Energy Detection For Spectrum Sensing In Cognitive Radio

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this comprehensive reference text discusses concepts of cognitive radio and the advances in the field of spectrum sensing this text discusses the concept of cognitive radio for next generation wireless communication and a very critical aspect of cognitive radio that is spectrum sensing in detail it covers important topics including narrowband spectrum sensing wideband spectrum sensing cooperative spectrum sensing system and channel models detection algorithms approximation of decision statistics and theoretical analysis of detection algorithms in detail separate chapters are dedicated to discussing the analysis and use of

detection algorithms for narrowband spectrum sensing wideband spectrum sensing and cooperative wideband spectrum sensing aimed at graduate students and academic researchers in the fields of electrical engineering and electronics and communication engineering this text discusses concepts of cognitive radio and research in spectrum sensing presents mathematical analysis of algorithms considering practical environment explains novel wideband spectrum sensing algorithms with detailed analysis provides mathematical derivations to help readers discusses basic spectrum sensing algorithms from narrowband spectrum sensing to the more advanced wideband spectrum sensing

this springer brief focuses on the current state of the art research on spectrum sensing by using energy detection a low complexity and low cost technique it includes a comprehensive summary of recent research fundamental theories possible architectures useful performance measurements of energy detection and applications of energy detection concise practical chapters explore conventional energy detectors alternative forms of energy detectors performance measurements diversity techniques and cooperative networks the careful analysis enables reader to identify the most efficient techniques for improving energy detection performance energy detection for spectrum sensing in cognitive radio is a valuable tool for researchers and practitioners interested in spectrum sensing and cognitive radio networks advanced level students studying wireless communication will also benefit from this brief

doctoral thesis dissertation from the year 2020 in the subject engineering communication technology grade a language english abstract cooperative spectrum sensing technique is used to maximize the utilization of unused licensed spectrum as the cooperation among the secondary users increases the detection performance increases which increases the average channel throughput and energy efficiency but it depends on the number of cooperative secondary users fusion rules channel conditions and detection threshold in this thesis average channel throughput energy consumption and energy efficiency are estimated for variable number of secondary users and detection thresholds using hard fusion rules i e and or and majority fusion rules from the results it has been observed that the performance of and fusion rule is better at low detection thresholds and for less number of secondary users the performance of or fusion rule is better at high detection thresholds and for large number of secondary users the performance of majority fusion rule follows the performance of and fusion rule at low detection thresholds and it follows the performance of or fusion rule at high detection thresholds however as the number of cooperative secondary users increases the energy required for spectrum sensing and reporting sensing results to the fusion center increases which increases the energy consumption and reduces the energy efficiency therefore energy efficiency can be improved by maximizing the average channel throughput or by minimizing the energy consumption to minimize the energy consumption in cooperative spectrum sensing optimization technique has been proposed in this thesis and it is used for further improvement of energy efficiency with this optimization technique optimal number of cooperative secondary users are derived by maximizing the energy efficiency using and and or fusion rules but not with majority fusion rule because it is very difficult to estimate the optimal number of cooperative secondary users using majority fusion rule so optimization of final decision threshold was proposed in the existing methods to maximize the energy efficiency using majority fusion rule therefore and and or fusion rules are used in this work to optimize the number of cooperative secondary users

this springerbrief investigates advanced sensing techniques to detect and estimate the primary receiver for cognitive radio systems along with a comprehensive overview of existing spectrum sensing techniques this brief focuses on the design of new signal processing techniques including the region based sensing jamming based probing and relay based probing the proposed sensing techniques aim to detect the nearby primary receiver and estimate the cross channel gain between the cognitive transmitter and primary receiver the performance of the proposed algorithms is evaluated by simulations in terms of several performance parameters including detection probability interference probability and estimation error the results show that the proposed sensing techniques can effectively sense the primary receiver and improve the cognitive transmission throughput researchers and postgraduate students in electrical engineering will find this an exceptional resource

