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A Note on "Amplify-and-Forward Relay Networks under Received Power Constraint"

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***Abstract*—This letter is to correct the incorrect optimal relay coefficient at the *k*-th relay derived in [1] for an amplify-and-forward (AF) wireless relay network under received power constraints. While the trends remain the same, with the correct optimal relay coefficient in this paper, nonnegligible improvement, e.g., about 0.8 dB at BER $= 10^{-7}$, can be achieved.**

***Index Terms*—Relay networks, received power constraint.**

In [1], the eigenvector in (15) is associated with $\bar{\mathbf{f}}^*$ instead of $\bar{\mathbf{L}}^*\bar{\mathbf{f}}^*$. In other words, the solution provided in (15) of the original paper is not $\bar{\mathbf{f}}^*$ and should be $\bar{\mathbf{L}}^*\bar{\mathbf{f}}^*$. The corresponding corrected parameters α and $\mathbf{f}$ for the correlated noise at the relays are written, respectively, as

$$\alpha = \frac{\sqrt{p_c}}{\sqrt{\mathbf{h}_s^* \mathbf{D}_{\mathbf{h}_t}^* \mathbf{W}^{-*/2} \mathbf{B}^{-2} \mathbf{W}^{-1/2} \mathbf{D}_{\mathbf{h}_t} \mathbf{h}_s}} \tag{1}$$

$$\mathbf{f} = \frac{\sqrt{p_c}}{\sqrt{\mathbf{h}_s^* \mathbf{D}_{\mathbf{h}_t}^* \mathbf{W}^{-\frac{*}{2}} \mathbf{B}^{-2} \mathbf{W}^{-\frac{1}{2}} \mathbf{D}_{\mathbf{h}_t} \mathbf{h}_s}} (\mathbf{B}^{-1} \mathbf{W}^{-\frac{1}{2}} \mathbf{D}_{\mathbf{h}_t} \mathbf{h}_s)^* \mathbf{W}^{-\frac{1}{2}}. \tag{2}$$

And the corresponding corrected relay amplifying coefficients for the uncorrelated noise at the k-th relay are written as

$$f_k = \frac{\sqrt{p_c} h_{s_k}^* h_{t_k}^*}{|h_{t_k}|^2 \sigma_{r_k}^2 \left(\frac{\sigma_{v_t}^2}{p_c} + \frac{\sigma_{v_s}^2}{\sigma_{r_k}^2} \right) \sqrt{\sum_{i=1}^{K} \frac{|h_{s_i}|^2}{\sigma_{r_i}^2 \left(\frac{\sigma_{v_t}^2}{p_c} + \frac{\sigma_{v_s}^2}{\sigma_{r_i}^2} \right)^2}}} \tag{3}$$

where $k = 1, \cdots, K$.

To compare the system BER performance between the correct optimal f_k in (3) and the incorrectly derived f_k in (20) of [1], a Monte-Carlo simulation is performed. All simulation environments are similar to those shown in Figs. 3 and 4 of [1].

Figure 1 shows the received signal power difference at the destination under the power constraint of 0 dB, $p_c = 1$, with $K = 5$ and 10. Observe that, as shown in Fig. 1, the received signal power with the correct optimal f_k in (3) at the k-th relay is 13% less than the one with the incorrectly derived f_k in (20) of [1] when $K = 10$ and SNR = 30 dB. In particular, the received signal power difference between the two results will become larger as either K or SNR increases.

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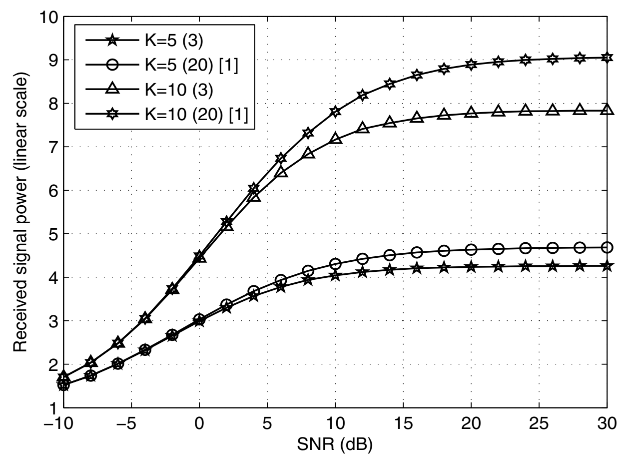

Fig. 1. Received signal power at destination in linear scale for power constraint of 0 dB, $p_c = 1$, with $K = 5$ and 10.

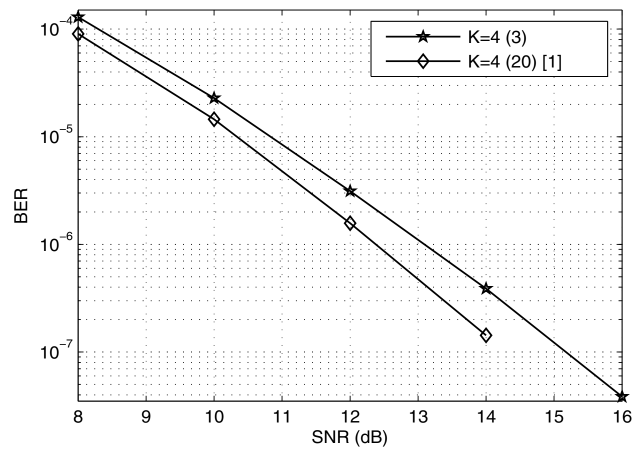

Fig. 2. BER performance of SNR maximization subject to power constraint of 0 dB with $K = 4$.

Figure 2 shows the BER performance versus SNR with $K = 4$ using (3) and (20) of [1] under the power constraint of 0 dB. Fig. 2 shows that the BER performance with the correct optimal f_k in (3) is about 0.8 dB better at BER $= 10^{-7}$ than the one with the incorrectly derived f_k in (20) of [1]. Similarly, the BER difference between the two results will become larger as either K or SNR increases.

References

[1] A. S. Behbahani and A. M. Eltawil, "Amplify-and-forward relay networks under received power constraint," *IEEE Trans. Wireless Commun.*, vol. 8, no. 11, pp. 5422–5426, Nov. 2009.