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Performance Analysis of MIMO Relay Systems in the Presence of Co-Channel Interference and Feedback Delay

A. PRIYANKA[1], D. SUBBA RAO[2], SWAPNA KUMARI B[3]

[1]PG Scholar, Dept of ECE, Siddhartha Institute of Engineering and Technology, Ibrahimpatnam, Hyderabad, TS, India, E-mail: priyankaamudala@gmail.com.

[2]HOD, Dept, ECE, Siddhartha Institute of Engineering and Technology, Ibrahimpatnam, Hyderabad, TS, India, E-mail: subbu.dasari@gmail.com.

[3]Assistant Professor, Dept of ECE, Siddhartha Institute of Engineering and Technology, Ibrahimpatnam, Hyderabad, TS, India, E-mail: swapnakumari7@gmail.com.

Abstract: In this paper we analysis about MIMO relay systems in the presence of co-channel interference and feedback delay. Now a days, fading is a serious problem to transmit the information from transmitter to the receiver. Due to this Fading, we can't get the full diversity order. so, that for achieving a Multiuser diversity, we have to analyze the performance of Average SER and outage probability of the system by increasing SNR over Rayleigh fading channels with feedback delay and co-channel interference. For both the average SER and outage probability of the systems, exact as well as approximate closed form expressions at the high SNR regime are obtained, and the Multiuser diversity order achieved by the systems are characterized. Our results suggest that the full multiuser diversity order can only be achieved when there is ideal feedback, and once in the presence of feedback delay, the diversity order reduces gradually. In addition, the key parameters such as the outage probability and average SER play very important role in the performance analysis and the design of the wireless communication systems over Rayleigh fading environment. Our results suggest that the full multiuser diversity order can only be achieved when there is ideal feedback, and once in the presence of feedback delay, the diversity orderreduces gradually. The proposed power allocation offers a significant improvement on the SER performance.

Keywords: Amplify-And-Forward (AF) Relaying, Multipleantenna System, Feedback Delay, Co-Channel Interference (CCI), Multiuser Diversity, Power Allocation.

I. INTRODUCTION

Fading is the deviation of attenuating signal over a certain propagation medium. A fading channel is a communication channel and it occurred due to phase shift, attenuation, scattering, diffraction etc. Fading may vary with time, frequency etc. For achieving a diversity order, we have to reduce the fading of the communication channel. Due to this, the work investigated the performance analysis of outage probability in Dual-Hop multiple Antenna technique in the presence of interference and in the fixed-gain relaying schemes only achieves diversity order is one and the variable-gain relaying scheme achieves N for the system. In, the authors investigated the performance analysis of BER(bit-error-rate)using a STBC(space time block coding) technique for achieving a co-operative diversity of the system and it shows 2*1 antenna has better BER performance than 3*1 and 4*1 system. In, the authors compared the Bit error rate analysis of both Rayleigh and Rician fading channels in QAM modulation scheme and in this paper shows Rayleigh fading channels has very low BER than in the Rician fading channels. In an effort to further improve this, they compared the performance analysis of BER between Rayleigh and Rician fading channels in M-DPSK modulation scheme and the DPSK technique produce a very low BER in Rician fading channel than in the Rayleigh fading channels. In, the authors evaluated the performance analysis of outage probability in both Rayleigh and Rician fading channels in terms of source velocity and outage probability and it shows, the outage probability of the Rayleigh fading channels has the very lower than Rician fading channels.

In, they proposed on the outage performance of selection amplify-and-forward relaying scheme has the lower outage probability than AF relaying scheme in cooperative relay networks. In, optimized MIMO relay weights that minimize the transmit power subject to signal-to-interference-plus-noise ratio(SINR) with optimal beam-forming in wireless MIMO relay networks and they verified the performance gain of Multiple antenna relay systems in terms of transmit power and symbol error probability. In, authors proposed a performance analysis of Ergodic secrecy rate for MISO (Multiple Input single Output) broadcast channel. It is a optimum combiner and also called as, "Ratio-squared combining and pre-detection combining". In this scheme is used to combine an original input signal with delayed input signsal. MRC achieves maximum SNR in fading channels and it will provide a high real-time efficiency, optimal performance, improve the output SNR and interference ratio. MRT (maximum ratio transmission) is a method of transmitting more information to the receiver. For achieving a multiuser diversity both MRT/MRC schemes are used and also obtained by opportunistic userscheduling at either the transmitter or the receiver. For a sufficient signal more number of antennas is used. Because if oneantenna has a deep fade means another antenna has a sufficient signal to transmit the information.

