displayed by the MIMO channel [7], which is viewed as the general development of the 2×2 Jones network portrayal used to depict the polarization impact in SMF. This infers MIMO sign preparing, which is broadly utilized in present remote correspondence frameworks, offers amazing assets for upgrading MIMO-SDM signal execution. For instance, it permits various transmitters also, collectors to be utilized to acknowledge bigger framework throughput as well as higher transmission unwavering quality than is conceivable with single-input single-yield (SISO) transmission. Be that as it may, the transmission execution of MIMO-SDM signals, which use spatial modes as free waveguides for parallel information streams, is altogether affected by differential mode delay (DMD) and mode subordinate misfortune (MDL). They remain the prevailing hindrances to upgrading the presentation of MIMO-SDM transmission [8], [9]. So far a large portion of MIMO-SDM transmission tests have utilized direct MIMO evening out strategies with versatile weight refreshing calculations to de-multiplex spatial channels.

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Nonlinear MIMO identification plans, which for the most part give higher transmission execution, are likewise relevant to optical MIMO-SDM transmission, in spite of the fact that their exhibition have been examined in just a couple SDM transmission tests/reenactments with regards to optical MIMO-SDM transmission with in excess of two spatial channels (i.e., polarization channels) [7], [10].

II. SPATIAL DIVISION MULTIPLEXING IN OPTICAL FIBERS

However, the key requirement for MIMO transmission to work is spatial diversity, i.e. the condition number of the transmission matrix H has to be low (near 1 to maximize transmission capacity). A key advantage of optical transmission systems is that transmission medium, the optical fiber itself, can be engineered to the designer's liking for increasing the number of spatial transmission channels. The most obvious and simplest method of spatial diversity is by employing multiple SSMFs, as shown in Fig. 1. The main advantage of this approach is that all components are readily available, and accordingly, no research is required, and the capacity crunch can be alleviated. However, employing single mode fibers scales the cost per transmitted bit linearly. Key to reducing costs is the sharing of components in a transmission system. To this end, multiple solutions have been proposed over the last few years

- Few-mode fibers (FMFs)
- Multimode fibers
- Multi-core fibers (MCFs)
- Coupled-core fibers (CCFs)
- Hollow-core photonic bandgap fiber

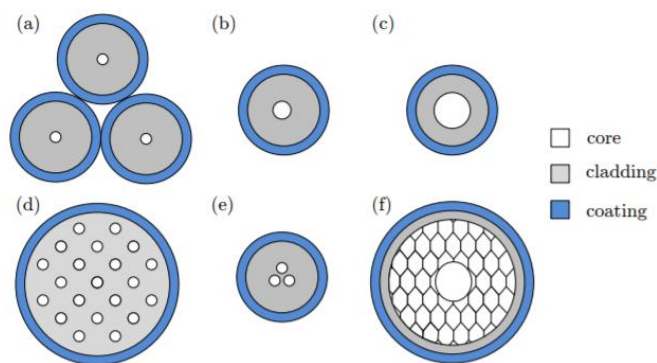


Fig. 1: Schematic representation of the suggested optical fiber types for SDM

III. FBMC TECHNIQUE

The filter bank multicarrier scheme was introduced first time by Saltzberg and Chang in the year 1971. FBMC is also a family of OFDM technique. In the beginning this approach were adopted to support the OFDM technique. The main intention to identify this technique is to overcome the limitations of existing multicarrier modulation schemes. FBMC uses specific pulse shaping filters which generates good confine sub-band in time and frequency domain with the help of filter bank and its polyphase structure. In communication system, digital signal processing signals have high bandwidth in the range of GHz. Most of the presently available FPGA's and DSP Hardware kits are having clock rate in the range of some MHz's. In order to reduce the clock frequency, multiplexing techniques are used to sort out the required data rate at lesser clock frequency. The efficient way of achieving this task, is through adopting filter bank multicarrier modulation (FBMC) technique for sub-band processing of input signals. FBMC is considered as a promising alternative multicarrier technique for future communication systems. The next generation of mobile

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communications (5G) is ambitious by more spectral efficient wave-forms. FBMC has gained a high degree of interest to provide flexibility for 5G mobile communications system, as a 5G waveform candidate. In the advancement in digital signal processing (DSP) capabilities, research has been carried out to identify alternative to existing multicarrier modulation technique for next generation communication system.

