Combined Dominance and Average Algorithms for Spectrum Sharing in Cognitive Radio Networks

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Abstract: Cognitive radio networks (CRNs) are networks of nodes equipped with cognitive radios that can optimize performance automatically by changing its behavior to adapt to the environment. The Cognitive radio is a kind of two-way radio that automatically changes its transmission or reception parameter this alteration of parameters is based on the active monitoring of several factors in the external and internal radio environment, such as radio frequency spectrum, user behavior and network state the optimizes that use of available radio-frequency (RF) spectrum while minimizing interference to other users. This paper presents a major functionality in cognitive radio network (spectrum sensing and sharing) the idea of spectrum sharing for the participation of more than one operator uses one channel at the same time will be explained, taking in consideration the different types of sharing techniques using (distributed sharing), finally we modeling our work using game theory based on reduction through dominance and average algorithm through using graphic user interface in Matlab program. Simulations are used to study the performance of our proposed algorithm and demonstrate its effectiveness in terms of improving the overall network throughput, reducing the average transmission power and provide efficient bandwidth sharing. In this research represent the game theory and provides comprehensive treatment for it, with cognitive radio networks applications, which helps in design and efficient in the future of network by self-enforcing and distributed spectrum sharing schemes.

Keywords: cognitive radio network, game theory, spectrum sharing, QoS

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1. Introduction

The idea of Cognitive Radios as an aggressive solution to increase spectrum utilization was promoted in the Spectrum Policy Task force report of the FCC in, There is not an obvious definition of what is real cognitive radio consist of, but we can give a convincing and relative definition by define the cognitive radio as network of radios that co- exists with higher preference primary user, by sensing their presence and modifying, It is own transmission characteristics in such a way that they do not yield any felled confusion[1][2].

While the relatively simplistic strategy of abandoning the impacted 802.11 a frequency channels is far from optimal in terms exploitation of the spectrum, it does indicate that the regulators are willing to accept that spectrum can be shared through sensing and avoidance [3].

In cognitive radio networks (CRNs), nodes are equipped with cognitive radios (CRs) that can sense, learn, and react to changes in network condition. It can learn from the adaptation and make future decisions, all while taking into account end-to-end goals[3]. A Gognitive radio is a type of directionradio that alteration its reception or transmission parameters -dual outomatically, anode communicates efficiently where entire wirless licensed. The parameters communication network, while obviate modification is stand on the effective monitoring of many operations in the internal and external radio environment like radio frequency spectrum the set of parameters taken into account in deciding on transmission and reception changes, and for historical reasons, we can distinguish certain types of cognitive radio[4].

This paper proposes a new method in spectrum sharing or the participation of more than one operator uses one channel at the same time based on game theory. In this paper, it will be concentrated on the problem of designing efficient distributed sharing algorithms to meet the requirements of networked applications. The proposed algorithm has the following properties that make it the best to apply in computer network: It must be able to maximize the overall performance of the network depend on the principle in game theory (reduction through dooming and average).

2. Related Works

There have been many works done in the area of spectrum sharing in cognitive radio network by using different methods.

R. Etkin, A. Parekh, and D. Tse [5] show the concept of the limited available spectrum and the inefficiency in the spectrum usage necessitate a new communication paradigm to exploit the existing wireless spectrum opportunistically this new networking paradigm is referred to as Cognitive Radio(CR) networks. In CR networks, one of the main challenges in open spectrum usage is the spectrum sharing.

Xinbing Wang and Zheng Li, Pengchao Xu[6]present a dynamic updating algorithm in which each secondary user achieves Nash equilibrium in a distributed manner. The stability condition of the dynamic behavior for this spectrum sharing scheme is studied. The discussion is generalized to the case in which there are multiple primary users in the network, where the properties of Nash equilibrium are shown under appropriate conditions.

S. Haykin [7] shows the concept of A major shift in radio design is now just beginning which attempts to share spectrum in a fundamentally new way, these radios are addressing the fact that spectrum is actually poorly utilized in many bands, in spite of the increasing demand for wireless connectivity.