In wireless communication systems, multiple numbers of antennas and users are widely used. Most of the cases there existing the usage of a relaying network Because relay networks has a great importance in this systems due to their ability to extend the coverage area and thereby improving the throughput Relaying techniques are obey the amplify and forward protocol. The use of multiple antennas at transmitter and receiver in wireless systems popularly known as Multiple Input Multiple Output technology MIMO technology constitutes a breakthrough in wireless communication system design as shown in Fig.1. For achieving the goal of improve the performance of multiuser relaying networks, a number of suggestions are introduced. In previous works, mainly using TAS/MRC technique in which highest instantaneous signal to noise ratio is selected for transmission but the key limitation of this works is the noise limited scenario. Motivating by the previous works, this paper introducing a multiuser multiple antenna AF relaying network with feedback delay and CCI over Rayleigh fading channel.

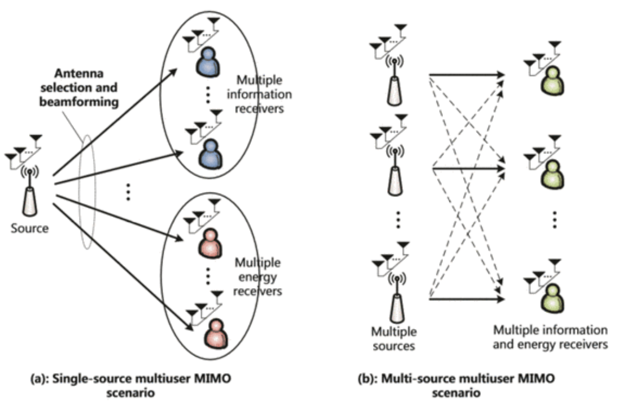

Fig.1. MIMO Systems.

The remainder of the paper is organized as follows. Section II introduces the MRT/MRC Scheme. In Section III, we present System Model. Numerical results and discussions are provided in Section IV. Finally, Section V concludes the paper and summarizes the findings.

II. MRT/MRC SCHEME

MRC (maximum Ratio Combining) is a method of combing the signal i.e, the signals from channels are combined together. It is a optimum combiner and also called as, "Ratio-squared combining and pre-detection combining". In this scheme is used to combine an original input signal with delayed input signal. MRC achieves maximum SNR in fading channels and it will provide a high real-time efficiency, optimal performance, improve the output SNR and interference ratio. MRT (maximum ratio transmission) is a method of transmitting more information to the receiver. For achieving a multiuser diversity both MRT/MRC schemes are used and also obtained by opportunistic user scheduling at either the transmitter or the receiver. For a sufficient signal more number of antennas is used. Because if one antenna has a deep fade means another antenna has a sufficient signal to transmit the information.

III. SYSTEM MODEL

Let us consider the multiple antenna AF relaying networks as shown in Fig.2, where source and destinations are communicating through a relay. It is assumed that Ns represents number of source antenna, ND represents the number of destination antenna and NI represents the number of interferers and also assumed that all the links are considered as Rayleigh fading channel i.e, there is no line of sight between transmitter and receiver. AWGN (Additive White Gaussian noise) is the basic noise model circuit and it is the good model for more satellite and space communication links. The whole communications between source and destination have two parts. During the first part, source transmits the signal symbol to the destination and to maximize the SNR at the relay source applies a MRT principle. Here, in part one, total transmits power is fixed in this system. During part two, the signal is transmitted from relay to the destination after applying a MRC principle and relay node just identify and select the user with best link between relay and the destination and it will feedback the desired destination to the source as shown in Fig.3. So, in this order transmitter implements the Multiuser Diversity.

