(1)

OPTIMAL DECODING FOR WIRELESS RELAY NETWORKS WITH DECODE-AND-FORWARD COOPERATION PROTOCOL

Taha Abdelshafy Abdelhakim Khalaf

Abstract:

In this paper, we derive an exact upper bound (UB) on bit error rate (BER) of the decode-and-forward (DF) cooperation protocol. The destination uses the maximum a posterior (MAP) decoder to estimate the data sent from the source. The MAP decoder is optimal in the sense that it minimizes the the end-to-end error probability. The complexity of derivation comes from the fact that however the source generates data with equal probability, the data received at the destination does not have the same a priori probability. That is because of the error that occurs in the source-to-relay link. Hence, the MAP decoding rule can not be simplified to the maximum likelihood (ML) decoding rule. The results show that the upper bound is very tight. Therefore, the closed form expression of the upper bound can be used to fully study and understand the diversity performance of the DF cooperation protocol.

Keywords:

Relay Network, Diversity, Decode-and-Forward, MAP Decoder.

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(2)

COMPRESSED MEASUREMENTS BASED CYCLOSTATIONARY DETECTOR FOR WIDEBAND COGNITIVE RADIOS

Mohammed Y. Abdelsadek , Mohammed Farrag, and Taha A. Khalaf

Abstract:

Cyclostationary feature detection is one of the most powerful spectrum sensing techniques used for cognitive radio (CR) systems. This is because of its robustness against noise uncertainties. However, this technique needs high sampling rates, which is limited by the state-of the-art analog to digital converters (ADCs), especially in wideband regime. Comressive sensing (CS) was used by many researchers for solving this problem via sub-Nyquist sampling rates. However CS solves the high sampling rate problem, but it does not reduce complexity considerably. This is because spectrum sensing is performed in three steps: sensing compressed measurements, then reconstructing the Nyquist rate signal, and finally performing cyclostationary detection (CD) on the reconstructed signal. In this paper we suggest performing CD directly on the compressed measurements skipping the reconstruction step which is the most complex step in CS. This can be realized by designing the sensing matrix with constraints different from those used in the conventional CS. Results show that performance is improved relative to applying CD on the Nyquist rate signal. This is in addition to reduction in receiver complexity resulting from reducing sampling rates. A detection probability of 78.7% can be achieved with only 7% of samples used by the conventional cyclostationary detection technique that achieves a detection probability of 32.7%.

Keywords:

Cognitive radio, Spectrum Sensing, Cyclostationary Detector, Compressive Sensing.

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(3)

Tradeoff Between Reliability and Security in Multiple Access Relay Networks Under Falsified Data Injection Attack

Taha A. Khalaf, Member, Sang Wu Kim, Senior Member, and Alaa E. Abdel-Hakim, Member,

Abstract:

We consider a multiple access relay network where multiple sources send independent data to a single destination through multiple relays, which may inject falsified data into the network. To detect the malicious relays and discard (erase) data from them, tracing bits are embedded in the information data at each source node. In addition, parity bits are added to correct the errors caused by fading and noise. When the total amount of redundancy, tracing bits plus parity bits, is fixed, an increase in parity bits to increase the reliability requires a decrease in tracing bits, which leads to a less accurate detection of malicious behavior of relays, and vice versa. We investigate the tradeoff between the tracing bits and the parity bits in minimizing the probability of decoding error and maximizing the throughput in multisource, multirelay networks under falsified data injection attacks. The energy and throughput gains provided by the optimal allocation of redundancy and the tradeoff between reliability and security are analyzed.

Keywords:

Multiple access relay network, tradeoff between reliability and security, falsified data injection, forward error correction.

