INTERNATIONAL JOURNAL OF SCIENTIFIC PROGRESS AND RESEARCH (IJSPR) ISSN: 2349-4689
Volume-14, Number - 01, 2015

Designing of Dual Hop Wireless Cooperative Network with Relay Modes and Efficient Combining Techniques

Meenakshi Pal[1], Asst. Prof. Anupam Vyas[2], Asst. Prof. Arun Shukla[3]
[1]M-Tech Research Scholar, [2]Research Guide, [3] HOD
Department of Electronics & Comm., SRGI, Jhansi

Abstract - Cooperative communication means wireless nodes can help each other for communication. In this work, study of cooperative wireless communication is done, and proposes a cooperative system with different relay selection modes for the better error rate performance of the cooperative communication system. The cooperative relay network is the integrated part of the long distance communication system and the optimum performance of it makes communication reliable as well as improve better quality of service. In this paper we have simulated the cooperative relay network with four different relay selection modes having harmonic and maximum values of SNR with or without collaboration. The proposed approach contains the combining techniques employed at the receiver to combine various signals received from different cooperative channels like SD, SR and RD. The combining techniques referred here is MRC and SC with four different relay modes and two cooperative modes AF(Amplify and Forward) and DF(Detect and Forward). The combined signals are followed by detection technique, Minimum Mean Square Error(MMSE) to reduce the bit error rate(BER) and found enhancement in the existing results.

Keywords - Relay Selection Modes, AF, DF, MRC Combining, C-MRC Combining, SC Combining, MMSE.

I. INTRODUCTION

In the foreseeable future, the large-scale deployment of wireless devices and the requirements of high bandwidth applications are expected to lead to tremendous new challenges in terms of efficient exploitation of the achievable spectral resources. The coming wireless personal communication systems are expected to provide ubiquitous, high-quality, and high-rate mobile multimedia transmission. However, in order to achieve this objective, various technical challenges need to be overcome. Signal fading due to multi-path propagation is one of the major impairments to meet the demands of next generation wireless networks for high data rate services.

To mitigate the fading effects, time, frequency, and spatial diversity techniques or their combinations can be used. Among different types of diversity techniques, spatial diversity is of a special interest as is does not incur the system losses in terms of delay and bandwidth efficiency.

Spatial diversity has been studied intensively in the context of Multiple-Input-Multiple-Output (MIMO) systems [1]. It has been shown that utilizing MIMO systems can significantly improve the system throughput and reliability [2]. However, MIMO gains hinge on the independence of the paths between transmit and receive antennas, for which one must guarantee antenna element separation several times the wavelength, a requirement difficult to meet with the small-size terminals.

To overcome this problem, and to benefit from the performance enhanced by MIMO systems, cooperative diversity schemes for the relay transmission have been introduced in [3-5].

Orthogonal Frequency Division Multiplexing (OFDM) is a popular multicarrier modulation technique in the modern wireless communications, since it possesses the advantages of frequency parallel transmission, high speed communications and efficient spectrum usage.

In this work OFDM transmission into the cooperative communication domain is investigated. The diversity gains from both spatial domain and frequency domain are combined and so cooperative communication can further enhance the reliable, high speed transmission, and enable the spectrum efficiency. We propose a cooperative OFDM tall Toeplitz scheme, which guarantees full cooperative diversity, taking outage diversity and multipath diversity into account; in addition it easily combats Carrier Frequency Offsets (CFOs), using Linear Equalizers (LEs) only. Compared to the conventionally used Maximum-Likelihood Equalizers (MLEs), the system complexity is reduced significantly.

There are mainly two relaying protocols in cooperative relay networks: Amplify-and-Forward (AF) and Decode-and-Forward (DF).

In the past decades, wireless communication has benefited from a variety of technology advancements and it is considered as the key enabling technique of innovative future consumer products. As shown in Fig. 1.1, in order to satisfy the requirements of various applications from generation to generation, many kinds of innovations in wireless technologies and devices have been developed and utilized in our daily life. In future, significantly technical achievements are required to ensure that wireless communications have appropriate architectures suitable for supporting a wider range of services and higher speed data transmission delivered to the users.

II. COOPERATIVE RELAYING TECHNIQUES

In cooperative communication, the two most common cooperative relaying protocols are decode-and-forward (DF) and amplify-and-forward (AF). In AF, the received signal is amplified and retransmitted to the destination. The advantage of this protocol is its simplicity and low-cost implementation. However, the noise is also amplified at the relay. In DF, the relay attempts to decode the received signals. If successful, it re-encodes the information and retransmits it. If some relays cannot fully decode the signal, they will be discarded.