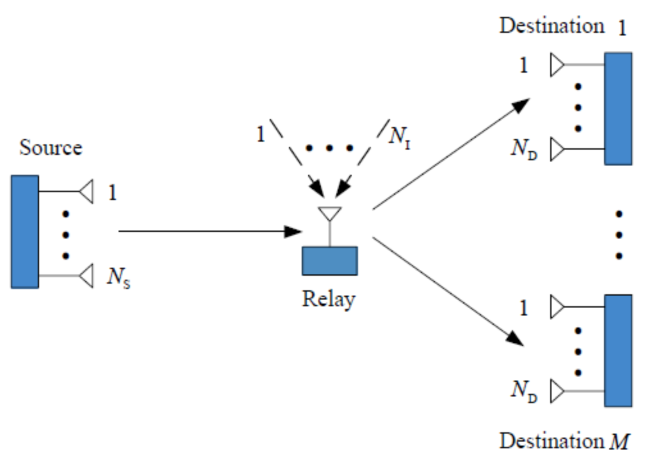

Fig.2. System Model.

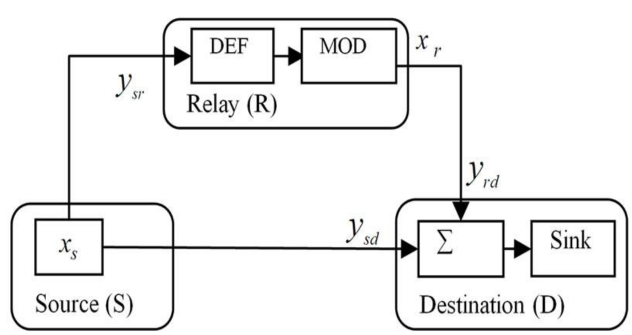

Fig.3.source to destination links.

It is based on the opportunistic scheduling principle and it can be written as,

$$F_{\gamma_2}(x) = \frac{x^{MN_D}}{(N_D!)^M \bar{\gamma}_2^{MN_D}} \quad (1)$$

i.e., High SNR (signal to noise ratio) of the second hop is scheduled for the transmission.

When $\rho_1 = \rho_2 = 1$ or more than 1, then the full diversity order can be achieved and when $\rho_1<1$, $\rho_2<1$, then the diversity order reduces to one. So, it will provide a very poorer performance.

A. Symbol Error Rate

A symbol can be described as either a pulse (in digital baseband transmission) or a "tone" (in passband transmission using modems) representing an integer number of bits.

$$\overline{P}_s = a\mathrm{E}\left[Q\left(\sqrt{2b\gamma_D}\right)\right] \quad (2)$$

B. Ergodic Capacity

The ergodic capacity can be defined as the expected value of the instantaneous mutual information of the end-to-end SINR γD, which can be represented as

$$C = \frac{1}{2}\mathrm{E}\left[\log_2(1+\gamma_D)\right] \quad (3)$$

IV. NUMERICAL RESULTS

In this section, we conduct numerical simulations to validate the analytical results presented in the previous section. Without loss of generality, we define the SNR as γ1, and assume thatγ1 = γ2. Also, although our analytical results apply to arbitrary number of interferers with arbitrary interference power distribution, here we limit the simulation to the case where there are three interferers, i.e., NI = 3, with average INR μ_i = 5dB. Finally, we set the outage threshold γ^{th} = 5dB. Fig. 4 shows the outage probability of multiuser multiple antenna AF relaying networks for different ρ_1 and ρ_2. It is