Amir Ghasemi[8] show the concept of opportunistic unlicensed access to the (temporarily) unused frequency bands across the licensed radio spectrum is currently being investigated as a means to increase the efficiency of spectrum usage.

Rui Zhang, Ying-Chang Liang[9] exploits multi-antennas for the minor sender to operative equation between overlap avoidance in the major recipient and spatial multiplexing for the minor sending. Convex to forming algorithm used cove optimization manner for the optimal send spatial spectrum that reach strength of the major sending. Suboptimal resolve for ease performance and even offered and their accomplishments are compare with the optimal resolve. Moreover, algorithm evolved for the single-channel sending are even elongated to the case of multi-channel sending during the the minor user is able to reach profiteering spectrum sharing by send adaptation not just in vacuity distance even in time and frequency domains as well[10] .

3. Cognitive Radio Network

Radio that able to alteration its sender parameters stand on interact with its environment its known as Cognitive Radio (CR) Through above definition the cognitive radio can be realize by two basic feats [11] capacity during real-time interact with the environment of radio. The part of spectrum that are unutilized at a particular period or site can be identified. As clear in in figure in white space or spectrum hole it, know it when CR enable the usage of unutilized spectrum temporally. For thus, the best spectrum can be chosen, advantage with-out confusion with the licensed servant and shared with other servant [12].

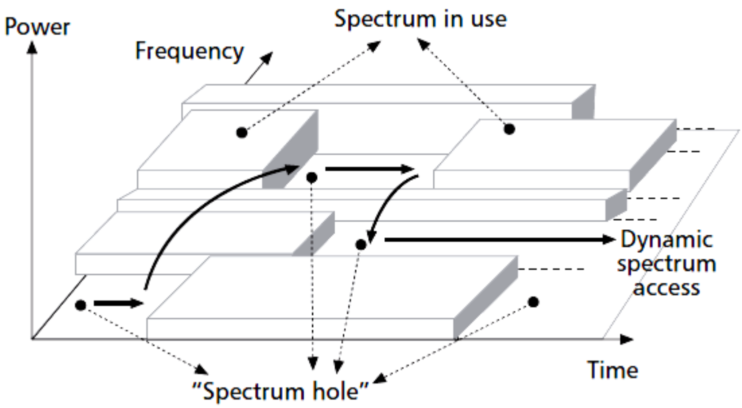
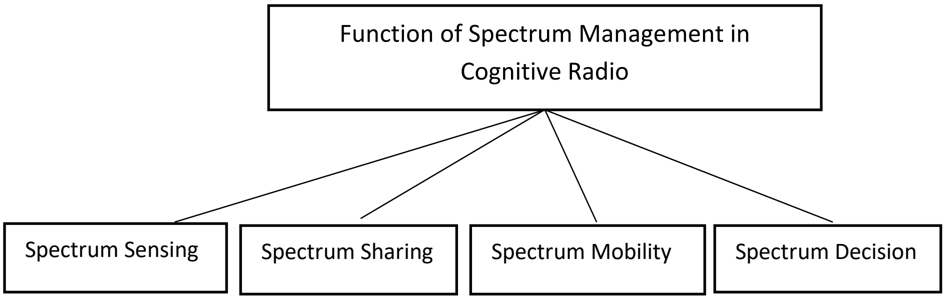


Figure 1. Spectrum-hole concept.

4. Cognitive Radio Network Techniques

Cognitive radio techniques are classified into spectrum management that holding perfect obtainable spectrum to meet servant communication request while not forming undue interference to else (minor) servant. To gathering the (QOS) requests aggregate obtainable spectrum constraints, the Cognitive radio should determine on the better spectrum constraint for thus, in the Cognitive Radio the function of spectrum management are desired and it can be categorized as spectrum sensing, spectrum sharing, spectrum decision and spectrum mobility as shown in figure2 [13][14].