Cooperative Orthogonal Frequency Division Multiplexing (OFDM) communication Among the existing air-interface techniques, OFDM is a promising technique for high-bit-rate wireless communications [9]. It possesses the advantages of frequency parallel transmission, high speed communication and efficient spectrum usage. By introducing OFDM transmission into the cooperative communication domain, the gains from both sides are combined. When transmitted through the multipath channel, OFDM can help that cooperative communication gain from multipath diversity.

Most conventional OFDM-based wireless communication systems append Cyclic Prefix (CP) to provide robustness against multipath effects.

Application of cooperative mobile communication

The application of cooperative mobile communication can be illustrated as in Fig. 1.1. The mobile handsets, which have a cooperative capability, form a cooperative relay network. These relays decode and forward or amplify and forward the data to the target, when the direct transmission cannot perform so well.

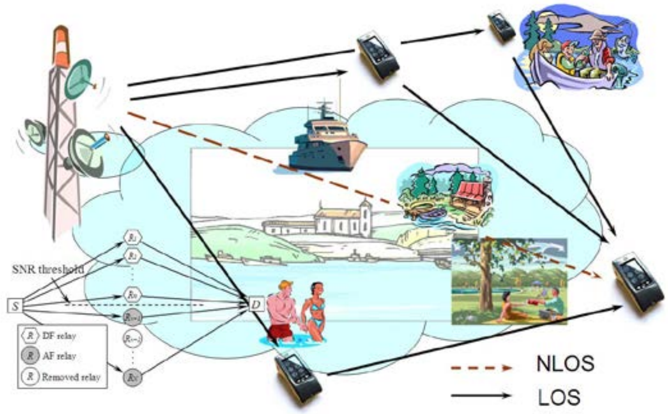

Fig. 1.1. Application of cooperative relay (mobile handset) communication.

III. PROPOSED METHODOLOGY

The cooperative relay system is made the communication possible with relay based approach which is the operation similar like amplification during transmission to reduce the effect of interferences and noises mixed with the signal during transmission over wireless channel.

But system still need to be improved to make long distance communication possible with less noises and distortions during transmission. The same thing kept in mind the a cooperative relay system is proposed in this paper. Which is explained in this section. The block diagram of the proposed cooperative relay system with relay selection scheme with multiple modes amplify and forward (AF) and detect and forward(DF) followed by combining technique coherent-maximal ratio combining (C-MRC) and selection combining (SC). To reduce the effects of errors detection algorithms are applied which are maximum likelihood (ML), minimum mean square error(MMSE) and zero forcing (ZF). The whole system is shown with the major blocks in Fig. 2.1. Where data is randomly generated to achieve the all the possibility of noise encounters. The channel considered here Gaussian channel which is the most near to practical channel behavior. After applying combining techniques at the receiver signal is then detected by the detection algorithms and then finally get the data at the output.

The proposed system is explained using the block diagram in the Fig. 2.1, and this system is simulated in the simulation environment and the simulation steps are shown in the Fig. 2.2 with the help of flow chart. In the simulation step first the simulation environment need to be created with the help of variables, followed by the initialization of the channel coefficient initialization which are source to destination (SD) , source to relay (SR) and relay to destination(RD) having four different relay selection schemes. The data is generated randomly to achieve all the possibilities with the system integration. Then the proposed methodology is applied i.e. combining techniques followed by linear(MMSE, ZF) and non-linear(ML) detection techniques to get the optimum results. Last step is to compare and display all the possible relay selection results with different techniques and modes.

