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Joint throughput and transmission range optimization for triple-hop networks with cognitive relay

Key words: Decode-and-forward (DF); Triple-hop; Cognitive relay networks (CRNs); Time and power allocation; Superposition coding

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Motivation

The traditional dual-hop network scheme with a cognitive relay has the following shortcomings:

- First, the secondary user (SU) data flow must be consistent with the primary user (PU) data flow. It means that the network provides only one-way communication;
- Second, the transmission range is still limited by the dual-hop relay methodology.

Main idea

- The SU pair become two relays in the triple-hop networks that can relay primary signal.
- The transmission performance can be optimized by time and power allocation.

Method

1. The triple-hop relay scheme with a source, two half-duplex relays, which is inspired by (Shoukry *et al.* 2014).
2. Superposition coding (SC) is introduced to handle the two-receiver case which provide substantial gains in spectral efficiencies over such orthogonal schemes as the time division multiplexing (TDM) (Vanka *et al.* 2012b).
3. The optimal policy for time and power allocation is obtained by proving that the objective function is a concave function. Karush–Kuhn–Tucker (KKT) conditions are introduced to achieve the solution.

Major results

- The proposed scheme can enlarge the transmission coverage without increasing the number of hops.

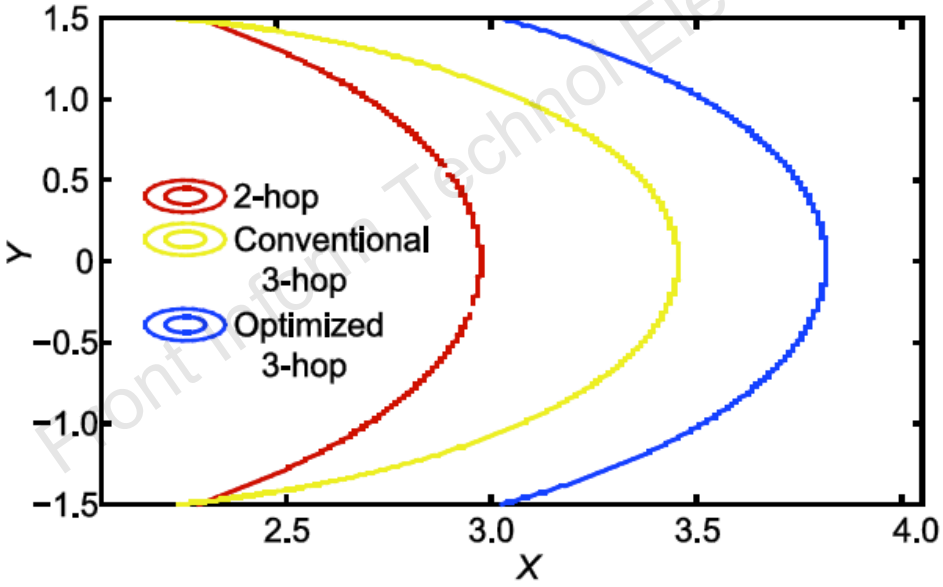

Fig. 3 Transmission range for P_2 to receive a signal

Major results

- The proposed scheme inherits the advantages of Dual-hop and Conventional triple-hop networks.

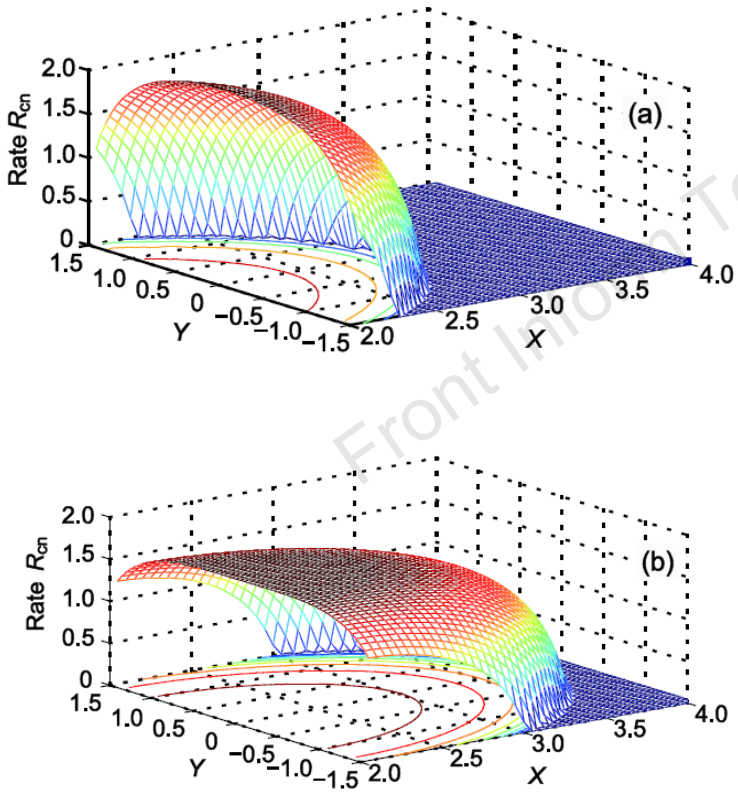

Fig. 4 Value of R_{cn} versus different locations of P_2 of dual-hop (a), conventional triple-hop (b), and optimized triple-hop (c)

Conclusions

- The proposed scheme uses SU pair as relays that can enlarge the transmission coverage.
- The proposed scheme uses SC to handle the two-receiver case.
- Simulation results were presented to prove the the-oretical design concept. Under the given conditions, the transmission distance is increased by 11%, and the secondary throughput is improved by 14%.