5. Spectrum Sensing

Is considered one of the techniques of the CR which feels packages unused and is trying to use an opportunistic manner to be to prevent interference with the primary user (PU) from the requirements of improved users' presidents (PU) and the discovery of empty space has a special type called control sensing) can the secondary (SU) to find a group spectra are available and how the user feels s spectrum frequently that have more techniques [15].

Generally, spectrum sensing techniques can be classified into match filter detection, energy detection, feature detection and wavelet detection. In addition, the cooperative and non-cooperative fashion can be servant by sensing techniques. After sampling and reliable receiver of a larger domain signal, the techniques of the digital signal processing are used to supplemental raise the sensitivity of radio. Most of the newest spectrum sensing works stand on local minor users monitoring and centered on primary sender detection [15].

6. Spectrum Sharing

The capability to maintain the Quality of Service (QoS) of Cognitive Radio users without causing interference to the PU by coordinating the multiple access of users as well as allocating communication resources adaptively to the hangs of radio environment performed in the middle of transmission session and within the spectrum band.

Spectrum access since there may be multiple CR users trying to access the spectrum; this access should also be coordinated in order to prevent multiple users colliding in overlapping portions of the spectrum [16].

6.1 Spectrum Sharing Techniques

We can classify the Spectrum techniques into for step design/Decision, centralized control and distributed control we view each of them as follow:

•Design/Decision Processes

A big number of possible design and decision processer analysis in the coming sub-divided into classifications of manageable set techniques which previously suggest to decide/design Cognitive radio operational parameters to ease coexistence with other servant.

•Centralized Control

In these resolves, the access procedures and spectrum allocation control by centralized entity with assist of these procedures. In general, the assumption of distributed sensing procedure include that every entity in the CR network forwards their value about the spectrum distribution to the central entity and its create a spectrum distribution map[17].

•Distributed Control

The coexistence is treat by multiple entities in a distributed. Who in general (although not always) activate with various information sets and have conflicting priorities. For examples of coexistence distributed control. Embodiment the inter-cell power control effects (e.g., cell breathing), algorithms rooted in game theory, CSMA/CA algorithm, graph-coloring algorithms[18].

6.2 Features of Spectrum-Sharing

Sharing arrangement can be characterized and classified via two features and we can realize and define it as follows: first in case or if sharing depended on existence or cooperation the deference based on cooperation that is profound implication in both policy and technology in model. The device must cooperation and communicate with each other to avoidance alternative inference even if it under various administrative control. Commonly it is means through other things[18]. The protocol is must be support and realize by all systems in the band. This is also a problem when attempting to share spectrum with legacy equipment, which was not designed or deployed with new sharing arrangements in mind. Forcing systems with no trust relationship to cooperate also poses complex security challenges. The second feature in the taxonomy proposed of a spectrum-sharing arrangement define, whether the sharing arrangement comprises among equals or primary secondary sharing. We can summarize the spectrum sharing as we show in figure3[19].

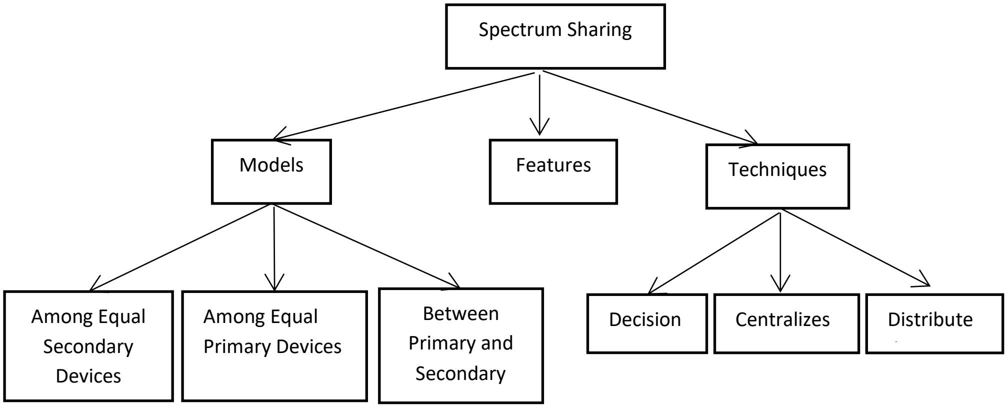


Figure 3. Summarize Spectrum Sharing

7. Game Theory Concept

Game theory is using and applying commonly in the telecommunication -system, biology, psychology and economic political science, which is supplies analytical appliances to suppose the result of complex interactions through all intellectual entities.

