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SPECTRUM OCCUPANCY MEASUREMENT OF WEAKLY CORRELATED NOISE OVER FADING CHANNELS

Harshini.S.S, Dept of Communication System, Adhiyamann College of Engineering, Hosur,
Dattatreya.K.A, Dept of ECE, Adhiyamann College of Engineering, Hosur.

Abstract:

In cognitive radio networks, in order to avoid interference form secondary users to the primary license holders of the spectrum, reliable spectrum sensing is necessary. In scenarios where the noise samples are correlated, the spectrum sensing methods optimized considering impairment by independent noise samples will not provide optimum performances. To address this issue, a locally optimum detection method for random signals under a weakly correlated noise model over fading channels is proposed. The probabilities of false alarm and detection of the proposed detector in the low signal to noise ratio regime are analyzed. The average probabilities are calculated over different channel gains. Numerical and simulation results demonstrate the superiority of the proposed method over the known energy detection method with comparable complexities. Furthermore, we consider the scenario where the estimated correlation is different from the real correlation and investigate the effect of this correlation mismatch on the probabilities of false alarm and detection of the proposed method.

Keywords- Optimum detection, Fading, Corelation.

1. INTRODUCTION

Communication is the activity of conveying meaningful information. Communication requires a sender, a message, and an intended recipient, although the receiver need not be present or aware of the sender's intent to communicate at the time of communication; thus communication can occur across vast distances in time and space. The communication process is complete once the receiver has understood the message of the sender. Wired communication: Wired technology has been around for ages. It first became popular in the early 1900's with the introduction of the telephone network. The use of wired connections spawned the creation of other technologies like multiplexing and SONET.

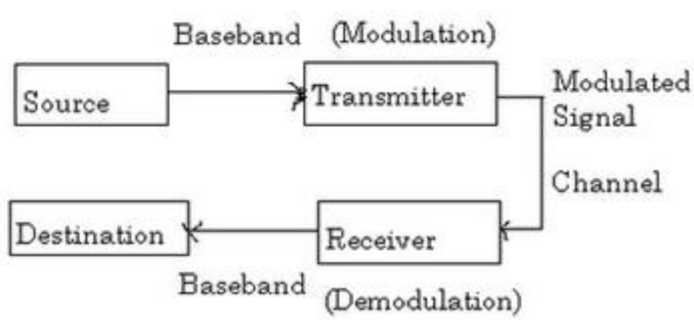

Fig.1. General block diagram

Using physical wires means that electronic signals are being transmitted over a metal conductor. Currently, this is the most reliable way to transmitting/receiving data or voice on the planet. The Internet itself transmits a large amount of data through fiber optic cabling but also employs a large amount of T1/T3 lines that run over standard copper wiring. The theory of FSO is essentially the same as that for fiber optic transmission. The difference is that the energy beam is collimated and sent through clear air or space from the source to the destination, rather than guided through an optical fiber. FSO systems can function over distances of several kilometers. As long as there is a clear line of sight between the source and the destination, communication is theoretically possible. Even if there is no direct line of sight, strategically positioned mirrors can be used to reflect the energy.

2. EXSTING SYSTEM

Using cognitive radios (CRs), the secondary users (SUs) are allowed to use the spectrum originally allocated to primary users (PUs) as long as the primary users are not using it temporarily. To avoid interference to the primary users, the SUs have to perform spectrum sensing before their attempts to transmit over the spectrum. Upon detecting that the PU is idle, the SUs can make use of the spectrum for transmission, and the overall utilization efficiency of the spectrum is enhanced. Cognitive radio is viewed as a novel approach for improving the utilization of a precious natural resource: the radio electromagnetic spectrum. The cognitive radio, built on a software-defined radio, is defined as an intelligent wireless communication system that is aware of its environment and uses the methodology of understanding- by-building to learn from the environment and adapt to statistical variations in the input stimuli, with two primary objectives in mind, highly reliable communication whenever and wherever needed. efficient utilization of the radio spectrum. Following the discussion of interference temperature as a new metric for the quantification and management of interference, the paper addresses three fundamental cognitive tasks.

3. COGNITIVE NETWORK

In recent years, the words cognitive and smart have become buzzwords that are applied to many different networking and communications systems. At a minimum, in the current literature we find mention of cognitive networks. The opportunistic use of the wireless spectrum has been a hot research topic in the wireless communications community in recent years due to the intense competition for the use of spectrum at frequencies below 3 GHz. Cognitive network has a cognitive process that can perceive current network conditions, and then plan, decide and act on those conditions. The network can learn from these adaptations and use them to make future decisions; all while taking into account end to end goals. A cognitive network consists of a number of traditional wireless service subscribers and they are called as cognitive users. The traditional wireless service subscribers have the legacy priority access to the spectrum and are usually called primary users in this network. Cognitive users presented in this system are also known as the secondary users, are allowed to access the spectrum only if communication does not create significant interference to the licensed primary users. CRNs are networks that have cognitive and reconfigurable properties and the capability to detect unoccupied spectrum holes and change frequency

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for end-to-end communication. In most of the existing proposals, CRNs employ three steps of basic functionality. Observing and sensing is the first step of the cognitive process. The next step is to identify and analyze the spectrum. The last step is sharing the spectrum information and executing spectrum assignment.

