

A Review on Two-Way Relaying Transceiver Hardware Impairments

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Abstract

Hardware impairments in physical transceivers are acknowledged to have a lethal consequence on communication systems; Even though very scarce contributions have examined their influence on relaying. This paper gives a review one numerating effect in a two way amplify-and-forward (AF) configuration of transceiver impairments. More precisely the real signal to noise and distortion ratios at both transmitter nodes are attained. These are used to calculate asymptotic and precise closed form expressions for the outage probabilities, as well as submissive expressions for Symbol Error Rate (SER). It is clearly revealed that non-zero lower limits on the SER and Outage Probability (OP) occur in the high-power regime this stance in divergence to the distinct case of ideal hardware, where the SER and OP tends asymptotically to zero.

Keywords: Two-way relay transceiver, Hardware Impairment, Symbol error rate, Outage probability, Amplify and forward (AF) Protocol.

INTRODUCTION

Relays can bring substantial performance gains to wireless networks in a cost-effective way; for eg. uniform quality of service, spatial diversity gains and coverage gains[1]. In the standard half duplex approach, the transmission among a source and a destination inhabits two time slots, so the through put of an effective system in bits

per channel use is condensed by a factor of two [2] – [4]. Two-way relaying permits two nodes to communicate in two time slots with the assistance of a relay node and can be used to resolve this problem. The two nodes transmit information concurrently in the 1st time slot to the relay, and relay directs the information to the selected destinations in the 2nd time slot. Most research aids in the field of relaying suppose that the transceiver hardware of the relay node is ideal. Even though in practice, the transceiver hardware of wireless equipments are always impacted by impairments; for e.g. phase noise, amplifier amplitude-amplitude non-linearity, and IQ imbalance [5]–[7]. Impairments forms a essential capacity upper limit that cannot be overcome by increasing the transmit power; therefore, they have a very substantial influence particularly in high rate systems [8]. Meanwhile relays are required to be of low cost equipment their transceiver hardware are more prone to impairments as they are of lower quality.

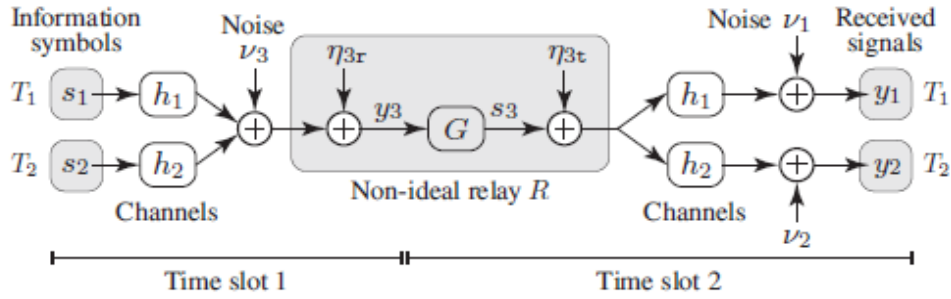


Figure 1: Block diagram of two-way AF relaying with a non-ideal relay with η_{3t}, η_{3r} .

In spite of the significance of impairments for relaying, there are very rare pertinent works and these only examine their impact on one-way relaying. In this framework [9], [10] and references therein examined how transceiver impairments distress symbol error rate and outage probability respectively in one-way relaying. Inspired by the above conversation thereafter methodically evaluate the influence of relay transceiver impairments in a two-way relaying configuration, by taking amplify and forward (AF) protocol. More precisely, expressions for the SNDR i.e. Signal to Noise and Distortion ratio on both transmitting nodes, as well as closed form expressions for the precise and asymptotic OP/SER. This allows an accurate classification of the influence of transceiver hardware impairments on both metrics. Our asymptotic examination delivers engineering visions on how the best communication performance differs with the level of impairments. This paper gives the review on the impact of hardware impairments in a two way relaying configuration [5], [14].

LITERATURE REVIEW

In 2010, Raymond H.Y. Louie et al. [2] analyses the performance of practical physical layer network coding for two way relay channels and compare them. This paper deliberates a network comprising of two a single relay node and source nodes which is used to assist communication among the two source nodes. For this situation, this paper examined transmission by transmitting over two, three or four time slots. Paper reveals that the two time slot PNC system delivers a maximum sum rate, but a lower sum bit error rate i.e. Bit Error Rate (BER) than the four time slot transmission system for a no. of practical situations. Paper reveals that the three time slot PNC system offers a good tradeoff between the two and four time slot transmission systems, and also attains the best maximum sum rate or sum BER in practical situations. To ease comparison, we descend novel closed form expressions for the maximum sum rate and sum BER and outage probability. This paper deliberate an resourceful relaying system for a network with multiple relay nodes, where a single relay is selected to maximize whichever the maximum sum rate or minimize the sum BER. Paper outcomes specify that the resourceful relaying system can expressively enhance system performance as compared to a single relay network.