There are three basic ingredients in the game, a collection of possible acts, a collection of utility functions and players, which they are supposed to be rational fully and choose their acts in a deterministic manner, each player can try to guess the movements of the else players and choose the most fitness strategy to the problem and for, thus, it is based on the past actions[20].

We concentrate on the cooperative spectrum sharing game through multiple cognitive radios. Various path has been served for the spectrum sharing game. The author example of the problem is the spectrum sharing between multiple cognitive radio transceiver pairs as an exact potential game. And the transmission of channels and power levels to be classified for the cognitive radios comes as definition for the strategies. In such former work, the game achieves Nash Equilibrium in case of the players' number fixed and the players react with each other. For other explain we can say the loading of communication is fixed. In this paper simulate the number of user's is raise with time in the system condition. And study the effectiveness of the network performance when the new user combines the network. This paper gives better network performance through channel access methods proposition when such condition happens. We call approach with varying number of players spectrum sharing game[16].

7.1 Type of Game Theory

We can classify the type of game theory One-person, Two person and Two Person Zero Sum Game we view each of them as follow type of game theory are classified into:

•One-Person

A single-person game, the player just attention to teaching a specific state in the game exists, so there is no real tussle of interest in the game. For the game-theory respective the game of one-person are not attracting because there is not antagonist taking conscious select that the player must accord with anyway, in case of internal tangle they can be interesting from a probabilistic goal [21][22].

•Two-Person

Two-person games are the biggest grade of similar games. The game coming from 2-person games is the n-person game it is more tangled. These games on wide range analyzed via game theorists. Anyway, the hardness emerging foretelling interaction potential between players when these theories are extending since opportunities emerge for collusion and cooperation [22].

•Two Person Zero Sum Game

Is a game with two players, refers to them player A and player B. The winner equals the loser incurred player. For example, chess game with two players deal that the loser would pay Rs 50 to the winner at the end of the game, so that is mean the total of the losses and win equal zero. As well it is two person - zero sum game. And all that let you need to realize about the game of payoff matrix. The payoffs (when the players achieve contentment at the end of the game as a quantitative value) in case of losses or win, and the payoff matrix when the player choose their specific strategies and it can perform in the matrix form. The gain of one player is same amount to the loss of the other and vice - versa, when the sum is zero in the game. This clarify, the payoff table of single player and the payoff table of the other players would have the same amounts. So, it is enough to from payoff table to any one of the players [21][22].

8. Proposed Algorithm

In a cognitive radio network, multiple secondary users sense the spatial channels and share the spectrum use with incumbent primary users. Each secondary transmitter competes with others to increase its own information rate while generating limited total interference to the primary receivers.

The major thought of mechanism is that to have ability to fair and active sharing of spectral resources through SUs. In this paper the spectrum ability in cognitive radio network will be modeled such a frequent cooperative game. And the detail of the theory and attainment of cooperative spectrum sharing is offered clearly. While we supposed there are several SUs and one PU to make a decision or choose a best band from several possible choices. This work also considers the situation of dynamic games, where the number of SUs changes. The advantages of cooperative sharing are proved by simulation. In the end we presented game-based mechanism and competitive action to evolve the effectiveness of the all system accessing the spectrum.

This paper represents the various options and payoffs in a matrix and can then calculate the best single band or combination of bands using matrix algebra and techniques from linear programming. Game theory is yet another illustration of the power of matrix algebra and linear programming.