4. PROPOSED SYSTEM

Beamforming can be used for radio or sound waves. It has found numerous applications in radar, sonar, seismology, wireless communications, radio astronomy, acoustics, and biomedicine. Adaptive beamforming is used to detect and estimate the signal-of-interest at the output of a sensor array by means of optimal spatial filtering and interference rejection. Beam forming is a signal processing technique used in sensor arrays for directional signal transmission or reception. This is achieved by combining elements in the array in such a way that signals at particular angles experience constructive interference while others experience destructive. Conventional beamformers use a fixed set of weightings and time-delays (or phasing's) to combine the signals from the sensors in the array, primarily using only information about the location of the sensors in space and the wave directions of interest.

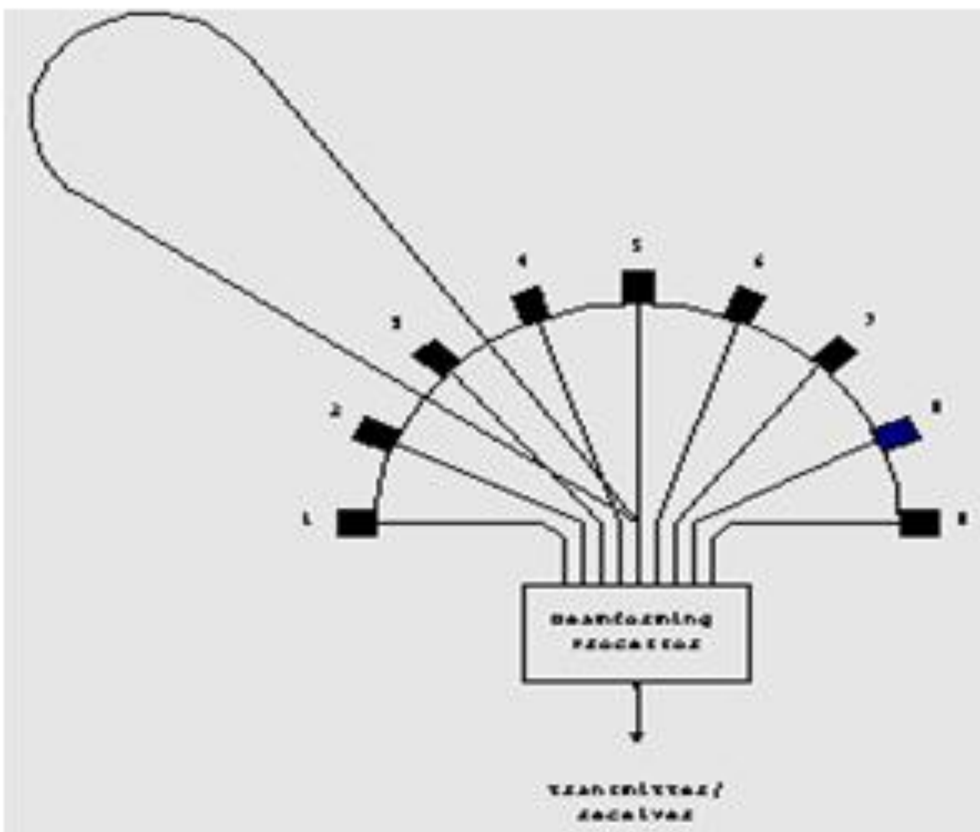

Fig.1.Beam forming

In contrast, adaptive beamforming techniques generally combine this information with properties of the signals actually received by the array, typically to improve rejection of unwanted signals from other directions. This process may be carried out in either the time or the frequency domain. Precoding is a generalization of beamforming to support multi-layer transmission in multi-antenna wireless communications. In conventional single-layer beamforming, the same signal is emitted from each of the transmit antennas with appropriate weighting such that the signal power is maximized at the receiver output. When the receiver has multiple antennas, single-layer beamforming cannot simultaneously maximize the signal level at all of the receive antennas. In point-to-point systems, some of the benefits of precoding can be realized without requiring channel state information at the transmitter, while such information is essential to handle the co-user interference in multi-user systems.

5. SOFTWARE DESCRIPTION

Matlab was originally designed as a more convenient tool (than BASIC, FORTRAN or C/C++) for the manipulation of matrices. It was originally written to provide easy access to matrix software developed by the LINPACK and EISPACK projects. After- wards, it gradually became the language of general scientific calculations, visualization and program design. Today, Matlab engines incorporate the LAPACK and BLAS libraries, embedding the state of the art in software for matrix computations. It received more functionalities and it still remains a high-quality tool for scientific computation. Matlab excels at numerical computations, especially when dealing with vectors or matrices of data.

