

Chapter 11

Performance Analysis of Multi-Antenna Relay Networks over Nakagami- m Fading Channel

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ABSTRACT

In this chapter, the authors present the performance of multi-antenna selective combining decode-and-forward (SC-DF) relay networks over independent and identically distributed (i.i.d) Nakagami- m fading channels. The outage probability, moment generation function, symbol error probability and average channel capacity are derived in closed-form using the Signal-to-Noise-Ratio (SNR) statistical characteristics. After that, the authors formulate the outage probability problem, optimize it with an approximated problem, and then solve it analytically. Finally, for comparison with analytical formulas, the authors perform some Monte-Carlo simulations.

1. INTRODUCTION

Cooperative communication has been an interesting topic for researchers in recent years. Cooperative communications refer to systems or techniques that allow users to help transmit each other's messages to the destination. Most cooperative transmission schemes involve two phases of

transmission: a coordination phase, where users exchange their own source data and control messages with each other and/or the destination, and a cooperation phase, where the users cooperatively retransmit their messages to the destination.

To enable cooperation among users, different relay technology can be employed depending on the relative user location, channel condition and

transceiver complexity. There are some of the basic cooperative relaying techniques such as Decode-and-Forward (DF) in which the relay decodes the received signals and forwards it either as is or re-encoded to the destination regardless whether the relay can decode correctly or not.

The relay could also only forward the correctly decoded messages, which is referred to as the Selective DF (S-DF) protocol, Amplify-and-Forward (AF) in which the signal received by the relay is amplified, frequency translated and retransmitted, Coded Cooperation (CC) that can be viewed as a generalization of DF relaying schemes where more powerful channel codes (other than simple repetition codes used in the DF schemes) are utilized in both phases of the cooperative transmission. When using repetition codes, the same codeword is transmitted twice (either by the source or the relay) and, thus, bandwidth efficiency is decreased by one half and Compress and Forward (CF) schemes, which refer to cases where the relay forwards quantized, estimated, or compressed versions of its observation to the destination. In contrast to DF or CC schemes, the relay in CF schemes need not decode perfectly the source message, but need only to extract, from its observation, the information that is most relevant to the decoding at the destination. The amount of information extracted and forwarded to the destination depends on the capacity of the relay-destination link Dohler and Li (2010).

LITERATURE REVIEW

Because the relay selection schemes make an efficient use of time and frequency resources, several selective combining schemes have been introduced in recent years. In Blatses et al. (2006), the authors introduced an opportunistic relaying method, which a single relay based on the best end-to-end instantaneous SNR criterion is selected

and then forwards the message to the destination. They derived analytical results at high SNRs and the outage probability wasn't derived in closed-form. The authors in Beaulieu and Hu (2006) and Hu and Beaulieu (2007) analyzed an adaptive DF relay method, which only a number of relays were selected to send the messages to the destination. They proved that increasing the number of relays could not always decrease the outage probability.

A selection combiner at the destination with AF relays have been studied in Sagias et al. (2008) on Nakagami-m fading channels where, a closed-form formula for the outage probability was derived. Different relaying schemes are investigated in Jing et al. (2009), the authors have calculated the diversity of some existing single-relay selection schemes. They have managed to develop the relay selection idea to the case in which more than one relay is taking part in cooperation. They have researched the complexity of these schemes, too. In Duong et al. (2009), the authors presented closed-form formulas for the performance of selective DF relaying in Nakagami-m fading channels without considering the direct link between source and destination. The authors in Ikki and Ahmed (2010) introduced a closed-form expression for the outage probability and average channel capacity using the best relay selection scheme over independent and non-identical Rayleigh fading channels. In Amarasuriya et al. (2010) the authors have developed a Multiple Relay Selection (MRS) scheme. In this method the relays are selected so that the output SNR satisfies a predefined SNR. The authors in Kalantari et al. (2011) have derived closed form expressions for the outage probability in opportunistic AF and DF relaying over Log-normal fading channels. In their method, the weakest channel of each relay is defined, and then the relay that its weakest channel is stronger than others is selected. The Log-normal distribution not only models the moving objects, but also the reflection of the bodies. Moreover, it

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