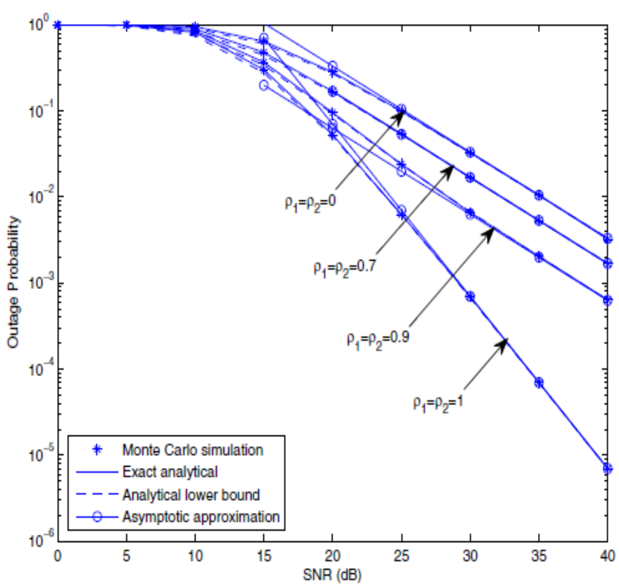

Fig.4. The outage probability under different values of correlation $\rho_1 = \rho_2$for $N_S = 2$, $N_D = 2$, M = 2 and $N_I = 3$.

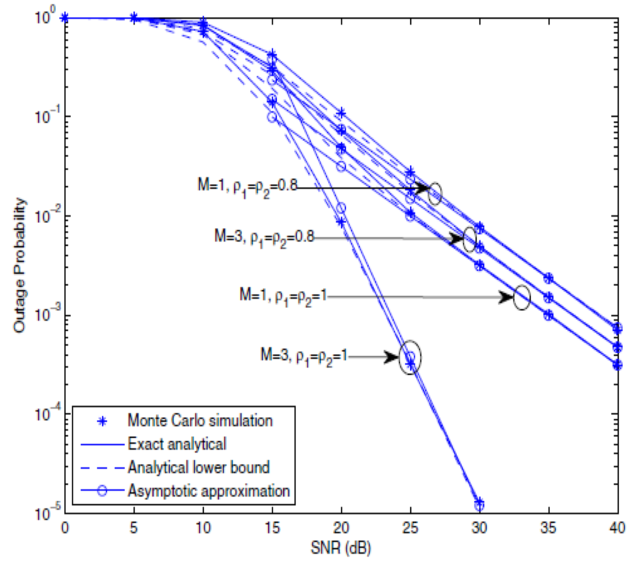

Fig.5. The outage probability under different values of user M for $N_S = 3$,$N_D = 1$ and $N_I = 3$.

observed that the analytical results are in exact agreement with the Monte Carlo simulation results, and the outage lower bound is sufficiently tight across the entire SNR range of interest, while the high SNR curves work quite well even at mode rate SNRs (i.e., $\bar{\gamma}1$ = 20dB). In addition, we can see that, only if $\rho_1 = \rho_2 = 1$, the full diversity order can be achieved. As long as $\rho_1 <1$ or $\rho_2 <1$, the achievable diversity order reduces to one. Moreover, the larger the feedback delay, the poorer the outage performance.

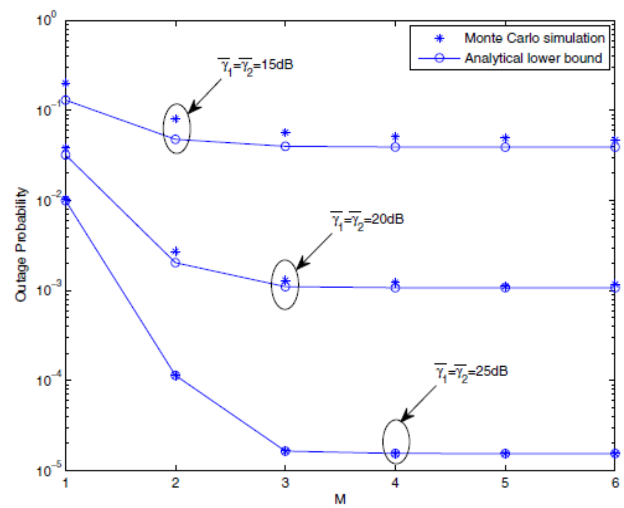

Fig.6. Impact of numbers of user on the outage probability under perfect feedback for $N_S = 4$, $N_D = 1$ and $N_I = 3$.

