Decoding Algorithm of Superposition Modulation in Cooperative Network without SIC

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***Abstract* –In this paper, we propose a new decoding strategy for SM in cooperative communication method using without SIC. The advantage of the proposed method is that we can derive LLR(Log Likelihood Ratio) regardless of the successive decoding of large power ratio information. The new decoding scheme can outperform conventional cooperative diversity base on DF-SM by about 1-3dB in the BER range of interest.**

1. INTRODUCTION

Recently, as IoT is applied to various fields, there is a need for research on high reliability communication systems. In the IoT communication system, it is difficult to install a plurality of antennas in order to obtain a diversity effect in a low-cost small device. Therefore, cooperative communication technique obtaining a space diversity effect is a proper alternative.[1]

As far as we surveyed, various algorithms have been developed for cooperative communication techniques. There is a method AF, in which a relay node decides whether to receive (Amplify and Forward), or DF (Decode and Forward), a packet of a source node and retransmits the packet of the source node. At this time, a method of lowering the BER by setting an optimal threshold value of the signal noise value has also been proposed.[2] Also, when using multiple relay nodes, a relay node selection algorithm with the best channel state based on signal noise has also been introduced.[3] However, in the conventional SM scheme, SIC decoding can be applied depending on the information bit having a large power ratio. In this paper, a method of independently decoding information of each node is introduced.[4]-[6] This solves the bottleneck of the existing SM scheme.

1. SYSTEM MODEL

In this paper, we consider a cooperative network system consisting of one source node (), one relay node (), and one destination () as shown in Fig.1. We assume all nodes have a single antenna. The channel coefficients between nodes, denoted byand , are random variables having a complex Gaussian distribution with an average of 0 and a variance per dimension of 0.5. For simplicity, we assume channel information is perfectly estimated. Also, and  are the complex Additive White Gaussian Noises with an average of 0 and a variance per dimension. The information bit of the source node and the relay node are denoted by  and .

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Fig.1 Cooperative network phase diagram

1. PROPOSED DECODING ALGORITHM

We consider a sensor node uplink scenario where transmits a packet including its own information() to  and . It is attempted for  and  to decode received signal in the 1st phase.

 (1)

If decoding fails,  sends a NACK to request retransmission. At this time,  retransmits power by superposing power ratio  on  and  on  in the 2nd phase. The received retransmitted signal is as follows.

 (2)

 (3)

SIC decoding can be performed only if information bits having a large power ratio are successfully decoded in the conventional SM retransmission method in Fig.2. Depending on the channel conditions whether SIC is able or not, it is determined the opportunity of decoding the small power ratio signal, in this example.

Fig.2 Conventional and Proposed Decoding Algorithm

If large power ratio signal is not decoded in the retransmission phase, it is waste of resource for both phases and nodes. In the proposed decoding algorithm, LLR for each node is derived by the adaptive power ratio mapping table. For example, adaptive power ratio QAM mapping table is used to derive bit LLR for each node regarding to the conditions in the case of QPSK modulation used. Without SIC step,  bit LLR is generated for BLC decoding algorithm with the previous derived LLR.

1. .SIMULATION RESULT

For practical demonstration, we set log MAP method to generate LLR with Turbo Code(13, 11) and Equal Gain Bit Level Combining with QPSK modulation. The BER for the proposed algorithm is measured by varying (SNR between  and ) under Quasi-static Rayleigh fading channel. As shown in Fig.3, the proposed decoding algorithm gained 1 ~ 3dB in SNR over the conventional SM decoding method in BER  region.



Fig.3 Comparison of BER between Conventional SIC and Proposed SM decoding scheme

1. CONCLUSIONS

In this paper, we propose a method for decoding information of each node without using SIC which is used in SM transmission. The proposed method obtains SNR gain by decoding information of each node regardless of whether it is decoding conventional large power information.

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