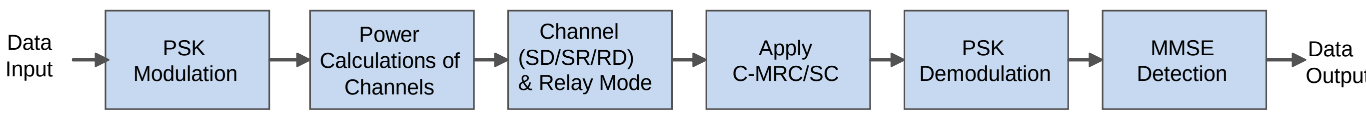

Fig. 2.1 Block Diagram of Proposed Methodology

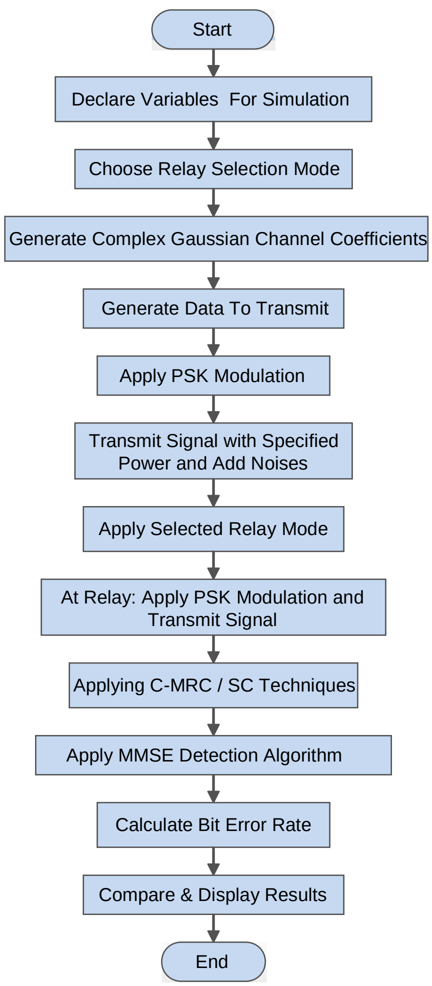

Fig. 2.2 Flow Chart of Proposed Methodology

IV. SIMULATION RESULTS

In this section the simulation results of the proposed system utilizing different cooperative modes(RD/SD/SR) and Various Relay Selection Modes and the optimum BER is achieved using minimum mean square error(MMSE) detection. The detected signals at the receiver side from various cooperative modes are than combined using efficient combining techniques(e.g. MRC, SC, C-MRC etc.) and outcomes are given in below figures.

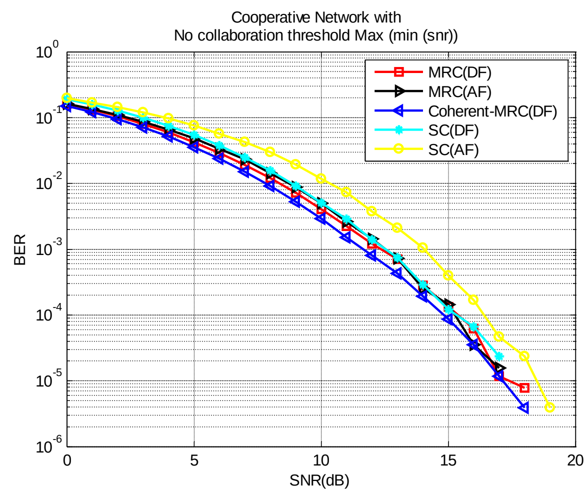

Fig. 3.1 BER Vs SNR Curves using No collaboration threshold Max (min (snr)) Mode(3) Relay Selection with MMSE Detection, Different Combining Techniques and Cooperative Modes

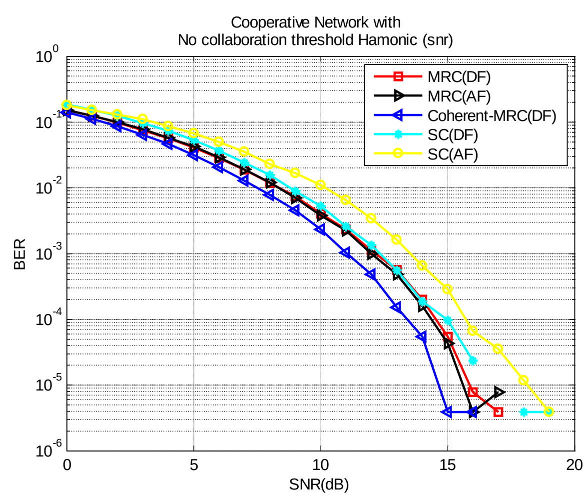

Fig. 3.2 BER Vs SNR Curves using No collaboration threshold Hamonic (snr) Mode(3) Relay Selection with

MMSE Detection, Different Combining Techniques and Cooperative Modes

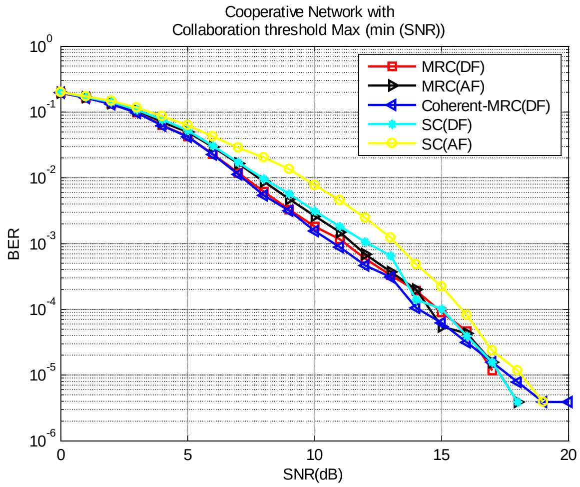

Fig. 3.3 BER Vs SNR Curves using Collaboration threshold Max (min (SNR))Mode(3) Relay Selection with MMSE Detection, Different Combining Techniques and Cooperative Modes