Fig5 examines the impact of the number of users on the outage performance. We observe that, when $\rho_1 = \rho_2 =$ 0.8,increasing the number of users M has marginal impact on the outage performance. This can be explained by the fact that only diversity order of one is achieved for the system under delayed feedback case, hence, increasing M does not provide additional diversity order for the system. In contrast, we see a significant outage improvement with the increase of the number of users M when $\rho_1 = \rho_2 = 1$. This is because more multiuser diversity can be obtained by increasing M under the perfect feedback case when $N_S > MN_D$. However, when $N_S < MN_D$, the diversity order of the system is limited to N_S. In such case, increasing M beyond NS does not provide an additional diversity gain. This observation is demonstrated in Fig. 6. Fig. 7 presents the average SER of system with quadrature phase shift keying (QPSK) modulation (a = 2, b = 0.5). As shown in the figure, the average SER lower bound is very tight with the Monte carlo simulations in the high SNR regime, which verifies the correctness of our analysis. Moreover, the asymptotic SER curves are plotted to obtain direct insights about the diversity order and array gain of the system under perfect feedback and delayed feedback, respectively. Just as in the outage probability case, we observe that high feedback delay, i.e., small ρ_1 and ρ_2, significantly degrades the error performance of the system.

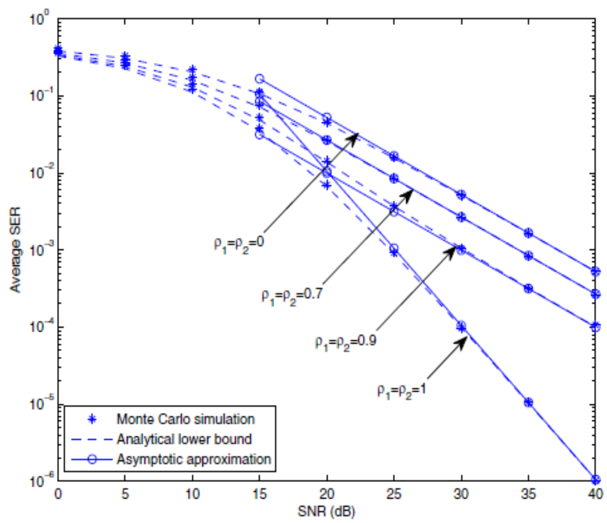

Fig.7. The average SER under different values of correlation ρ1 = ρ2 forN_S = 2, N_D = 2, M = 2 and N_I = 3.

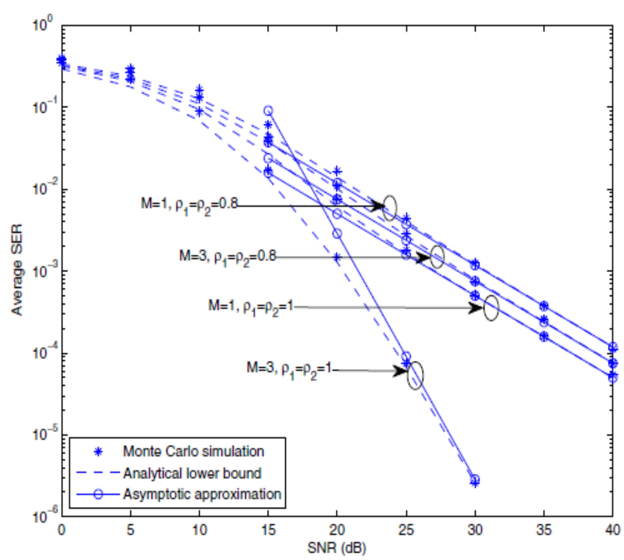

Fig.8. The average SER under different values of user M for N_S = 3,N_D = 1 and N_I = 3.