Due to the finite transition region at the end of the FIR pass band, small gaps are produced between the sub-bands, which avoid crosstalk and spectral leakage. Analysis filter bank is used at transmitter for sub-band processing of higher band into several lower band signals with the help of decimation filter. After processing of signals, Synthesis filter bank is used at receiver to form a replica of the original signal, using interpolator based on the sub-band channels. Finally, sub-band channels are recombined into a full band output signal.

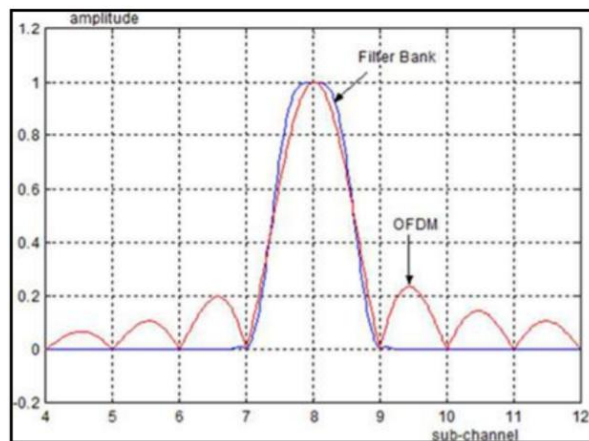


Fig. 2: Time domain response of FBMC prototype filter and OFDM technique

IV. BLOCK DIAGRAM OF FBMC

Most of the investigated and analyzed new communication techniques are algorithmic stage. Hardware and software implementation cost are considered as main parameters required for future mobile communication systems. But, for practical implementation of any wireless communication system are bound by many parameters. These parameters include economic, social, hardware complexity and essential need of users. These constraints can be achieved effective use of resources and technology. Therefore, this thesis mainly deals with design and implementation of advanced and efficient hardware architecture, which may be suitable for the physical layer of future communication (5G) transceiver architecture prototype on FPGA. With this essence, a novel hardware architecture design for future communication (5G) system, based on Filter Bank Multicarrier modulation technique is presented. This technique is being studied and considered these days by recent researches for the future adoptable 5G air interface. It provides enhanced range of spectrum compartment compared to conventional multicarrier modulation technique and allows enhanced mobility management. There are some other alternative and subcategories for FBMC as well.

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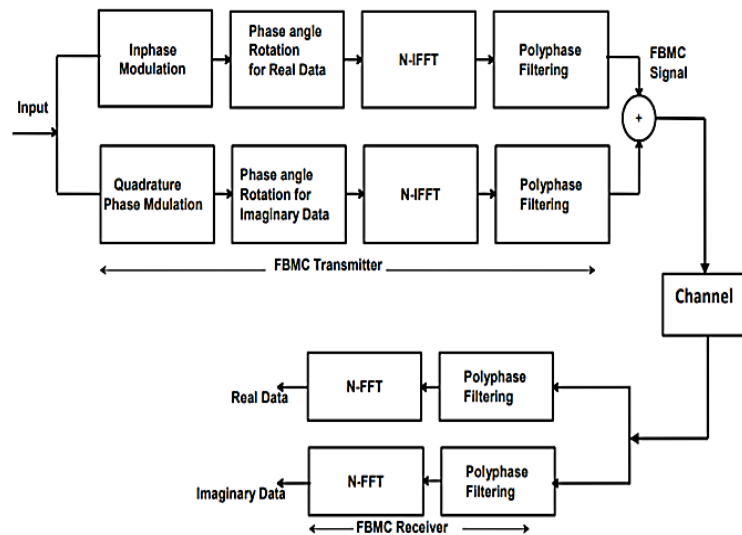


Fig. 3: Block diagram of FBMC transceiver

V. PROPOSED METHODOLOGY

There are different categories of prototyping transmitter for FBMC transceiver. Many FBMC transmitters are designed using NK-IFFTs and it requires more signal processing operations. And also, it requires more computational complexity to reduce the complexity in IFFT and avoid the overlapping of signals in the receiver instead of parallel implementation of NK-IFFTs; we are only utilizing 2 N-IFFTs. Where N indicates number of inputs and K represents overlapping factor of each sub-band. So the range of the impulse response is $L = NK$. To construct the FBMC signal it performs the Inverse - Fourier transforms (IFFT) both sides and then it performs the polyphase filtering.