In 2012, X. Liang, et al. [3] study the outage performance for a two way relay channel using amplify and forward approach in interference restricted situations. The precise integral form expression for outage probability is evaluated under diverse power interference situations. The lower limit and the estimation for the outage probability are also calculated in closed form. The ideal power distribution between terminals is attained when relays transmit power is large and when the impact of interference is discouraged. Mathematical outcomes validates that the lower limit works well in conditions where relay's transmit power is smaller than at terminals of source, although the calculation fits flawlessly with the precise outcomes in normal conditions and mainly when relay is at large power than that of the source terminals in interference limited schemes.

In 2012, N. Yang et al. [4] proposed and analyses two multiple input multiple output MIMO two way relaying systems with amplify and forward protocol in Nakagami fading channels, where multi antenna sources interconnect through a single antenna relay. Precisely, paper presented a novel framework for the comparative examination of beam forming and antenna choice with non identical fading constraints in the two source relay links. To simplify the assessment, paper gives new asymptotic and estimated expressions for the Sum Symbol Error Rate (SSER) with M-ary phase shift keying i.e. M-PSK and M-ary Quadrature Amplitude Modulation (M-QAM). Based on the asymptotic SSER paper concludes that beam forming and antenna selection

have the identical diversity order. The diversity order is subjugated by the weaker source relay link which is evaluated by the product of the no. of antennas at source end and the fading constraint. This Research Paper differentiates two schemes in terms of their average signal to noise ratios i.e. SNRs and array gains. To attain additional understanding, paper discourse the crucial questions of how to assign the total transmit power such that the SSER is minimized? Paper in response gives the form of novel concise expressions for the power distribution factor that precisely distributes the total transmit power between the relay and the sources. An essential conclusion is derived that antenna assortment bids the same SSER as beam forming when the source in the feebler link is fortified with a single antenna.

In 2014, Emil Bjornson et.al. [8] Worked upon the capacity of ideal multi Input Multi Output (MIMO) channels have a high SNR grade that equals the minimum of the no. of receive and transmit antennas. This communication examines if this result grips when there are alterations from physical transceiver impairments. This Paper concluded methodically that such physical MIMO channels have a limited upper capacity for at all SNR and channel distributions. The high SNR grade thus downfalls to zero. This seems depressing, but paper concludes the reassuring outcomes that the relative capacity gain of engaging MIMO is at least as large as with ideal transceivers.

In 2012, Jingya Li et.al. [9] Investigate the performance of dual hop two way AF relaying in the existence of In phase and Quadrature phase imbalance (IQI) at the relay node. Specifically, the effective Signal to Interference Noise Ratio (SINR) at both sources is being derived. These SINRs are used to project an rapid power distribution arrangement, which capitalize on the minimum SINR of the two sources under a total transmit power restraint. The key to this optimization problem is systematically evaluated and used to evaluate the outage probability of the two way AF relaying scheme. Both mathematical and analytical results demonstrate that IQI can create essential performance bounds on two way relaying, which cannot be evaded by simply refining the channel situations.

In 2013, Emil Bjornson et.al. [10] revealed that transceiver hardware impairments have harmful influence on the recital of communication systems. Specifically for high rate systems the massive majority of technical aids in the field of relaying supposed to be of ideal transceiver hardware. This paper enumerates the influence of transceiver hardware impairments in dual hop AF relaying both for variable and fixed gain relays. The outage probability in this real situation is a function of the rapid end to end signal to noise and distortion ratio i.e. SNDR. This paper arises closed form expressions for the asymptotic and precise OPs under Rayleigh fading secretarial for hardware

impairments at both the relay and the transmitter. The performance loss at low spectral efficiency is small but can otherwise be very extensive. In specific, it turns out to be high signal to noise ratio i.e. SNR, the rapid end to end SNDR encounters to a deterministic constant i.e. SNDR upper limit which is inversely proportional to level of impairments. This stance in unambiguous distinction to the ideal hardware for which the end to end SNDR raises without limit in the high SNR command.

CONCLUSION

In this paper, a two way relay system is being considered where two source nodes interconnect to each other through a relay node using an amplify and forward protocol. Communication is being established over two, three or four time slots. Through numerical and systematic analysis, paper have revealed that the two and four time slot transmission arrangements may outdoes the other contingent on various practical situations, and whether the performance metric is the sum BER or maximum sum rate. This Paper have revealed that at high SNR the two time slot PNC system achieves worse than the four timeslot transmission system in terms of sum BER for appropriately at dissimilar powers at source end though the two time slot PNC system achieves better than the four time slot transmission system in terms of maximum sum rate. The three time slot PNC system, Paper concluded that it achieves a performance which either lies between or surpasses the performance of the two and four time slot transmission system and hence offers a good tradeoff. In final conclusion, paper considered an adaptive relaying system with K relays, and exhibited that the use of extra relays can pointedly upsurge system performance and provides a diversity gain K times than the diversity gain with only one relay.

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