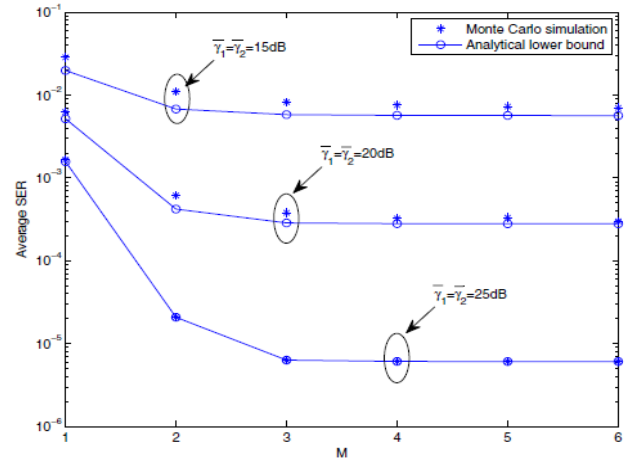

Fig.9. Impact of numbers of user on the average SER under perfect feedbackfor N_S = 4, N_D = 1 and N_I = 3.

Fig. 8 examines the impact of number of users on the average SER of multiuser multiple antenna relaying systems for perfect feedback and delayed feedback cases. Similar to the outage probability case, we observe that increasing M has no impact on the average error performance in the case of delayed feedback, while the average SER is significantly improved by increasing numbers of user due to the increase in multiuser diversity under the perfect feedback case. However, as can be observed in Fig. 9, such performance gain gradually diminishes when M becomes larger due to the limitation of the full diversity order to NS, which means opportunistic scheduling will not improve the channel quality of the first hop, resulting in a less noticeable performance improvement. Fig. 10 illustrates the ergodic capacity of the system with different ρ_1 and ρ_2. As can be readily observed, the proposed lower and upper bounds are generally quite tight across the entire SNR range. In particular, the capacity upper bound overlaps with the Monte Carlo simulation results in the high SNR regime. In addition, we also observe the intuitive result that the ergodic capacity of the system improves when feedback delay is reduced, i.e., when ρ1 and ρ2 increase from 0 to 1.

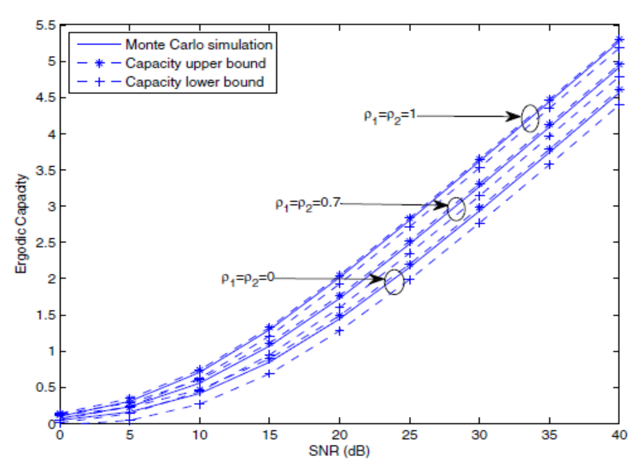

Fig.10. Impact of feedback delay on the ergodic capacity for N_S = 2,N_D = 2, M = 2 and N_I = 3.

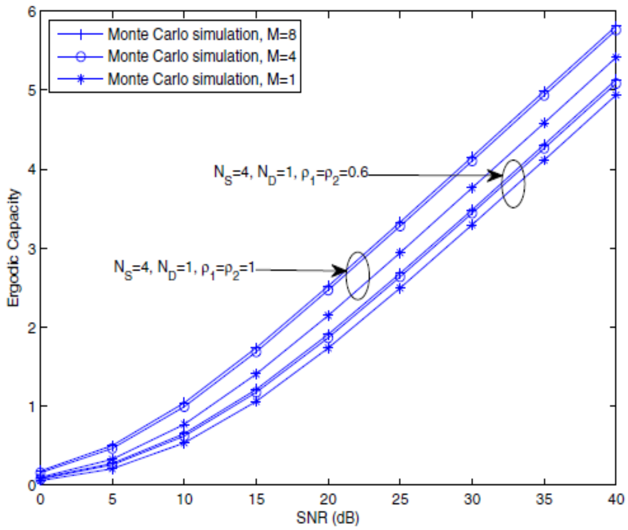

Fig.11. Impact of numbers of user on the ergodic capacity for N_S = 4,N_D = 1, and N_I = 3.