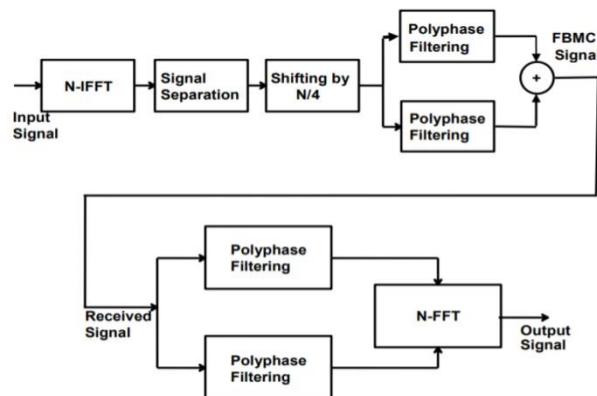


Fig. 4: Simplified FBMC transceiver

The multiplication of IFFT with phase rotation vector θ_k in frequency domain leads to circular shift of $N/4$ in time domain, which results in reconstruction of the FBMC signal. N-IFFT Signal Separation Shifting by $N/4$ Polyphase Filtering Polyphase Filtering + FBMC Signal Input Signal Polyphase Filtering Polyphase Filtering Received N-FFT Signal Output Signal by utilizing two polyphase filter modules as depicted in the above Figure 3. To construct the FBMC signal in transmitter, we can use NK-IFFT and Polyphase filters. In receiver, we may use polyphase filtering

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stage and NK-FFT to recover data. In order to retrieve the original signal back, pipelined FFT Architecture is used. By using pipelined FFT Architecture it is easy to compute higher FFT point by making short variations in the code. Therefore, with this architecture, the complexity level and area utilization get reduces while the speed of communication system improves.

VI. SIMULATION RESULTS

MIMO-OFDM 2×1 System with filter optimization based FBMC technique discussed in this research work in term of attenuation (dB). From the above graphical representation it can be inferred that the proposed algorithm gives the best performance for FBMC technique.

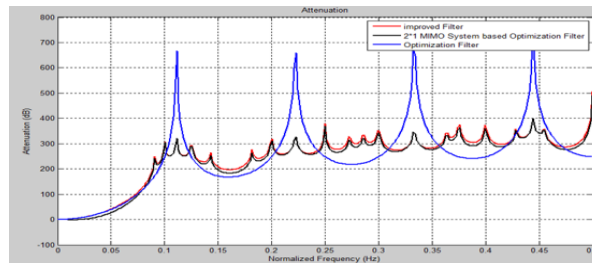


Fig. 5: Attenuation Graph of 2×1 MIMO system based Optimization Filter

MIMO-OFDM 2×1 System with filter optimization based FBMC technique discussed in this research work in term of magnituderesponse (dB) is shown in figure 6.

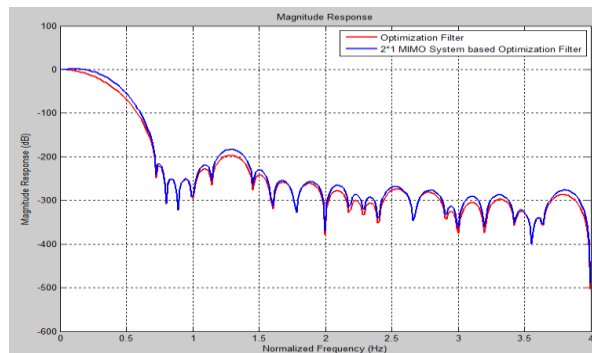


Fig. 6: Magnitude Response of 2×1 MIMO system based Optimization Filter

MIMO-OFDM 2×1 System with filter optimization based FBMC technique discussed in this research work in term of bit error rate (BER) is shown in figure 7. The offset quadrature amplitude modulation (OQAM) is increase signal to noise ratio (SNR) compared to QPSK.