recent research shows that 70 of the available spectrum is not utilized efficiently the bandwidth gets expensive owing to shortage of frequencies for efficient utilization of spectrum we need to sniff the spectrum to determine whether it is used by primary user or not the term cognitive radio refers to the adoption of radio parameters using the sensed information of the spectrum there are three major categories of spectrum sensing techniques transmitter detection receiver detection and interference temperature detection this book presents a survey of techniques suggested in the literature for spectrum sensing with a performance analysis of transmitter based detection techniques a fuzzy logic based technique for primary user detection has also been proposed in comparison with transmitter detection techniques purposed technique provides good results under low snr values

human factors play a critical role in the design and interpretation of remotely sensed imagery for all earth sciences remote sensing and cognition human factors in image interpretation brings together current topics widely recognized and addressed regarding human cognition in geographic imagery especially remote sensing imagery with complex data it addresses themes around expertise including methods for knowledge elicitation and modeling of expertise the effects of different aspects of realism on the interpretation of the environment spatial learning using imagery the effect of visual perspective on interpretation and a variety of technologies and methods for utilizing knowledge in the analysis of remote sensing imagery written by leaders in the field this book provides answers to the host of questions raised at the nexus of psychology and remote sensing academics and researchers with an interest in the human issues surrounding the use of remote sensing data will find this book to be an invaluable resource the topics covered in this book are useful for both the scientific analysis of remote sensing imagery as well as the design and display of remote sensing imagery to facilitate a variety of other tasks including education and wayfinding features brings together remote sensing environmental and computer scientists discussing their work from a psychological or human factors perspective answers questions related to aesthetics of scientific visualization and mathematical analysis of perceptible objects explains the perception and interpretation of realistic representations provides illustrative real world examples shows how the features of display symbols elements and patterns have clear effects on processes of perception and visual search

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cognitive networks assure to tackle spectrum deficiency problems by

accommodating secondary unlicensed users in the spectrum region which is under utilized cooperative spectrum sensing methodologies are still an open window of research this work is related to cope up the problem of spectrum deficiency and associated problems by developing an approach for establishment of grouping clustering among secondary users in a cooperative spectral environment this approach ensures that members within a group are highly correlated as a result the workload on each sensing node within a group is reduced the effectiveness of this approach depends upon the accuracy of fused decision related to the presence or absence of primary licensed user at a particular band 50mhz to 100mhz this approach also depends on the factor that time taken in sensing the primary licensed users should be less enough so that decision in vacating the band by the cognitive radio secondary users could be taken in fewer time frames this latter metric is known as agility which eventually comes with the outcome of minimum interference to primary users via their early recognition

cognitive radio networks crn will be widely deployed in the near future and this springerbrief covers some important aspects of it as well as highlighting optimization strategies in resource allocation and spectrum sensing in crns the cognitive approach in radio access is introduced in the first part of this springerbrief and then next the benefits of cooperative spectrum sensing are highlighted and a framework for studying it under realistic channel conditions is described new exact closed form expressions for average false alarm probability and average detection probability are derived in this scenario a novel approximation to alleviate the computational complexity of the proposed models are also discussed once the spectrum opportunities are identified efficient and systematic resource allocation ra shall be performed the second part of this springerbrief describes the taxonomy for the ra process in crn a comprehensive overview of the optimization strategies of the crn ra is also provided the device to device d2d communication scenario is discussed then as a case study and various optimization strategies for the application of the cr technology in the d2d realm is studied the application of advanced geometric water filling gwf approach in crn d2d environment for optimum resource allocation is presented in detail numerical results provide more insight quantitatively overall this book is suitable for a wide audience that include students faculty and researchers in wireless communication area and professionals in the wireless service industry

the inadequate use of wireless spectrum resources has recently motivated researchers and practitioners to look for new ways to improve resource efficiency as a result new cognitive radio technologies have been proposed as an effective solution sensing techniques for next generation cognitive radio networks is a pivotal reference source that provides vital research on the application of spectrum sensing techniques while highlighting topics such as radio identification compressive sensing and wavelet transform this publication explores the standards and the methods of cognitive radio network architecture this book is ideally designed for it and network engineers practitioners and researchers seeking current research on radio scene analysis for cognitive radios and networks

spectrum management has become a crucial issue in wireless networks however optimal utilization of the spectrum among the different users is not a trivial task over the last two decades wireless communication has witnessed a significant increase in applications however fixed strategies for allocating the spectrum bands cannot handle multiple requirements simultaneously which is a core requirement of the emerging wireless applications more importantly licensed users or primary