In Fig. 9, the impact of number of users on the ergodic capacity of the system is studied. We see that, in the case of delayed feedback, opportunistic scheduling only provides marginal ergodic capacity improvement when the number of users M increases from 1 to 8. In contrast, ergodic capacity enhancement due to multiuser diversity is much more pronounced in the case of perfect feedback. Moreover, when M becomes larger than N_S, the additional capacity gains diminish quickly, since in such case, the performance will be primarily limited by performance of the first hop. Fig. 12 studies the impact of power allocation on the average SER of the system. It can be observed from the figure that the proposed optimal power allocation scheme improves the SER performance compared with the uniform power allocation scheme. However, the SER improvement is much more significant for the case with perfect feedback.

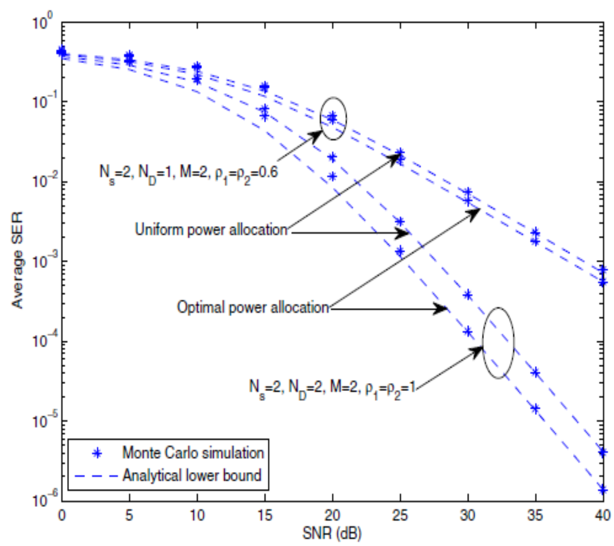

Fig.12. The average SER of multiuser multiple antenna relaying systems with N_I = 3: the optimal power allocation vs. the equal power allocation.

V. CONCLUSION

In this paper, provided a performance analysis of Multiuser diversity in AF relaying networks over a Rician Fading channels we have analyzed the performance of Average SER of the system by increasing SNR. For the average SER of the systems, exact as well as approximate closed form expressions at the high SNR regime are obtained, and the multiuser diversity order achieved by the systems are characterized., and we also concluded that, For, achieving aMultiuser diversity average SER decreases gradually by increasing SNR of the system with perfect feedback case. The parameters under considerations are outage probability, ergodic capacity and average SER of the system. The relation between the correlation coefficient and the parameter under study are deeply evaluated here. In this paper we also gave importance to optimum power allocation method instead of equal power allocation scheme. By using this method we can minimize the average SER of the multi user multiple antenna system. And as a result an enhanced performance is obtained. This paper finding suggested that, feedback delay results in loss of multiuser diversity and spatial diversity and full diversity order can be achieved only in the presence of ideal feedback.

VI. FUTURE SCOPE

In future work, we have to analyze the average SER with power allocation over the various fading channels and also analyze the Performance of Multiuser Diversity in various Fading Channels by changing the number of antennas at both transmitter and Receiver and also increasing the number of users.

VII. REFERENCES

[1] Yuzhen Huang, Student Member, IEEE, Fawaz Al-Qahtani, Member, IEEE, Caijun Zhong, Member, IEEE,Qihui Wu, Senior Member, IEEE, Jinlong Wang, Senior Member, IEEE,and Hussein Alnuweiri, Senior Member, IEEE, "Performance Analysis of MultiuserMultiple Antenna Relaying Networks withCo-Channel Interference and Feedback Delay", IEEE Transactions on Communications, Vol. 62, No. 1, January 2014.

[2] J. N. Laneman, D. N. C. Tse, and G. W. Wornell, "Cooperative diversityin wireless networks: efficient protocols and outage behavior," IEEETrans. Inf. Theory, vol. 50, no. 12, pp. 3062–3080, Dec. 2004.