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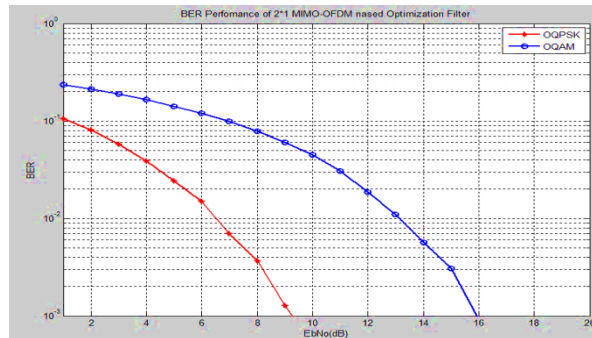


Fig. 7: BER Analysis of 2×1 MIMO system based Optimization Filter

MIMO-OFDM 2×2 System with filter optimization based FBMC technique discussed in this research work in term of attenuation (dB) is shown in figure 7.

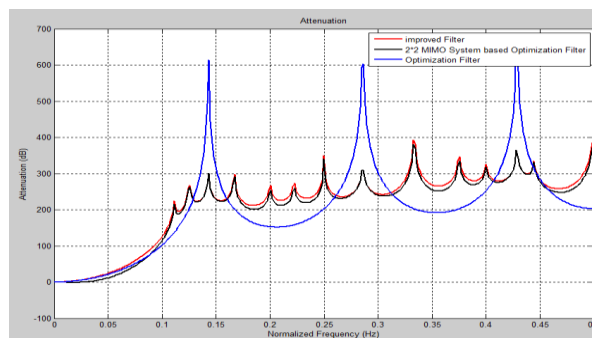


Fig. 8: Attenuation Graph of 2×2 MIMO system based Optimization Filter

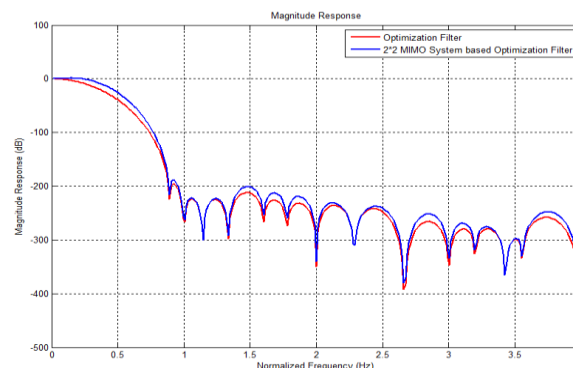


Fig. 9: Magnitude Response of 2×2 MIMO system based Optimization Filter

MIMO-OFDM 2×2 System with filter optimization based FBMC technique discussed in this research work in term of magnituderesponse (dB) is shown in figure 9.

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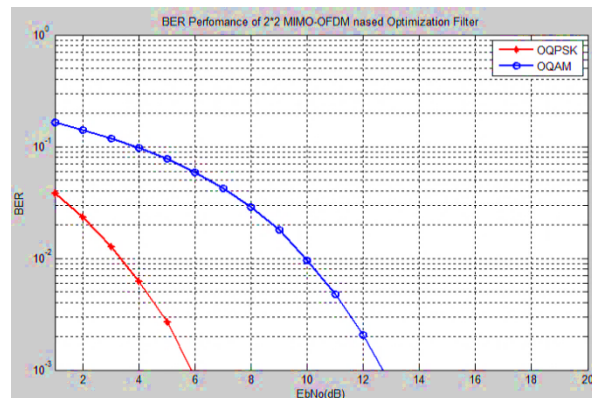


Fig. 10: BER Analysis of 2×2MIMO system based Optimization Filter

MIMO-OFDM 2×2 System with filter optimization based FBMC technique discussed in this research work in term of bit error rate (BER) is shown in figure 10. The offset quadrature amplitude modulation (OQAM) is increase signal to noise ratio (SNR) compared to OQPSK.

VII. CONCLUSION

Both OFDM and FBMC strategies depend on the basic working principles of IFFT/FFT computational engines. However, the procedure of adding CP in OFDM prompts an overhead that adversely impacts on the transmission bandwidth efficiency. Though cyclic prefix is absent in case of FBMC and blend of filter banks prompts greatest productivity and information transmission speed. A similar channel bank can be utilized for transmission and reception in FBMC transceiver architecture which ensures low BER and high performance compatibility in terms latency and throughput. The out-of-band reduction of the prototype filter amplitude curve in FBMC system assures spectral preservation of other subscribers which leads to new physical layer containment for future communication system.

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