WIDEBAND SPECTRUM ANALYSIS OF GSM BAND USING NI-USRP 2920

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Abstract
Cognitive radio can help to determine the scarcity of radio resources by presenting dynamic spectrum allocation contrary to traditional static spectrum allocation. Among the steps of enabling dynamic spectrum allocation for cognitive radios is spectrum sensing. The spectrum sensing is the most considerable capability of CRs to truthfully detect the presence or absence of PUs in the band. Two major problems in sensing a wide bandwidth are fluctuations in noise power level and corrupted performance at low SNR. A energy detection method of spectrum sensing calculates the energy of the received signal and compared it with a decision threshold. Wideband spectrum sensing (WSS) would enhance future CR throughput and reduce the sensing delay by accessing multiple bands.

Index Terms- Cognitive Radio, energy detection, low SNR, NI-USRP, Wideband sensing.

I. INTRODUCTION

Cognitive Radio (CR) can help to decide the insufficiency of radio resources by presenting dynamic spectrum allocation rather than the traditional static spectrum allocation policy. Among the main components of the cognitive radio concept is to be able to measure, sense, learn, and be aware of the parameters related to the radio channel characteristics, accessibility of spectrum and power, radio's operating environment, user requirements and applications. In cognitive radio terminology, Primary users can be identified as the users that have higher priority to usage of a specific part spectrum. Alternatively secondary users, which have lower priority, to use that spectrum in such a way that they do not cause harmful interference to primary users. As a result secondary users need to have intelligent radio features, such as sensing the spectrum correctly to check whether it is being used by a primary user or not.

A main undertaking in cognitive radio is that the secondary users ought to observe the presence of primary users in an authorized spectrum and give up the frequency band as rapidly as feasible. Effective spectrum sensing is likely one of the preliminary challenge to access licensed band without causing damaging interference to primary users. Spectrum Sensing algorithms will have to have excessive detection possibility to look after primary users from obstruction and low false alarm likelihood for secondary users to transmit powerfully in vacant bands. The higher the detection probability, the better primary users (PUs) can be protected. The lower the false alarm probability, the more chances a channel can be utilized by secondary users (SUs).

The common strategies of spectrum sensing are matched filter detection, cooperative sensing, feature detection, energy detection, eigen value based sensing, etc. out of this all strategies energy detection is the easiest one. The energy detection method does not require any previous information about a primary user signal and is comparatively simple to implement so that it has been attracting a lot of concentration. A simple energy detection process calculates the energy of the obtained signal and compares it with a decision threshold value. The signal is said to be present at a specified frequency when its energy value exceeds the defined threshold. The efficiency of energy detection method for that reason greatly depends on setting of the detection threshold.

For the development of an effective but simple sensing algorithm using spectral data obtained by way of NI Universal Software Radio peripheral (USRP 2920). In actual-time wideband spectrum sensing, variants within the noise power stages and the SNRs throughout the spectrum may arise.

II. RELATED WORK

Cognitive radio (CR) has been remarkable as a remodeling science which holds the promise of advancing inexperienced communications. By using permitting secondary users (SUs) to make use of vacant spectrum from primary licensed networks, CR introduces an shrewd approach, which can opportunistically select the community and broadcast parameters to support the radio spectrum effectiveness and meet the rigorous necessities in future wireless networks. Spectrum sensing is a distinguished functionality to allow dynamic spectrum access in cognitive radio networks. Tevfik Y¨ucek [2] A survey of spectrum sensing methodologies for cognitive radio is provided. More than a few features of spectrum sensing challenge are studied from a cognitive radio standpoint and multi-dimensional spectrum sensing concept is presented. Nan Wang [5] The performance of spectrum sensing is dependent mostly on the settings of a detection threshold. Most usual spectrum sensing strategies undertake a constant resolution threshold to distinguish PU alerts from the noise. It is complicated to assurance the detection and false alarm probability with the fixed threshold environment system, above all when the noise power fluctuates. In this paper a novel adaptive threshold spectrum sensing algorithm is proposed to acquire an effective trade-off between the detection and false alarm probability. D. Datla, A. Wyglinski [4] presents Sensing threshold is an important parameter in spectrum sensing. When a detector does not properly adjust its threshold, the sensing performance is degraded. Most of the existing techniques used a static threshold. However, the noise is random, and, thus the threshold should be dynamic. In this paper, They suggest an approach with an estimated and dynamic sensing threshold to increase the efficiency of the sensing detection.

III. SPECTRUM SENSING TECHNIQUES

A key challenge in cognitive radio is that the secondary users have to detect the presence of primary users in a authorized spectrum and vacant the frequency band as early as possible so as to obstruct interference to licensed users. Spectrum sensing aims to determine spectrum availability and the presence of the licensed users.

1. Energy Detection:

Energy detection spectrum sensing is widely used in cognitive radios. It is a non coherent detection technique that detects the primary signal based on the sensed energy. Due to its effortlessness and no necessity on a priori information of primary user signal, energy detection (ED) is the most accepted sensing technique in cooperative sensing.

The ED is claimed to be the Blind signal detector on account that it ignores the structure of the signal. It estimates the presence of the signal by way of evaluating energy received with a known threshold derived from the statistics of the noise.