[3] J. Sydir and R. Taori, "An evolved cellular system architecture incorporatingrelay stations," IEEE Commun. Mag., vol. 47, no. 6, pp. 115–121,June 2009.

[4] S.W. Peters and R.W. Heath, "The future ofWi-MAX: multi-hop relayingwith IEEE 802.16j," IEEE Commun. Mag., vol. 47, no. 1, pp. 104–111,Jan. 2009.

[5] J.-B. Kim and D. Kim, "Comparison of two SNR-based feedbackschemes in multiuser dual-hop amplify-and-forward relaying networks,"IEEE Commun. Lett, vol. 12, no. 8, pp. 557–559, Aug. 2008.

[6] C. K. Sung and I. B. Collings, "Cooperative multiplexing with interferencesuppression in multiuser wireless relay networks," IEEE Trans.Wireless Commun., vol. 9, no. 8, pp. 2528–2538, Aug. 2010.

[7] N. Yang, M. Elkashlan, and J. Yuan, "Outage probability of multiuserrelay networks in Nakagami-m fading channels,"

IEEE Trans. Veh.Technol., vol. 59, no. 5, pp. 2120–2132, June 2010.
[8] J. Kim, D. S. Michalopoulos, and R. Schober, "Diversity analysis ofmulti-user multi-relay networks," IEEE Trans. Wireless Commun., vol.10, no. 7, pp. 2380–2389, July 2011.
[9] X. Zhang, W. Wang, and X. Ji, "Multiuser diversity in multiuser twohop cooperative relay wireless networks: system model and performanceanalysis," IEEE Trans. Veh. Technol., vol. 58, no. 2, pp. 1031–1036, Feb.2009.
[10] N. Yang, M. Elkashlan, and J. Yuan, "Impact of opportunistic schedulingon cooperative dual-hop relay networks," IEEE Trans. Commun., vol.59, no. 3, pp. 689–694, Mar. 2011.

Author's Profile:

Ms. A PRIYANKA has completed her B.Tech. in ECE, from Siddhartha Institute of Engineering and Technology , Ibrahimpatnam, , R.R, Telangana, JNTU Hyderabad India , Hyderabad. Presently she is pursuing her Masters in Digital Electronics & Communication Systems, from Siddhartha Institute of Engineering and Technology, Hyderabad, TS. Email-id:priyankaamudala@gmail.com.

Dr. D Subba Rao, is a proficient Ph.D person in the research area of Image Processing from Vel-Tech University, Chennai along with initial degrees of Bachelor of Technology in Electronics and Communication Engineering (ECE) from Dr. S G I E T, Markapur and Master of Technology in Embedded Systems from SRM University, Chennai. He has 13 years of teaching experience and has published 12 Papers in International Journals, 2 Papers in National Journals and has been noted under 4 International Conferences. He has a fellowship of TheInstitution of Electronics and Telecommunication Engineers (IETE) along with a Life time membership of Indian Society for Technical Education (ISTE). He is currently bounded as an Associate Professor and is being chaired as Head of the Department for Electronics and Communication Engineering discipline at Siddhartha Institute of Engineering and Technology, Ibrahimpatnam, Hyderabad. Email –Id: subbu.dasari@gmail.com

Mrs. Swapna Kumari B, a highly enlightened person honored as Master of Technology in Digital Electronics and Communications Systems from Gurunanak Institute of Technical Campus, Hyderabad, with initial award as Bachelor of Technology in Electronics and Communication Engineering form Mahatma Gandhi Institute of Technology, Hyderabad. With her research full knowledge, a paper for International Journal has been published along with having a presence in an International Conference and also is entitled under the membership of Indian Society for Technical Education (ISTE). Her total career experience as of today is of 4 years as an Engineering Teacher and is currently sited as an Assistant Professor in Electronics and Communication Engineering stream at Siddhartha Institute of Engineering and Technology, Ibrahimpatnam, Hyderabad. Email – Id: swapnakumari7@gmail.com