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PAPR Reduction in FBMC-OQAM Systems Based on Discrete Sliding Norm Transform Technique

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Abstract—This paper deals with the Peak to Average Power Ratio (PAPR) drawback appeared in Filter-Bank Multi-Carriers with Offset-QAM (FBMC-OQAM) which is the candidate waveform in 5G wireless communication systems. A post-Inverse Discrete Fourier Transform (IDFT) Discrete Sliding Norm Transform (DSNT) is proposed based on L_2-metric and the norm of five samples at each sliding operation. The overlapping structure of FBMC-OQAM is considered in the proposed L_2-by-5 DSNT formulation. It can significantly reduce the PAPR in FBMC-OQAM systems, which ensures a linear amplification at the High Power Amplifier (HPA) and avoids signal distortion. The main advantages of this technique are its lower computational complexity compared to the known techniques, and the fact that it does not require any Side Information (SI) at the receiver. Simulation results show that the L_2-by-5 DSNT technique can achieve an improvement of 40% in PAPR reduction at CCDF = 10^{-3} compared to the original FBMC-OQAM system.

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1. INTRODUCTION

Multicarrier modulation (MCM) is widely used in wireless communication systems where a wideband signal at a high symbol rate is divided into several signals, each of which occupies a narrower band at a lower rate. Its main advantage is the robustness against multipath propagation and narrowband interference.

Orthogonal frequency division multiplex (OFDM) is until now, the most important class of MCM. Its power and robustness are well proved in 4G wireless communication systems [1–6]. However, the OFDM approach has some major limitations due to its rectangular waveform. It generates a cardinal sine function in the frequency-domain with side lobes close to the main one. A significant Out-Of-Band (OOB) problem occurs accordingly. To avoid this drawback, large guard bands should be employed resulting in a loss of spectral efficiency.

Furthermore, another loss of spectral efficiency also appears when the Cyclic Prefix (CP) is added for mitigating Inter Symbol Interference (ISI) [4, 7]. Moreover, the OFDM approach shows a high sensitivity against frequency offsets caused by the Doppler effect in the mobile channel.

Due to the previous drawbacks, OFDM does not operate well in 5G systems, in which some requirements are needed such as: bandwidth spectral efficiency, very high reliability, ultra-low latency for all tactile internet applications.

Recently, the Filter-Bank Multi-Carriers with Offset QAM (FBMC-OQAM) approach is proposed as a potential alternative technique to OFDM in several recent works such as [1, 4, 8–10] and references therein. It has received a great attention due to several reasons including the pulse shaping that is well-localized in time- and frequency-domains, its robustness against the phase noise and frequency offset [11] and any lack of synchronism between different users.

Unfortunately, similar to any other multicarrier technique, the FBMC-OQAM method suffers from a very high PAPR (Peak to Average Power Ratio) factor. As a result, when the output signals pass through a nonlinear High-Power Amplifier (HPA), they will undergo two types of distortions: an in-band distortion expressed by a rise of Bit Error Rate (BER) and an out-of-band distortion, which may generate Adjacent

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

ADDITIONAL INFORMATION

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