To increasing the sum value of the cognitive radio network. The transportation of problem in the minor user offer as a cooperative game. Transport covariance matrix is the strategy of any major user. While the utility is an approximation for the rate of the information. The major users' negotiation over the distribution if the final balance utility through achieve bargaining solution. Through network utility functions and well -designed singular, the bargaining solution is paring to optional and unique. The converges evolved to the optimal solution equal signaling through network in an efficient distribution algorithm. The result of Numerical clarify the representation progress in sum -rate in the cognitive radio network through the solution in the game of cooperative bargaining which compared with the Nash-equilibrium solution if the non-cooperative game. The real licensed spectrum stays untaken for a long while of the time. For that the cognitive radio systems have been assumed in account to effectively to use these spectral holes.

A unoccupied for long periods of time. Thus, cognitive radio systems have been proposed in order to efficiently exploit these spectral holes.

The numerical result clarify that the assumed mechanism can achieve the maximum total gain os SUs with best objectivity. Also in this page else solutions showed, that is happened by uniform a reputation -based game midst SUs. The goal of the game is to choose one of the SUs to be major - PU and sequence the access to else SUs. The numerical results clarify that the assumed game able to introduce best opportunity to SUs to use spectrum more effectively and improve the PU proceeds.

8.1 Assumptions and system model: PU's and SU's and allocation function

In the next part. We are considering spectrum overlay-vased cognitive radio wireless system with single PU and N SUs. The PU is interesting to participate. Some parts (bi) of the three spectrum (f) with SU i. The PU requests every SU an installment of c per unit bandwidth for the spectrum share, and the c is the functionalism affordable for sharing via the SUs the yield of SU i is indicate by ri per unite of reachable transmission value. Figure 4 shows a simple example.

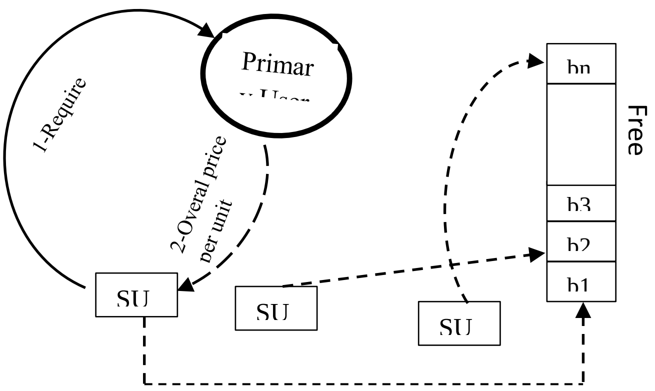


Figure 4. System model for spectrum sharing.

Centralize focalized making the scenarios that considering in this work by both resolve distributed and focalized. For the previous condition. Every SU supposed it is able to monitor the strategies adopted via else user. (i.e. either users able to argue their shares among them, or transmit update of every SU share by the PU. In last condition the spectrum sharing adaption based on communication in each the PU and SUs only that is performed by distribution (ie, the major user do not have the ability to monitor the payoffs and the strategies of the each other). The least value of time will be deleted based either the min/max algorithm or the average algorithm.

In this section includes the steps of how the proposed algorithm, also show the demonstrable example, that work in our program and the method of data entry and represent the functions of each interface and view the result.

Table 1: Components of spectrum sharing games in cognitive radio networks

	Open spectrum sharing	**Licensed spectrum sharing (auction)**
Players	Minor servants that compete for an unlicensed spectrum band.	Both major and minor servants
Actions	Transmission parameters, such as transmission energy level, access valus, waveform, etc.	Minor servants: which licensed bands they require to wage and how much they would pay for leasing the licensed bands; major servants: which minor servants they will lease each unused band to and the charge.
Payoff	Non-decreasing function of the quality of service (QoS) by utilizing the spectrum.	Monetary gains, e.g., revenue minus cost, by leasing the licensed spectrum.

The strategy of this work is moving to control. Whether whole it is payoffs are beneficial to the player at test. Like the matching ones in the other move. In the payoff matrix expression, we can explain it in the following way:

A. In the payoff matrix the line r control lines, whether each payoff in line r is > the matching payoff in lines.

B. In the payoff matrix the column r control column s, whether each payoff in line r is ≤ the matching payoff in column s

Notice that, each column or line control the other when the two column or lines are equal. A line or a column control another accurately whether one control the other and both not equal.

