ISSN: 2321-7782 (Online)
Volume 2, Issue 5, May 2014
International Journal of Advance Research in Computer Science and Management Studies
Research Article / Survey Paper / Case Study
Available online at: www.ijarcsms.com

Revocation of PAPR by Efficient Optimization of Source and Relay

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Abstract: This paper is mainly concerned with source power allocation in wireless relay networks where a single or multiple relays assist transmission from a single or multiple sources to a destination. Single-carrier frequency division multiple access (SC-FDMA) technique with frequency domain equalization is adopted in source and relay in order to avoid the amplification of the multiple access interference. Source power allocation and optimization of relay beam forming is performed in order to improve the overall network performance measured in terms of SINRs of users. The main aim is to (i) minimize the Peak to Average Power Ratio (PAPR) of the transmitted signal. (ii) Maximizing the minimum signal-to-interference-plus-noise ratio (SINR) under various transmitted power constraints. (iii) Minimizing the total transmitted power subject to prescribed SINR thresholds of users. Simulation results confirm the excellent performance and computational efficiency. Spectral efficiency of the proposed algorithm will increase with respect to the number of users.

I. INTRODUCTION

Wireless communication is one of the most vibrant areas in communication field today. Wireless communication is the transfer of information between two or more points that are not connected by an electrical conductor. Wireless networking is used to meet many needs.

Future generation wireless networks are expected to provide high data-rate services under limited bandwidth and power resources. A major challenge in the design of such networks is how to effectively deal with the frequency selectivity of broadband wireless channel. Another technical challenge in the design of modern mobile wireless communication networks is to provide an acceptable quality of service (QoS) for all users, including those at the cell edges where the communication links may suffer a severe propagation path loss and/or shadowing. Such a challenge can be addressed by using relays to extend the coverage and/or capacity of wireless networks. Most cooperative relay beamforming designs were considered only for frequency-flat fading channels. This paper examine the joint optimization of source power allocation and relay beamforming for frequency selective fading channels, with the combination of AF relaying and SC-FDMA technique for multi-user multi-relay networks. Such innovation has attracted a great interest due to its potential in providing a significant performance improvement for the uplink transmission. In such multi-user multi-relay networks, the important problems are (i) to design appropriate power control and relay beamformers in order to provide QoS fairness among users under a limited power resource, and (ii) to consume the minimum amount of power while maintaining an acceptable QoS for all users.

II. SYSTEM MODEL

Consider an uplink transmission which has K source terminals $\{S1, . . . , SK\}$ simultaneously communicate with the destination terminal D with the help of M relay terminals $\{R1, . . .,RM\}$. Each terminal is equipped with a single antenna and operates in a half-duplex mode. SC-FDMA technique is employed at the sources and relays and the relays use AF protocol. The key advantage of SCFDMA over OFDMA is that SC-FDMA implements both DFT and IDFT at the transmitting nodes in order to spread the information symbols across multiple subcarriers, exploiting frequency diversity and resulting in a lower PAPR of the transmitted signals. In the first phase, the sources transmit their signals to the destinations and relays. In the second phase, there relays linearly process their received signals and then forward the resulting signals to the destination.

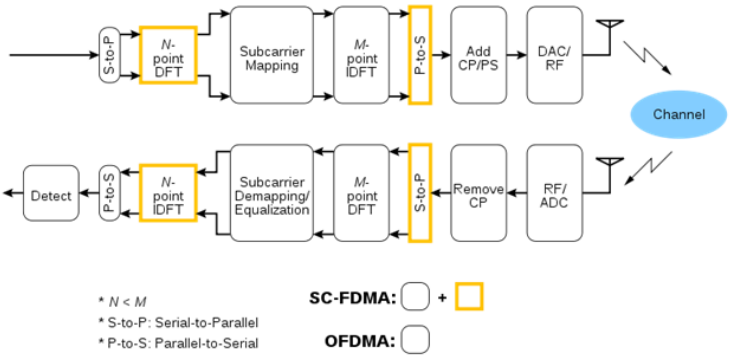

Fig.1 Block diagram of SC-FDMA modulation

SC-FDMA is a new multiple access technique that utilizes single carrier modulation, DFT spread orthogonal frequency multiplexing, and frequency domain equalization. It has a similar structure and performance as OFDM. SC-FDMA can be considered as an OFDM system with a DFT mapper. A transmitter includes a baseband modulator, DFT mapper, subcarrier mapping, inverse Fourier transform, cyclic prefix addition, parallel-serial conversion, and a digital-to-analog converter followed by an I-Q RF modulator. After mapping data bits into modulation symbols, the transmitter groups the modulation symbols into a block of N symbols. An N-point DFT transforms these symbols in time domain into frequency domain. The frequency domain samples are then mapped to a subset of M subcarriers where M is typically greater than N. Similar to OFDM, an M-point IFFT is used to generate the time-domain samples of these subcarriers, which is followed by cyclic prefix, parallel to serial converter, DAC and RF subsystems.

III. PAPR Analysis

SC-FDMA offers similar performance and complexity as OFDM. However, the main advantage of SC-FDMA is the low PAPR (peak-average-power ratio) of the transmit signal. PAPR is defined as the ratio of the peak power to average power of the transmit signal.