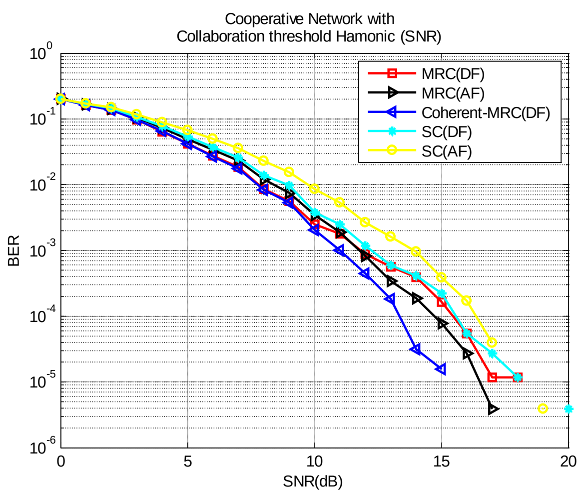

Fig. 3.4 BER Vs SNR Curves using Collaboration threshold Hamonic (SNR) Mode(4) Relay Selection with MMSE Detection, Different Combining Techniques and Cooperative Modes

From the above simulation results of proposed system with MRC and SC with four different relay selection schemes and MMSE detection technique, and it can be seen that the cooperative relay communication system outperform with MRC with AF cooperative mode with No Collaboration Threshold Harmonic(SNR) and SC with DF cooperative mode with Collaboration threshold Max (min (SNR)) relay mode.

V. CONCLUSION AND FUTURE SCOPE

From the simulation results we can say that the results of the proposed approach is better with the maximal ratio combining (MRC) using Amplify and Forward(AF) followed by detection algorithms MMSE using No Collaboration Threshold Harmonic(SNR) relay mode and SC combining technique with DF cooperative mode followed by MMSE detection using Collaboration threshold Max (min (SNR)) relay mode . It can been seen the simulation results in the previous section if this paper.

For further enhancement in the existing system the application of digital filtering with more efficient detection algorithms make system more robust and error free.

REFERENCES

[1] Butcharoen, S.; Pirak, C., "C-MRC-based path selection approach for cooperative multihop communications," Electrical Engineering/Electronics, Computer, Telecommunications and Information Technology (ECTI-CON), 2012 9th International Conference on , vol., no., pp.1,4, 16-18 May 2012

[2] Zhou, Q.F.; Lau, F.C.M., "Performance Bounds of Opportunistic Cooperative Communications With CSI-Assisted Amplify-and-Forward Relaying and MRC Reception," Vehicular Technology, IEEE Transactions on , vol.59, no.5, pp.2159,2165, Jun 2010

[3] J. N. Laneman, and G.W. Wornell, “Energy-efficient Antenna Sharing and Relaying for Wireless Networks”, IEEE Proceedings on Wireless Communications and Networking Conference, Vol.1, pp. 7–12, 2000.

[4] T. M. Cover and A. A. El Gamal, “Capacity Theorems for the Relay Channel”, IEEE Transactions on Information Theory, Vol. IT-25, pp. 572–584, September 1979.

[5] Kai Yan; Jian Jiang; Ying Guan Wang; Hai Tao Liu, "Outage Probability of Selection Cooperation With MRC in Nakagami- m Fading Channels," Signal Processing Letters, IEEE , vol.16, no.12, pp.1031,1034, Dec. 2009

[6] K. K. Wong, and E. Elsheikh, “Optimized Cooperative Diversity for a Three-node Decode-and-Forward Relay Channels”, IEEE 2nd International Symposium on Wireless Pervasive Computing: 5-7, San Juan, Puerto Rico, Piscataway, US, pp.296-301, February 2007.

[7] A. Sendonaris, E. Erkip and B. Aazhang, “User Cooperation Diversity–Part I: System Description”, IEEE Transactions on Communications, Vol. 51, No. 11, pp 1927-1938, November 2003.

[8] A. Sendonaris, E. Erkip and B. Aazhang, "User Cooperation Diversity–Part II: Implementation Aspects and Performance Analysis", IEEE Transactions on Communications, Vol. 51, No.11, pp 1939-1948, November 2003.

[9] J. N. Laneman, D. N. C. Tse, and G. W. Wornell, "Cooperative Diversity in Wireless Networks: Efficient Protocols and Outage Behaviour", IEEE Transactions on Information Theory, Vol.50, pp.3062–3080, December 2004.

[10] Yang, Weiwei; Liu, Xiaoning; Cai, Yueming; Wang, Lei, "On the performance of decode-and-forward relay networks using imperfect MRC receiver," Wireless Mobile and Computing (CCWMC 2009), IET International Communication Conference on , vol., no., pp.323,326, 7-9 Dec. 2009