It is a procedural language, combining an efficient programming structure with a bunch of predefined mathematical commands. While simple problems can be solved interactively with Matlab, its real power is its ability to create large program structures which can describe complex technical as well as non-technical systems.

Mat- lab has evolved over a period of years with input from many users. In university environments, it is the standard computational tool for introductory and advanced courses in mathematics, engineering and science. In industry, Matlab is the tool of choice for highly-productive research, development and analysis. After a detailed introduction describing the main usage as well as the different definitions in Matlab, some relevant selected topics, like amplitude modulation, fast Fourier transformation or convolution, are treated.

6.RESULT ANALYSIS

We propose an optimal locally optimum detector for spectrum sensing to achieve higher spectrum utilization in cognitive radio networks. We derive the optimal detector structure for MPSK modulated primary signals with known order over AWGN channels and give its corresponding suboptimal detectors in both low and high SNR (Signal-to-Noise Ratio) regimes.

Through approximations, it is found that, in low SNR regime, for MPSK ($M > 2$) signals, the suboptimal detector is the energy detector, while for BPSK signals the suboptimal detector is the energy detection on the real part.

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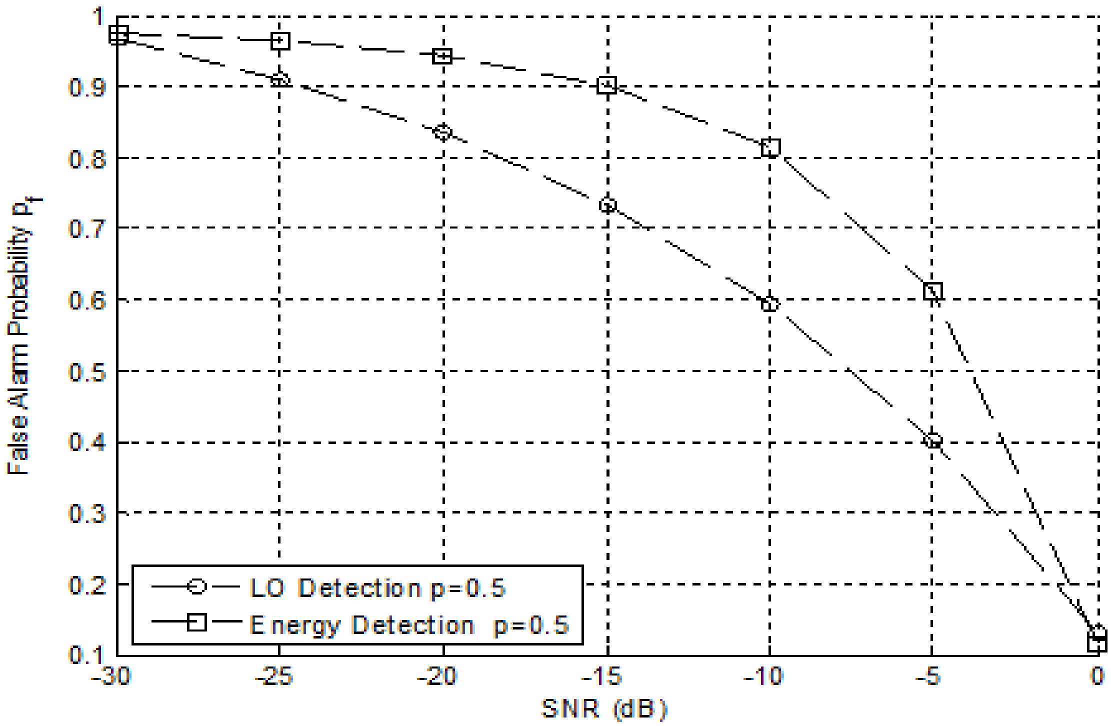

Fig.2. Average false alarm probabilities using analytical results as well as simulation results at different SNRs for detection probability

In high SNR regime, it is shown that, for BPSK signals, the test statistic is the sum of signal magnitudes, but uses the real part of the phase-shifted signals as the input. We provide the performance analysis of the suboptimal detectors in terms of probabilities of detection and false alarm, and selection of detection threshold and number of samples. The simulations have shown that Bayesian detector has a performance similar to the energy detector in low SNR regime, but has better performance in high SNR regime in terms of spectrum.

CONCLUSION

A locally optimum detector for detection of random signals under a weakly correlated noise model over fading channels has been proposed. In order to consider the effect of correlation mismatch, a general scenario was considered where the estimated correlation between noise samples is not necessarily equal to the actual correlation. The false alarm and detection probabilities have been obtained for a specific channel gain *h* and averaged over different channel gains. For comparison, we have also analyzed the performance of the energy detector under the same correlated noise. Based on the provided numerical and simulation results for the false alarm and detection probabilities, the proposed locally optimum detector has lower false alarm probability and higher detection probability compared to the energy detector. Also, the higher the correlation coefficient, the higher the gain achieved by the proposed detector compared to the energy detector. The proposed and energy detectors have the same performances when there is no correlation. In case of correlation mismatch, false alarm and detection probabilities have been calculated.

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