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(4)

Decoding scheme for relay networks with parity forwarding cooperation protocol

Taha A. Khalaf, Safwat M. Ramzy

Abstract:

The maximum a posterior (MAP) decoding scheme is presented here for cooperative communication networks that adopt the parity forwarding as a cooperation protocol. The MAP decoder is optimal in the sense that it minimises the error probability. The authors consider a wireless network that is composed of two sources: two relays and a single destination. A closed-form expression is derived for upper bound on the bit error probability. The complexity of derivation comes from the fact that although the source generates data with equal probability, the data received at the destination does not have the same a priori probability. That is because of the error that occurs in the source-to-relay link. Therefore, the MAP decoding rule cannot be simplified to the maximum likelihood decoding rule. The results show that the analytical upper bound is very tight and almost coincides with the exact error probability obtained from simulations at higher values of the signal-to-noise ratio. Accordingly, the closed-form expression of the upper bound can be used to fully study and understand the diversity performance of the system.

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(5)

Error probability in multi-source, multi-relay networks under falsified data injection attacks

Taha A Khalaf, Sang Wu Kim

Abstract:

We analyze the probability of decoding error in a multi-source, multi-relay wireless network, in which the adversary may inject falsified data through captured relay nodes. To detect malicious relay nodes and discard (erase) the data from those relay nodes, tracing bits are embedded in the information data at each source node. Parity bits are also added to the information data to correct the errors caused by the the channel impairments such as fading and noise. We analyze the tradeoff between the tracing bits and the parity bits in minimizing the probability of decoding error in multi-source, multi-relay networks under falsified data injection attacks.

Keywords:

INSPEC: CONTROLLED INDEXING decoding error statistics radio networks telecommunication security wireless channels INSPEC: NON CONTROLLED INDEXING channel impairments decoding error probability falsified data injection attacks multirelay wireless network multisource network

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(6)

Performance of maximum likelihood decoder in network coded cooperative communications

Khalaf, T.A.

Abstract:

Cooperative relaying is gaining a significant attention in that, intermediate relay nodes assist the source nodes to enhance the overall network efficiency. In network coded cooperative communications, the relay node linearly combines the data received from the sources and forward the linear combination to the destination. In this paper, we present the maximum likelihood decoding scheme for a network composed of two sources, single relay, and single destination. We derive a closed form expression for upper bound on the word error probability. The simulation results show that the analytical upper bound is very tight especially at higher values of the SNR. The results also show that there exists an error floor in the error probability. Therefore, the closed form expression of the upper bound is used to study the reasons of this error floor and how to mitigate it.

Keywords:

Cooperative Communications ML Decoder Multiple Sources Network Coding Relay

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(7)

COMPRESSED MEASUREMENTS BASED CYCLOSTATIONARY DETECTOR FOR WIDEBAND COGNITIVE RADIOS

Mohammed Y Abdelsadek, Mohammed Farrag, Taha A Khalaf

Abstract:

ABSTRACT Cyclostationary feature detection is one of the most powerful spectrum sensing techniques used for cognitive radio (CR) systems. This is because of its robustness against noise uncertainties. However, this technique needs high sampling rates, which is limited by the state-of the-art analog to digital converters (ADCs), especially in wideband regime. Comressive sensing (CS) was used by many researchers for solving this problem via sub-Nyquist sampling rates. However CS solves the high sampling rate problem, but it does ...

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(8)

Optimal positioning of relay node in wireless cooperative communication networks

Mohammed, H. Khalaf, T.A.

Abstract:

In this paper, we consider a wireless cooperative communication network that consists of single source, single relay, and single destination and derive a general upper bound (UB) on the end-to-end bit error rate (BER). The relay node uses the decode and forward (DF) cooperation protocol in order to increase the reliability of the source data at the destination. The derivation takes into account the distances between the system nodes in addition to the channel noise and fading effects. The destination uses the maximum a posterior (MAP) decoder to estimate the data sent from the source. The derived UB is very tight and it almost coincides with the exact BER results obtained from simulations. Therefore, the closed form expression of the UB can be used for further studies. In this paper, we use the UB closed form expression to study the effects of the relay position on the BER performance. The genetic algorithm is used to find the optimal location of the relay node.

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Compressed Measurements Based Spectrum Sensing for Wideband Cognitive Radio Systems

Taha A. Khalaf, Mohammed Y. Abdelsadek, and Mohammed Farrag

Abstract:

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Keywords:

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