Game theory rules in the following. And it is never played when move matching to accurately control or column. With the second rule line of each player are knowing of this. The game theory abstracts dominated line and column repeatedly as the condition may be. (there is no cause to select one on the other whether two line or column are equal. It is either may be abstracted. This operation is known as reduction via dominance.

The intent point is a payoff that in the same time a line least and column highest. To specify the intent points, circle the line the least and box the column the highest. To specify points are these inputs that are together boxed and circled.

Where the game has at least one specify point then the game is specified accurately. Which it in the following terms

A. Payoff amount is same in every intent points of the game.
B. selecting the column and line through any intent points awards mini-max strategies for each one of the players. In other meaning by using of these strategies (pure) the game is solved.

The amount of accurately specify game is the amount of the intent point entry a fair game has zero amount, additionally it is inequitable or based.

8.2 Reduction by Dominance and Average Algorithms

Many steps can be explained from this algorithm listed as follows:

Step 1: Composition of two-dimension matrix and given the initial value of matrix (G) which represents the initial value of spectrums (spectrum holes that discovering in spectrum sensing step).

Step 2: Computing the minimum value of each row and maximum value of each column through make the relation between values of same row and same column, and then we get minimum value from row and maximum values from column which represents the spectrum hole.

Step 3: Apply the maxim method in the results of step 2, for each value (minimum and maximum values spectrum holes which obtained from row and column of G matrix.

Step 4: Computing the saddle point (S.P.) if the max-min value equal min-max value, otherwise compare between all rows to get the row which has a less weight among them and then deleting it form the computing process.

Step 5: Searching the second dominance for the largest column after compare it with other columns and then deleting it, after that go to step2 for process of preprocessing of saddle point.

Step 6: Applying the algebraically method for each player in the game (two players which are obtained from above steps), then determining the values of each players through using one equation for each player to discover the stability point to the both of them, otherwise applying the average method.

Step 7: Using the same matrix in step one if contain the approximated value in each rows and column, then make cooperative process between two rows and two columns through addition these values.

Step 8: Repeat steps (3, 4 and 5) to find the saddle point (S.P) by way of equation and algebraically methods to develop the stability point.

Step 9: Termination steps.

8.3 Demonstrable Cases:

In this section we will demonstrate two cases that express the behavior of our model

Case 1: The first example we show, how we can obtain the:

$$G = \begin{bmatrix} 7 & 8 & 4 & 2 \\ 9 & 0 & 7 & 4 \\ 5 & 1 & 5 & 3 \\ 6 & 7 & 9 & 1 \end{bmatrix}$$

We obtain the minimum element in each row, and the maximum element in each column

Min-row

$$G = \begin{bmatrix} 7 & 8 & 4 & 2 \\ 9 & 0 & 7 & 4 \\ 5 & 1 & 5 & 3 \\ 6 & 7 & 9 & 1 \end{bmatrix} \quad \begin{matrix} 2 \\ 0 \\ 1 \\ 1 \end{matrix}$$

maxmin
2

Max-column

9 8 7 4

minimax
4

2≠4

So that 2< v < 6

Not Saddle point

Since 2 not equal 4, then it's not a saddle point. Sum of rows and sum of columns must be found to detect and delete the lower row and the highest column.

Sum-row

$$G = \begin{bmatrix} 7 & 8 & 4 & 2 \\ 9 & 0 & 7 & 4 \\ 5 & 1 & 5 & 3 \\ 6 & 7 & 9 & 1 \end{bmatrix} \quad \begin{matrix} 21 \\ 20 \\ 14 \\ 23 \end{matrix}$$

14 → Delete lower row

$$G = \begin{bmatrix} 7 & 8 & 4 & 2 \\ 9 & 0 & 7 & 4 \\ 6 & 7 & 9 & 1 \end{bmatrix}$$

Sum-column

22 15 20 7

22 ↓

Delete highest column

For the resulted 3×3 matrix we will have the minimum element in each row and the maximum element in each column.

