ENHANCED TRANSMISSION STRATEGY IN COGNITIVE RADIO NETWORKS USING COOPERATIVE SENSORS

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ABSTRACT:

Cooperative spectrum sensing is a technology that enables cooperative sensors to help cognitive radio (CR) transmitters to show intelligence and decide their transmission opportunities. Transmission will solely achieve success if spectrum is made available for each cognitive radio transmitters and receivers. Actuated by this observation, we use Boolean-Poisson model to investigate the geometric property of the realm that permits cognitive radio transmission to be helped with cooperative sensors. We discover that cooperative sensing cannot continuously be useful and therefore the region permitting cognitive radio transmission is usually not circular symmetry. We tend to establish the condition that transmission link is bidirectional. We tend to any extend this model into the sub-optimal situation among the secondary users and therefore the corresponding transmission allowable region. We derive the condition that secondary users cannot reduce their Bayesian risk by deploying cooperative sensors. We conclude with the rules for deploying CRs into existing network.

IndexTerms: cognitive radio, Bayesian risk, Nash equilibrium,Min-max, Cooperative sensor.

[1]INTRODUCTION

Cognitive radio (CR) allows each transmitter to first sense the availability of the spectrum and then intelligently decides its transmission actions based on the sensing results [1]. It attracts significant interest due to its potential to improve the utilization of the spectrum. One solution to improve the accuracy of the sensing is to allow each CR transmitter to be helped by its nearby sensors, commonly refers to as the cooperative sensors. Nevertheless, coordination and information exchange between CR
transmitters and cooperative sensors also introduce communication overhead and increase power consumption [2]. To reduce the overhead of feedback information, the authors quantize the feedback information to approach the performance of soft-decision based sensing. It has been shown that the hard decision fusion rules such as AND-rule, OR-rule and counting-rule can be applied to reduce the overhead of feedback information. Threshold based sensing approach which can further reduce the communication overhead by efficiently combining the feedback information. It was observed that information provided by some cooperative sensors may not always be accurate. Even it is accurate; it may not always provide enough contribution to the performance of CR networks compared to the adverse networks caused by the extra communication overhead. For this reason, choosing the proper cooperative sensors [3] is an important issue. Most existing works do not take into consideration of the location and distribution of the CR transmitters, receivers and cooperative sensors. In addition to the information about the existence of primary transmitters, we are interested in the geographical region in which CR transmitters can be successful. Geographical distribution is crucial for spatial spectrum reuse and determining the topology of CR networks. In this paper, we are interested in the feasible region allowing transmission between secondary users. These geographical information can also help build up a spectrum map or opportunistic routing protocol in CR networks in reference [5].

In this work, we explore the necessary condition to use cooperative sensors from the perspective of heterogeneous spectrum availability at secondary transmitters and receivers. The diverse distribution of secondary communication links was discussed from the information theoretic point of view. It is shown that even though cooperative sensing can help transmitters recover the transmission link, it does not guarantee that receivers can also utilize this link. That is, we cannot assume bidirectional and symmetric property of a communication link. Different from previous work that assumes only one primary transmitter in the network, we apply Poisson point process to model the spatial distribution of multiple primary and secondary users [2]. Finding the globally optimal solution for large multi-user networks cannot always be possible especially when the central controller is not available. In this paper, distributed optimization for the worst-case performance of the secondary users is investigated using tools from the game theory [2]. We try to understand secondary users best transmission performance under the guaranteed performance of primary users [4].
<table>
<thead>
<tr>
<th>Notation</th>
<th>Description</th>
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<tbody>
<tr>
<td>$S_c$</td>
<td>Cooperative sensors</td>
</tr>
<tr>
<td>$S_t$</td>
<td>Secondary transmitter</td>
</tr>
<tr>
<td>$S_r$</td>
<td>Secondary receiver</td>
</tr>
<tr>
<td>$\text{Alpha}(\alpha)$</td>
<td>Probability of existence of opportunistic link</td>
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<td>$\text{Beta}(\beta)$</td>
<td>Probability of existence of opportunistic link if $S_c$ feedbacks “existence”</td>
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<td>Probability of existence of opportunistic link if $S_c$ feedbacks “non-existence”</td>
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<tr>
<td>$r_d$</td>
<td>Detection radius of secondary transmitters</td>
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<td>$r_p$</td>
<td>Transmission radius of primary transmitters</td>
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<tr>
<td>$r_s$</td>
<td>Transmission radius of secondary transmitters</td>
</tr>
</tbody>
</table>

[2] EXISTING SYSTEM

Cognitive radio (CR) allows each transmitter to first sense the availability of the spectrum and then intelligently decides its transmission actions based on the sensing results. It attracts significant interest due to its potential to improve the utilization of the spectrum. One solution to improve the accuracy of the sensing is to allow each CR transmitter to be helped by its nearby sensors, commonly refers to as the cooperative sensors. CR transmitters and cooperative sensors also introduce communication overhead and increase power consumption. To reduce the overhead of feedback information, the authors quantize the feedback information to approach the performance of soft-decision based sensing. It has been shown that the hard decision fusion rules such as AND-rule, OR-rule and counting-rule can be applied to reduce the overhead of feedback information. Threshold based sensing approach which can further reduce the communication overhead by efficiently combining the feedback information [2]. It was observed that information provided by some cooperative sensors may not always be accurate. Even it is accurate; it may not always provide enough contribution to the performance of CR networks compared to the adverse networks caused by the extra communication overhead.