As PAPR is a major concern at the user terminals, low PAPR makes the SC-FDMA the preferred technology for the uplink transmission. PAPR relates to the power amplifier efficiency at the transmitter, and the maximum power efficiency is achieved when the amplifier operates at the saturation point. Lower PAPR allows operation of the power amplifier close to saturation resulting in higher efficiency. With higher PAPR signal, the power amplifier operating point has to be backed off to lower the signal Distortion, and thereby lowering amplifier efficiency. As SC-FDMA modulated signal can be viewed as a single carrier signal, a pulse shaping filter can be applied to transmit signal to further improve PAPR. PAPR comparison between OFDM and SC-FDMA variations such as interleaved SC-FDMA and localized SC-FDMA. With no pulse shaping filters, interleaved- SC-FDMA shows the best PAPR. Compared to OFDM PAPR, the PAPR of interleaved SCFDMA with QPSK is about 10 dB lower, whereas that of localized SC-FDMA is only about 3 dB lower. With 16-QAM, these levels are about 7 dB and 2 dB lower respectively. Therefore, interleaved SC-FDMA is a preferred modulation technique for lower PAPR. Pulse shape filtering of SC-FDMA in fact degrades the PAPR level of interleaved SC-FDMA whereas it shows no effect with localized SC-FDMA.

IV. Result and Discussion

The simulation results are analyzed in this section. Advanced LTE system offers better performance and the results are shown below, figure 2 shows that as number of user increases PAPR decreases rapidly. From figure 3it is clearly understood that spectral efficiency linearly increases with number of users as well as noise power. Total power for prescribed SINR of the existing OFDM is compared with the proposed SCFDMA and found to be efficient. Figure 5 infer that there is a slight improvement in the BER performance when compared to OFDM.

PAPR Analysis:

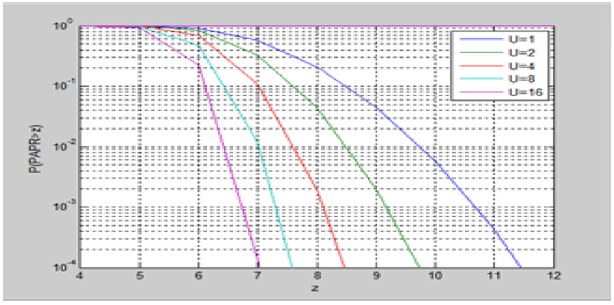

Fig.2 PAPR Vs Number of Users

SPECTRAL EFFICIENCY:

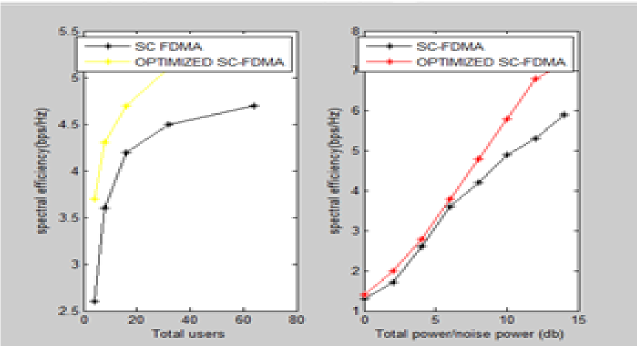

Fig.3 Spectral Efficiency Vs Total number of users / Noise Power

SINR:

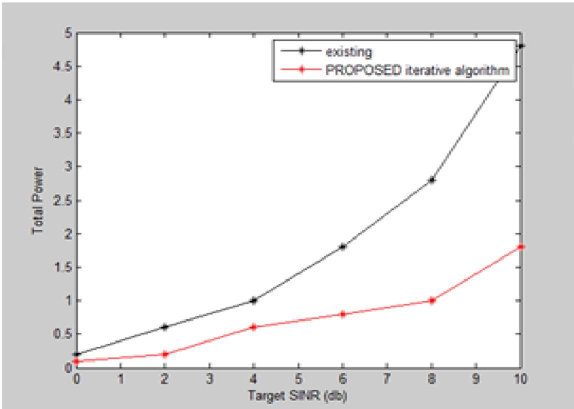

Fig 4 Total Power Vs Target SINR

BER PERFORMANCE OF SC-FDMA MODULATION:

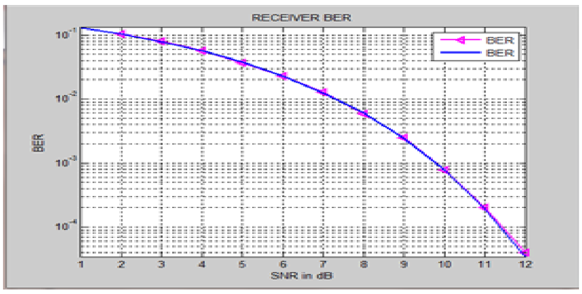

Fig 5 Bit Error Rate Vs SINR

V. CONCLUSION

The simulation results confirm that the algorithms converge in small numbers of iterations. The performance of our joint optimization methods is superior to other design methods that are simplified with equal source power allocation and equal beamforming weights, respectively. Simulation results show that using the proposed cooperative beamforming across relays offer a significantly-improved system performance, both in terms of the average SINR and BER, as compared to the equal-power beamforming. Spectral efficiency of the proposed algorithm increased with respect to the number of users SC-FDMA tries to reduce PAPR and improve the efficiency of the system for large number of users; still the system with small number of users suffers from high PAPR and poor performance. Instead of Clipping and filtering, Optimized iterative clipping and filtering (OICF) can be used in future to suppress the peak regrowth.

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