IJDACR
ISSN: 2319-4863

IJDACR
International Journal Of Digital Application & Contemporary Research

International Journal of Digital Application & Contemporary Research
Website: www.ijdacr.com (Volume 5, Issue 3, October 2016)

Optimum Relay Selection in Cooperative Communication

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Abstract –**This paper is focused towards the relay selection scheme of cooperative diversity network. Log-likelihood Ratio (LLR) based relay selection scheme is applied to cooperative diversity architecture with cooperative non-regenerative (AF) relying technique. Bit Error Rate (BER) performance is compared using different fading environments**

Keywords –**AF, BER, DF, LLR.**

I. Introduction

In wireless broadband networks cooperative communication developed as a move up to single hop cellular structure. As apparent from the present and future criterions, there is a developing accord in wireless group on adding multi-hop capacity to such networks. In substructure based wireless networks, empowering multi-hop relaying brings numerous prospects at various network layers. Displacing lengthy and pathetic links with tiny and more grounded links might diminish the weight on the link budget. Unconventional paths among the users and the base station give strength in contradiction of multi-path fading and shadowing, and present novel design possibilities for planning and routing.

In physical layer an essential prospect emerges with collaboration; because of the broadcast property of wireless communication, as the information is sent to its end point in different hopes, numerous nodes in the region can receive these transmissions. Transmissions from various nodes are normally influenced by various and statistically independent fading. Consequently, the last endpoint of the information can consolidate all the received signals using utilizing conventional combining strategies, for example, Maximal Ratio Combining (MRC) or Selection Combining (SC) and achieve diversity in contradiction of the destroying properties of fading. [1].

Diversity qualities acquired from multihop transmissions is typically alluded to as cooperative diversity qualities. Diversity is an essential method to expand robustness in contrast to channel fading. Cooperative diversity is a type of spatial diversity which could be acquired deprived of multiple antennas. It is particularly helpful at what time frequency, time and spatial diversity from various receiving antennas are not practical [2].

Since the source node in the cooperative communication scheme is influenced by the relay nodes to accelerate the communication, relay selection and resource allocation for the relay nodes become significant for best performance of the cooperative communication structure. By choosing the right nodes to relay the transmission, the framework can achieve higher capacity by using lower resources. In this work, optimal relay selection is addressed.

- The primary aim of this paper is to develop a Log-Likelihood Ratio-based Relay Selection Algorithm for Cooperative Communications.
- The performance of proposed system will be based on BER analysis of Rayleigh, Rician and Nakagami fading channels.

II. Proposed Methodology

Proposed framework contains a two-hop network structure which has one transmitter, one receiver and L number of relays as shown in Figure 1.

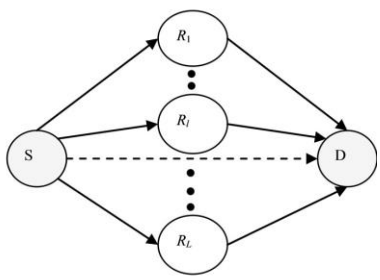

Figure 1: System Model

The transmission, relay and receiver are installed along with single antenna system assuming half duplex transmission. This arrangement contains peer

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to peer communication between the transmission end and receiver end. The considered noise is additive white Gaussian noise (AWGN).

The fading channel coefficients from source-to-destination, source-to-ith relay, and ith relay-to-destination links are represented by h_{SD}, h_{SR_i} and h_{R_iD} respectively. Here the channel coefficients are supposed to be autonomous and similarly dispersed flat Rayleigh fading channels. Every transmission is separated into two intervals. For the duration of the initial interval, the transmitter end conducts the signal thorough the relays and as well as to the receiver end. Consequently, the received signal at ith relay terminal from the transmitting end is expressed as:

$$r_{s,r_i} = sh_{SR_i} + n_{SR_i} \tag{1}$$

Where s is the transmitted signal which is supposed to be BPSK signal with amplitudes either $+\sqrt{E_s}$ or $-\sqrt{E_s}$. The received signal at receiver end from the transmitter end in line for to peer to peer communication link is expressed as:

$$r_{SD} = sh_{SD} + n_{SD} \tag{2}$$

Where h_{SD} and h_{SR_i} are the independent complex Gaussian fading channel parameters of the S-D link and S-R link correspondingly with zero mean and variances of $\sigma^2_{h_{SD}}$ and $\sigma^2_{h_{SR_i}}$ respectively. n_{SD} and n_{SR_i} are the additive white Gaussian noise of the S-D link and S-R link with zero mean and variances of $\sigma^2_{h_{SD}}$ and $\sigma^2_{h_{SR_i}}$ respectively.

