The objective of this research

I. To investigate a space-time coded cooperative wireless communications with Alamouti’s coding and cooperative maximum ratio combining (C-MRC) techniques

II. To propose an Alamouti-coded decode-and-forward protocol with optimum relay selection for three-user one destination cooperative communications

III. To analyze the SER performance of the Alamouti-coded decode-and-forward protocol for cooperative communications

Received Signal Model

\[
\begin{align*}
\gamma_{ij} &= \frac{E_{i}^{j}G_{i}^{j}}{N_{0}} + \frac{E_{i}^{j}G_{i}^{j}}{N_{0}} \\
\gamma_{ij} &= \frac{E_{i}^{j}G_{i}^{j}}{N_{0}} + \frac{E_{i}^{j}G_{i}^{j}}{N_{0}}
\end{align*}
\]

Cooperative Maximum Ratio Combining (C-MRC)

\[
\begin{align*}
\gamma_{ij} &= \frac{\gamma_{ij}^1 + \gamma_{ij}^2}{\gamma_{ij}^1 + \gamma_{ij}^2} \\
\gamma_{ij} &= \frac{\gamma_{ij}^1 + \gamma_{ij}^2}{\gamma_{ij}^1 + \gamma_{ij}^2}
\end{align*}
\]

According to the simulation result:

We present a curve of averaged SER versus SNR (dB) for three-user cooperative communication systems, including the curve for the decode-and-forward protocol with optimum relay selection and Alamouti-coded decode-and-forward protocol with optimum relay selection, and the ordinary cooperative decode-and-forward protocol. It is worth noticing that the best relay selection technique is much superior to the existing cooperative protocol because the diversity gain achieved in the systems results in increasing bandwidth efficiency, which in turns lowering the probability of detection error. In addition, the existing DF cooperative protocol requires over 5-dB more SNR than the proposed system to achieve the same probability of error performance, i.e. SER below $10^{-3}$.

Performance analysis

\[
A = b_{p_{s}}P_{s}^2(\frac{N_{t} + 2.4X_{c}}{M})(\frac{S_{r}}{S_{t}}) \\
b_{p_{s}} = \sin(\pi/M)
\]

Guidelines for the innovation

I. Firstly, we have proposed the Alamouti-coded decode-and-forward protocol for two-user cooperative communications

II. The simulation results show the performance enhancement by increasing the degree of freedom with the Alamouti technique

III. This proposed system can decrease the probability of error, as shown in the simulation results

IV. We could further apply the proposed system to investigate the Alamouti-coded decode-and-forward protocol with optimum relay selection for three-user cooperative communications

V. The proposed protocol achieves the full diversity by the virtue of increasing a number of signal transmissions in the relaying phase. This system can receive more bandwidth efficiency depend on the number of relays

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