Min-row

$$G = \begin{bmatrix} 8 & 4 & 2 \\ 0 & 7 & 4 \\ 7 & 9 & 1 \end{bmatrix} \quad \begin{matrix} 2 \\ 0 \\ 1 \end{matrix}$$

maxmin
2

Max-column

8 9 4

minmax
4

Sum-row

$$G = \begin{bmatrix} 8 & 4 & 2 \\ 0 & 7 & 4 \\ 7 & 9 & 1 \end{bmatrix} \quad \begin{matrix} 14 \\ 11 \\ 17 \end{matrix} \longrightarrow$$ Delete lower row

$$G = \begin{bmatrix} 8 & 4 & 2 \\ 7 & 9 & 1 \end{bmatrix}$$

Sum-column

15 13 3

↓

Delete highest column

Min-row

$$G = \begin{bmatrix} 4 & 2 \\ 9 & 1 \end{bmatrix} \quad \begin{matrix} 2 \\ 1 \end{matrix}$$

max-min
2

Max-column

9 2

min-max
2

The saddle point is 2

Case 2: The second example shows another example by giving the matrix:

Cooperative two rows

$$G = \begin{bmatrix} 4 & 6 & 3 & 7 \\ 3 & 5 & 2 & 5 \\ 1 & 2 & 7 & 3 \\ 6 & 4 & 2 & 7 \end{bmatrix} \quad \begin{matrix} 20 \\ 15 \\ 13 \\ 19 \end{matrix}$$

By summation the first row with second row that we have (3×4) matrix:

$$G = \begin{bmatrix} 7/2 & 11/2 & 5/2 & 12/2 \\ 1 & 2 & 7 & 3 \\ 6 & 4 & 2 & 7 \end{bmatrix}$$

$$G = \begin{bmatrix} 3.5 & 5.5 & 2.5 & 6 \\ 1 & 2 & 7 & 3 \\ 6 & 4 & 2 & 7 \end{bmatrix}$$

Sum-column

$$10.5 \quad 11.5 \quad 11.5 \quad 16$$

Cooperative two

By summation the first column with second column that we have (3x3) matrix:

$$G = \begin{bmatrix} 9 & 2.5 & 6 \\ 3 & 7 & 3 \\ 10 & 2 & 7 \end{bmatrix}$$

Min-row

$$G = \begin{bmatrix} 9 & 2.5 & 6 \\ 3 & 7 & 3 \\ 10 & 2 & 7 \end{bmatrix} \begin{matrix} 2 \\ 3 \\ 2 \end{matrix}$$

maxmin
3

max-column

$$10 \quad 7 \quad 7$$

minmax
7

7≠3…()

3<v<7 Not saddle point

sum-row

$$G = \begin{bmatrix} 9 & 2.5 & 6 \\ 3 & 7 & 3 \\ 10 & 2 & 7 \end{bmatrix} \quad \begin{matrix} 17 \\ 13 \\ 19 \end{matrix}$$

→ Delete lower row

$$G = \begin{bmatrix} 9 & 2.5 & 6 \\ 10 & 2 & 7 \end{bmatrix}$$

Sum-column

19 4 13

↓

Delete the highest column

Min-row

$$G = \begin{bmatrix} 2.5 & 6 \\ 2 & 7 \end{bmatrix} \quad \begin{matrix} 2 \\ 2 \end{matrix}$$

maxmin
2

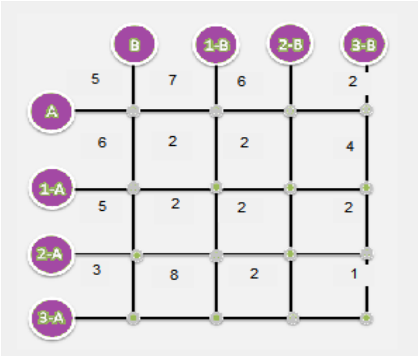
Max-column

2 7

minmax
2

The saddle point is 2

Figure2 shows the simulation of case1 and case 2.