For the duration of the second interval, each relay resend the signal to the receiver utilizing AF algorithm which is explained as follows:

Amplify and forward protocol (AF)

For the duration of the second interval in amplify and forward protocol (AF), every relay combines it's received signal by a gain and forwards the amplified signal to the receiver end. The drawback of this approach is that the noise at the relay will get intensified. Normally, this approach is used when the relays have bounded resources, for example power limitations, processing time or when the source-relay channel is fragile. Thus the received signal at the receiver end from i^{th} relay is expressed as:

$$\begin{aligned} r_{ri,d} &= G_i[r_{s,ri}]h_{R_iD} + n_{R_iD} \\ &= G_i[sh_{SR_i} + n_{SR_i}]h_{R_iD} + n_{R_iD} \\ &= G_i sh_{SR_i}h_{R_iD} + G_i n_{SR_i}h_{R_iD} + n_{R_iD} \end{aligned} \tag{3}$$

Where G_i is the gain of i^{th} relay, expressed by:

$$G_i = \sqrt{\frac{P_s}{P_s|h_{SR_i}|^2 + N_0}} \tag{4}$$

Where P_s the transmitted signal power and N_0 is the power spectral density.

This approach might be suitable for different types of modulation schemes such as BPSK and QPSK. For this instance, one has to determine the LLR for the type of respective modulation. Subsequent heading determines the LLR for BPSK modulation.

Origin of the Proposed Algorithm

For the duration of the initial interval the source transmits the BPSK signal to the relays and to the receiver end utilizing equations (1) and (2). For the duration of the second interval, the relays obtains the transmitted signal from the source, the log-likelihood ratio (LLR) is measured for every relay and expressed by:

$$\Delta = \ln \frac{P(r_{s,r_i}|h_{SR_i}, s = +\sqrt{E_S})}{P(r_{s,r_i}|h_{SR_i}, s = -\sqrt{E_S})} \tag{5}$$

Where the sign of Δ is the hard decision value and the magnitude signifies the dependability of the hard decision which is utilized to select the most consistent relay for detection. $P(r_{s,r_i}|h_{SR_i}, s = +\sqrt{E_S})$ and $P(r_{s,r_i}|h_{SR_i}, s = -\sqrt{E_S})$ are the probability density function (pdf) of the observation at the relays given the transmitted signal and channel. Utilizing equation (1) and deliberate that the additive noise is AWGN and the channel is complex, then these probability density functions might be expressed as:

$$P(s = +\sqrt{E_S}|h_{SR_i}, r_{s,r_i}) = \frac{1}{2\pi\sigma^2} e^{\frac{-|(r_{s,r_i} - h_{SR_i}\sqrt{E_S})|^2}{\sigma^2}} \tag{6}$$

$$P(s = -\sqrt{E_S}|h_{SR_i}, r_{s,r_i}) = \frac{1}{2\pi\sigma^2} e^{\frac{-|(r_{s,r_i} + h_{SR_i}\sqrt{E_S})|^2}{\sigma^2}} \tag{7}$$

Putting values of equation (6) and (7) into (5), the LLR simplified as:

$$\begin{aligned} \Delta = |r_{s,r_i}|^2 + 2\sqrt{E_S}Re\{r_{s,r_i}h^*_{SR_i}\} + |h_{SR_i}\sqrt{E_S}|^2 \\ - |r_{s,r_i}|^2 + 2\sqrt{E_S}Re\{r_{s,r_i}h^*_{SR_i}\} \\ - |h_{SR_i}\sqrt{E_S}|^2 \end{aligned} \tag{8}$$

Then, the magnitude of LLR $|\Delta|$ in its simplest form might be expressed as:

$$|\Delta| = \frac{4\sqrt{E_S}}{\sigma^2}|Re\{r_{s,r_i}h^*_{SR_i}\}| \tag{9}$$

Where $Re\{.\}$ signifies the real part, $(.)^*$ signifies the complex conjugate and $|.|$ signifies the magnitude of the equation.

