ABSTRACT

Orthogonal Frequency Division Multiplexing (OFDM) is a method of encoding digital data on multiple carrier frequencies and an attractive scheme for achieving high bit-rate wireless transmission. OFDM is a popular modulation scheme for many communication systems and is also adopted by various wireless standards such as Broadcast Radio Access Networks (BRAN), Digital Audio Broadcast (DAB), IEEE 802.11 a/b/g/n, Li-Fi, WLAN (Wireless Local Area Network), Wi-MAX (World Wide Interoperability for Microwave Access), LTE (Long term evolution), and LTE Advanced 4G mobile phone standards. The main advantages of OFDM are its high spectral efficiency, ability to cope with severe channel conditions without complex equalization filters, robustness against narrow band co-channel interference, inter-symbol interference and fading, facilitates Single Frequency Networks (SFN) and is less vulnerability to echoes. Some of the drawbacks of OFDM include sensitivity to frequency synchronization problems, high Peak-to-Average Power Ratio (PAPR), poor power efficiency of the linear transmitter circuitry and loss of efficiency caused by cyclic prefix/guard interval.

Peak to average power ratio is caused when large number of sub-carriers are out-of-phase. High PAPR causes the transmitter's power amplifier to run within a non-linear operating region, causes signal distortion at the output of the Power Amplifier (PA), saturation at the digital-to-analog converter (DAC) and saturation of the PA. High PAPR also causes inter-modulation between the sub-carriers and distorts the transmit signal constellation. Therefore, the PA must operate with large power back-off, approximate to that of the PAPR which leads to inefficient operation. High PAPR is also caused by signal distortion of the PA output and makes the RF power amplifier work inefficiently. High PAPR significantly degrades the transmit signal quality by changing the constellation nature of the transmit signal.

In order to overcome the drawbacks of high PAPR, several PAPR reduction techniques were proposed. Some of the PAPR reduction techniques for OFDM are Partial Transmit Sequences (PTS), Selective Mapping (SLM), Coding, Tone Reservation (TR), Tone Injection (TI), clipping, and Block Coding.

Partial Transmit Sequence (PTS) and Selective Mapping (SLM) are two existing distortion-less PAPR reduction techniques proposed for OFDM. They provide improved PAPR statistics at the expense of additional complexity with little loss in efficiency. SLM and PTS techniques have the advantages of good PAPR reduction performance, easy implementation and less performance degradation.

PTS technique becomes more suitable when complexity plays a important role. This technique provides better PAPR reduction performance with the increase in the number of sub-blocks. PTS is considerably better with respect to reduction capability versus additional complexity in the systems.

SLM algorithm is more suitable for systems which can tolerate more redundant information. Selective mapping technique is better than PTS in terms of reduction capability versus redundancy.

In this thesis, two optimization algorithms, Scaled Offset Particle Swarm Optimization (PSO) and Scaled PSO are applied to the PTS technique for reducing PAPR in OFDM systems. The proposed algorithms find the optimal phase factors at a faster rate than the Conventional PSO algorithm. The proposed algorithm have salient features such as faster convergence to the optimum value, provides a good control mechanism to the particle's velocity and also provides better PAPR reduction when compared to the Conventional PSO-PTS algorithm.

Riemann matrices, Centering matrices, Centered Riemann matrices and New centered matrices are applied as phase sequences to the Modified SLM technique and their PAPR reduction performances are studied and analyzed.

The proposed Modified SLM - New Centered scheme performs well in terms of PAPR reduction when compared to other schemes. The other advantage of these schemes is that it has less computational complexity when compared to the SLM technique.

Selection of phase sequences in SLM technique plays a vital role in reducing PAPR. Symmetric Hankel matrices are used as phase sequences to the SLM technique for reducing PAPR in OFDM systems. By applying Symmetric Hankel matrices as phase sequences, a good PAPR reduction performance is achieved.