![Fig2: Illustration of interference model](image)

[3] PROPOSED SYSTEM

We explore the necessary condition to use cooperative sensors from the perspective of heterogeneous
spectrum availability at secondary transmitters and receivers. The diverse distribution of secondary communication links was discussed from the information theoretic point of view. It is shown that even though cooperative sensing can help transmitters recover the transmission link, it does not guarantee that receivers can also utilize this link. That Is, we cannot assume bidirectional and symmetric property of a communication link [2] [6]. Different from previous work that assumes only one primary transmitter in the network, we apply Poisson point process to model the spatial distribution of multiple primary and secondary users [2]. Finding the globally optimal solution [4] for large multi-user networks cannot always be possible especially when the central controller is not available. In this paper, distributed optimizations for the worst-case performance of the secondary users are investigated using tools from the game theory [2]. We try to understand secondary users best transmission performance under the guaranteed performance of primary users [12].

**COGNITIVE RADIOS (CR):**

Cognitive radios having capable of sensing spectrum availability, is considered as a promising technique to alleviate spectrum scarcity due to current static spectrum allotment policy [2] [3]. Traditional CR link availability is solely determined by the spectrum sensing conducted at the transmitter (i.e. CR-Tx). If the CR-Tx with packets to relay senses the selected channel to be available, it precedes this opportunistic transmission. To facilitate the spectrum sensing, at time instant tn, we usually use a hypothesis testing as follows:

\[ H_1: Y = I + N \]
\[ H_0: Y = S + I + N \] (1)

Where

- \( Y \) means the observation at CR-Tx;
- \( S \) represents signal from primary system (PS);
- \( I \) is the interference from co-existing multi-radio wireless networks;
- \( N \) is additive white Gaussian noise (AWGN).

They are all random variables at time \( t_n \). We can conduct this hypothesis testing in several ways based on different criterions and different assumptions.

**Modules:**

The major motivation of our project is to utilize the radio more efficiently, and to be able to maintain the most efficient form of communication without interference and mobility model.

To make our project work as efficient we divided our project work into small modules, such as given as bellow.

- Application selection
- Customizing parameters
- Network selection

**Application Selection:**

We focus on a cellular cognitive radio network as our framework. In addition, we consider a new admission control as a way to improve the performance of our algorithm [2] [3][6]. We investigate the effect of letting users switch over base stations and show the resulting power saving efficiency [7] [8] [9]. Also, we demonstrate how a simple admission control algorithm can improve system performance in terms of power consumption, SIR levels, and network capacity [10].
Customizing Parameters:

Fully converged services:

[7], [8], [9], [10] Personal communications, information systems, broadcast and entertainment will have merged into a seamless pool of content available according to the user’s requirement. The user will have access to a wider range of services and applications, available conveniently, securely and in a manner reflecting the user’s personal preferences [4].

Network Selection:

In the current cellular systems, which are based on a star-topology[1], if the base stations are also considered to be mobile nodes in which a base station acts as a gateway providing a bridge between two remote ad hoc networks or as a gateway to the fixed network. This architecture of hybrid star and ad hoc networks has many benefits; for example it allows self-reconfiguration and adaptability to highly variable mobile characteristics (e.g. channel conditions, traffic distribution variations, and load-balancing) and it helps to minimize inaccuracies in estimating the location of mobiles.

Algorithm:

1: For each possible \( S_c \) of \( S_t \) do
2: \( S_t \) Access the channel and estimates \( \alpha \)
3: \( S_c \) feedbacks information \( I(S_c, r_d) \) to \( S_t \)
4: \( S_t \) eliminates \( \beta \) and \( \gamma \)
5: end for
6: if \( S_t \) in the homogeneous environment then
7: \( S_t \) determines \( S_c \) useful or not and access probability
8: end if
9: if \( S_t \) in the homogeneous environment then
10: \( S_t \) determines \( S_c \) useful or not and access probability
11: end if

\[ \alpha = P(1(S_t, r_p) = 1|1(S_t, r_d) = 1) \]
\[ \beta = P(1(S_c, r_d) = 1|1(S_t, r_d) = 1, 1(S_t, r_p) = 1) \]
\[ \gamma = P(1(S_c, r_d) = 0|1(S_t, r_d) = 1, 1(S_t, r_p) = 0) \]

[4] RESULT

The output attained is compared with the enhanced and existing systems so that we may perhaps plot the comparative graphs. In the below output graphs, Proposed system output is shown in green color and existing system is shown in red color.
Fig 3: Packet overhead Vs time graph

In these graphs we compare the performance of secondary transmitters and receivers both in proposed and existing systems. Fig3 depicts the difference between the proposed and existing system in terms of packet overhead and time. The packet overhead is comparatively reduced in the proposed system.

Fig 4: Packet size Vs time graph

Fig4 depicts the difference between the proposed and existing system in terms of packet size and time. Packet size is comparatively increased in the proposed system.

Fig 5: Packet dropping Vs time graph
Fig 5 depicts the difference between the proposed and existing system in terms of packet dropping and time. The packet drop is nullified within the range as per spatial distribution phenomenon.

[5] CONCLUSION

To achieve the success of large mobile networks, CR network is important to increase the utilization efficiency of the spectrum. In this work, we study the condition for which cooperative sensor is useful for the secondary users to make the accurate transmission decision from the view-point of transmission allowable region. We apply the game theoretic model to study the competition among secondary users; we analyze the NE of secondary users. As shown in our analysis and simulation results, we find that the transmission allowable region or connection topology of secondary users can be determined by the activities of primary transmitters. On the other hand, the goal of cooperative sensor brings additional information about spectrum about spectrum resource for transmitter side. However, it can only provide limited benefit to transmitter if transmitter already has enough information to make correct decision.

[6] REFERENCE


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