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III. Simulation Results

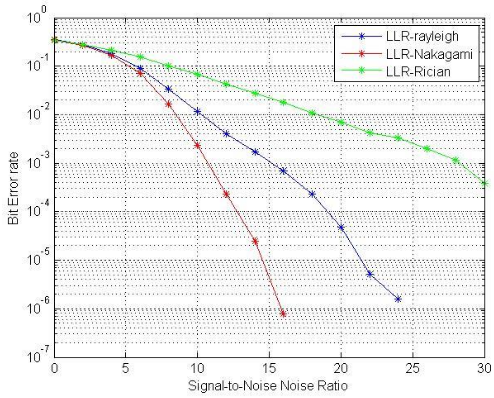

Figure 2: Comparison of BER performance for LLR relay selection scheme for different fading channels using BPSK modulation

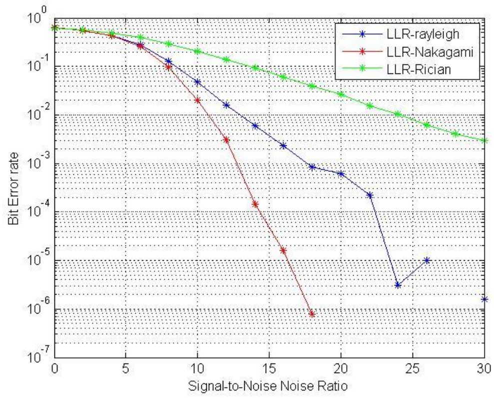

Figure 3: Comparison of BER performance for LLR relay selection scheme for different fading channels using QPSK modulation

IV. Conclusion

In this paper cooperative diversity architecture is developed for non-regenerative (amplify and forward) scheme. This system architecture utilizes the benefits of cooperative communication to enhance system performance. LLR based relay selection scheme is applied to the adopted system architecture. To evaluate system performance different fading environment have been considered. Bit error rate is considered as a performance evaluation parameter and Zero (0) BER is taken as reference level. Simulation results on the basis of Bit-Error-Rate vs. Signal-to-Noise Ratio has been presented. It was found that the LLR based relay selection in cooperative diversity improves system performance by 4 dB.

References

[1] A. Sendonaris, E. Erkip and B. Aazhang, "Increasing Uplink Capacity via User Cooperation Diversity", IEEE International Symposium on Information Theory, August 1998.

[2] A. Sendonaris, E. Erkip, and B. Aazhang, "User Cooperation Diversity– Part I: System description", IEEE Transactions on Communications, Vol. 51, Issue 11, pp. 1927 – 1938, November 2003.

[3] Adinoyi A, Fan Y, Yanikomeroglu H, Poor HV, Al-Shaalan F., "Performance of selection relaying and cooperative diversity", IEEE Transactions on Wireless Communications, Vol. 8, Issue 12, pp. 5790-5795, 2009.

[4] S. S. Ikki and M. H. Ahmed, "Performance analysis of generalized selection combining for amplify-and-forward cooperative-diversity networks," in Proc. IEEE ICC, Dresden, Germany, pp. 1–6, Jun. 2009.

[5] Y. Ding and M. Uysal, "Amplify-and-forward cooperative OFDM with multiple-relays: performance analysis and relay selection methods," IEEE Transactions on Wireless Communications, vol. 8, no. 10, pp. 4963–4968, Oct. 2009.

[6] G. Amarasuriya, M. Ardakani, and C. Tellambura, "Output-threshold multiple-relay-selection scheme for cooperative wireless networks," IEEE Transactions on Vehicular Technology, vol.59, no. 6, pp. 3091–3097, Jul. 2010.

[7] Li Y, Louie RH, Vucetic B, "Relay selection with network coding in two-way relay channels", IEEE Transactions on Vehicular Technology, Vol. 59, Issue 9, pp. 4489-4499, November 2010.

[8] Y. Liang, A. Ikhlef, W. Gerstacker and R. Schober, "Cooperative filter-and-forward beamforming for frequency selective channels with equalization," IEEE Transactions on Wireless Communications, vol. 10, no. 1, pp. 228–239, Jan. 2011.

[9] Zhi-Yong Liu, Weihai, "Single and Multiple Relay Selection for Cooperative Communication under Frequency Selective Channels", IEEE Region 10 Conference, TENCON, pp. 1-4, October 2013.

[10] El-Mahdy, Ahmed, and Ahmed Waleed, "Log-likelihood ratio-based relay selection algorithm for cooperative communications", IEEE, International Conference on Communications, Signal Processing, and their Applications (ICCSPA), pp. 1-6., 2015.