a

State

	B	1-B	2-B	3-B
A	5	7	6	2
1-A	6	2	2	4
2-A	5	2	2	2
3-A	3	8	2	1

b

Reduction of Dominos

	B	B-1	2-B	3-B
A	6	2		
1-A	2	4		
2-A				
3-A				

c

Stability Point

	B	1-B	2-B	3-B
A	5.5000	4.5000	4	3
1-A	5	2	2	2
2-A	3	8	2	1
3-A				

d

Figure (2): a, b, c, and d simulation result for case1 and case2

9. Conclusion

The aim of the cognitive radio operation is to find the spectrum holes with less time and less cost, the first step of this operation is Spectrum sensing which finds the holes in the primary user transmission in terms of interference that be used by the secondary user. The following step is Spectrum sharing which allows more than one secondary user using one spectrum in different times. In this paper game theory was be used to provide the best time to use the spectrum through the spectrum holes, therefore the algorithm of domination and average was being used to show the possibility to delete some unstable spectrum, which has little time to get the maximum use of time and shared between users.

Experimental results demonstrate the high performance of the proposed method in terms of computational complexity, sharing the global best solution, faster convergence and estimation accuracy. We find that this approach results in competitive performance compared to the theoretically sharing solution.

This work can be further extended by studying the (centralized entity), that controls the spectrum allocation and access procedures, and camper the result with our proposed method (distributed) sharing. Another idea is to use another types of strategy in game theory such as mixed strategy to share more than one user to using spectrum at the same time. In addition to use another models of spectrum sharing such as sharing between two secondary by use coexistence method.

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دمج خوارزميه الهيمنة وخوارزميه المعدل لمشاركه الطيف في شبكه الادراك الحسي الراديوية

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المستخلص: ان شبكه الادراك الحسي الراديوية تتكون من عدد من العقد مجهزة بمدركات راديوية التي من الممكن استخدامها للحصول على الاداء الامثل من خلال تغيير سلوكها بما يتوافق مع البيئة المحيطة. ان الشبكة الادراك الراديوية هي شبكات راديوية باتجاهين التي من الممكن ان تغير معاملات الرسال والاستلام. ان هذا التغيير في معاملات الرسال والاستلام يعتمد على المراقبة الشديدة للعوامل للبيئة الراديوية الداخلية والخارجية مثل طيف التردد الراديوي، ان سلوك المستفيد والشبكة توضح المثلية التي تمكن من استحدام ترددات الراديوية المتوفرة مع تقليل التداخل مع المستخدمين الاخرين. في هذا البحث الوظيفة الأساسية في شبكات تاتدراك الطيفي الراديوية في تحسس الطيف ومشاركته. سوف يتم التوسع في فكرة استخدام قناه واحدة ومشاركه الطيف بين اكثر من مستخدم في نفس الوقت اخذين بنظر الاعتبار الانواع المختلفة لطرق المشاركة باستخدام توزيع المشاركة. اخيرا نحن نمذجنا عملنا باستخدام نظريه الالعاب باعتماد على اسلوب التخفيض من خلال خوارزميات الهيمنه والمعدل باستخدام الواجهات الرسمية لبرنامج Matlab. تم استخدام المحاكاة لدراسة اداء الخوارزمه المقترحة وبيان كفاءتها من خلال تحسين معايير الإنتاجية للشبكة، تقليل معدل الطاقة المستهلكة في الارسال ويعطي كفاءه في المشاكه في عرض الموجه. هذا البحث يعطي معامله شامله لنظريه الالعاب مع تطبيقات مهمه في شبكات الطيف الراديوية وتساعد في تصميم ووضع خطه مشاركه طيف ادراك كفوءة، ذاتيه الفرض، وموزعه والتي سوف تؤثر على مستقبل الشبكات اللاسلكية.

الكلمات المفتاحية: شبكة الراديو المعرفية ، نظرية اللعبة ، تقاسم الطيف ، جودة الخدمة

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