2. Matched Filter:

A matched filter (MF) spectrum sensing is a linear filter designed technique to make best use of the output signal to noise ratio for a given input signal. When secondary user has a priori knowledge of primary user signal, matched filter detection is applied. Matched filter detection is similar to correlation wherein the unknown signal is convolved with the filter whose impulse response is the mirror and time shifted variant of a reference signal. Matched filter detection wants much less detection time given that it requires best O (1/SNR) samples to satisfy a given likelihood of detection constraint. When the information of the predominant user signal is known to the cognitive radio user, matched filter detection is optimal detection in stationary Gaussian noise.

3. Cyclostationary Feature Detection:

A cyclostationary process has arithmetical properties that vary periodically over time to identify the presence or absence of PU. The periodicity is commonly embedded in pulse trains, spreading code sinusoidal carriers, hopping sequences or cyclic prefixes of the primary signals. Due to the periodicity, these cyclostationary signals exhibit the features of periodic information and spectral correlation, which is not found in stationary noise and interference cyclostationary feature detection is tough to noise uncertainties and performs better than energy detection in low SNR regions. Even though it requires a priori capability of the signal behavior, cyclostationary feature detection is equipped of distinguishing the CR transmissions from quite a lot of varieties of PU signals.

4. Wideband Spectrum sensing:

Cognitive Radio (CR) can help to decide the insufficiency of radio resources by presenting dynamic spectrum allocation rather than the traditional static spectrum allocation policy. Effective spectrum sensing is among the beginning challenge to access certified band without inflicting dangerous interference to primary users. Wideband spectrum sensing (WSS) would enhance future CR throughput and shrink the sensing prolong via having access to multiple bands. Wideband spectrum sensing permits an opportunistic utilization of the frequency spectrum.

5. Gradient Based Spectrum sensing:

Effective spectrum sensing is among the beginning challenge to access certified band without inflicting dangerous interference to primary users. Sensing algorithms must have high detection probability to defend most important users from obstruction and low false alarm opportunity for secondary users to transmit effectively in vacant bands. The gradient centered sensing algorithm utilizing spectral data received by means of NI universal software Radio peripheral (USRP 2920). The approach is best than the in general used methods for purposes in sensing wide band with improved detection of likelihood.

IV. WIDEBAND SPECTRUM SENSING IN GSM BAND

Wideband spectrum sensing senses a frequency bandwidth that exceeds the coherence bandwidth of the channel. They are equipped to establish character spectral possibilities inside the analyzed frequency interval. Wideband spectrum sensing permits an opportunistic utilization of the frequency spectrum. We consider the wideband spectrum sensing for obtaining GSM white spaces between the frequency ranging from (890 - 915) MHz in real time Cognitive Radio System using NI-USRP and NI- Lab VIEW software platform for prototype implementation.

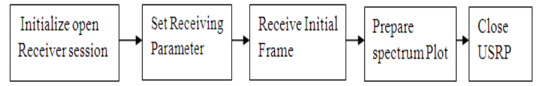

Fig.1 Block Schematic of wideband spectrum sensing

Fig. 1 shows the block schematic for the wideband spectrum sensing. We first initialize the USRP open receiver in this we can specify device name. Then set receiving parameter such as IQ rate, sampling frequency, bandwidth of spectrum. After that next block is receive initial frame then next block for the preparation of spectrum plot and last block is USRP close session this block close the current receiver session and release memory in use by that session.

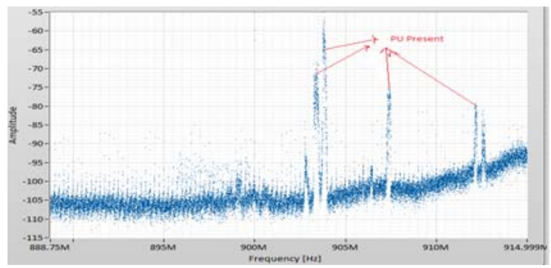

Fig. 2 Output of wideband spectrum sensing.

Fig. 2 shows the output of wideband spectrum sensing algorithm. Wideband spectrum sensing technique is a dynamic spectrum allocation therefore in real time scenario spectrum usage can be change with respect to time as the number of active transmissions and their corresponding parameters are change. Table 1 shows the output of Wideband spectrum sensing taken at different time intervals.

Table 1 Result of Wideband spectrum sensing taken at different time intervals

Sr.No	Frequency Band (MHz)	Occupied Frequency(MHZ)				Amplitude (dBm)			
		9am	11am	1pm	3pm	9am	11am	1pm	3pm
1	890-895	893	890	891	892	-94	-91	-86	-79
2	895-900	897	897	897	897	-95	-92	-73	-86
3	900-905	904	901	903	903	-53	-89	-80	-99
4	905-910	907	908	909	907	-74	-98	-99	-99
5	910-915	912	913	914	914	-79	-92	-87	-93

In the Table 1 from the wideband spectrum sensing the power spectrum obtained for GSM band at different time intervals provides the detail results for their occupancy. e.g. for the frequency band 890-895 MHz only at 893 MHz primary user is present and the approximately

80% band is unoccupied which can be used for other applications. i.e. Table 1 shows which frequencies are utilized and un-utilized, due to which we can easily use that particular frequency band for other types of applications without interference to primary user.

V. CONCLUSION

A wideband spectrum analysis is effective in detecting white spaces in GSM band which can be used for other applications. Wideband spectrum sensing algorithms specifically designed to satisfy the constraints of low computational complexities. The testing was done using NI USRP hardware device and NI-Lab VIEW platform.

VI. REFERENCES

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