users pus in wireless networks are intermittently connected leading to spectrum underutilization all of these limitations make it imperative that efficient strategies be developed to manage the spectrum among multiple users or networks cognition as a component of intelligence has been employed in communication technologies such as cr networks for reasoning and learning goals from this perspective a cognitive radio network is an adaptive data network that applies cognition as an optimization tool aiming to optimize spectrum sharing among multiple secondary users sus in addition to the pus in an autonomous and dynamic way spectrum sensing is an important element of cognitive radio technology since its outcome is the basis for all the subsequent stages of the cognition cycle however with stand alone cognitive radio devices local spectrum sensing techniques such as energy detection technique might draw a false conclusion about the presence of a primary transmitter due to several reasons e g fading shadowing hidden node problem noise uncertainty etc cooperative sensing minimizes the uncertainty due to those factors by exploiting the spatial variation of sus then concludes one global decision about the pu s presence absence in this research work i propose an intelligent cooperative spectrum sensing system whereby the contextual information of each secondary user is augmented in the fusion process wherein a set of information acquired by several contributing sus are fused to optimize a global decision incorporating the contextual information of the sus improves the spectrum sensing decision s reliability in the sense that false rejections and false acceptances are minimized and therefore utilization is optimized artificial neural networks as a machine learning and artificial intelligence tool has been employed as a fusion algorithm utilizing the context of every su to optimize final decisions experimental work is reported and discussed to demonstrate the effectiveness of the proposed technique

spectrum sensing is an important functionality of cognitive radio as a means to detect the presence or absence of the primary user pu in a certain spectrum band energy detection is a widely used spectrum sensing technique based on the assumption that the pu is either present or absent during the whole sensing period however this assumption is not realistic in a dynamic environment where the pu could appear or disappear at any time the performance of the conventional energy detector ed actually deteriorates in the scenario where the pu activity status changes during the sensing period therefore it is crucial to design a detector which can adapt to such an environment and reliably detect a change in the pu activity several sequential change detection techniques already exist in the literature however change detection in a fixed sensing duration has not been given enough attention in this dissertation three adaptive eds are proposed to improve the

given the ever growing demand for radio spectrum cognitive radio has recently emerged as an attractive wireless communication technology this dissertation is concerned with developing spectrum sensing algorithms in cognitive radio networks where a single or multiple cognitive radios crs assist in detecting licensed primary bands employed by single or multiple primary users first given that orthogonal frequency division multiplexing ofdm is an important wideband transmission technique detection of ofdm signals in low signal to noise ratio scenario is studied it is shown that the cyclic prefix correlation coefficient cpcc based spectrum sensing algorithm which was previously introduced as a simple and computationally efficient spectrum sensing method for ofdm signals is a special case of the constrained generalized likelihood ratio test glrt in the absence of multipath the performance of the cpcc based algorithm degrades in a multipath scenario however when ofdm is implemented by employing the inherent structure of ofdm signals and exploiting multipath correlation in the glrt algorithm a simple and low complexity

algorithm called the multipath based constrained glrt mp based c glrt algorithm is obtained further performance improvement is achieved by combining both the cpcc and mp based c glrt algorithms a simple glrt based detection algorithm is also developed for unsynchronized ofdm signals in the next part of the dissertation a cognitive radio network model with multiple crs is considered in order to investigate the benefit of collaboration and diversity in improving the overall sensing performance specially the problem of decision fusion for cooperative spectrum sensing is studied when fading channels are present between the crs and the fusion center fc noncoherent transmission schemes with on off keying ook and binary frequency shift keying bfsk are employed to transmit the binary decisions to the fc the aim is to maximize the achievable secondary throughput of the cr network finally in order to reduce the required transmission bandwidth in the reporting phase of the crs in a cooperative sensing scheme the last part of the dissertation examines nonorthogonal transmission of local decisions by means of on off keying proposed and analyzed is a novel decoding based fusion rule for combining the hard decisions in a linear manner

this special issue provides a sample of research that comprises the foundation of the emergent field of augmented cognition inspired fundamentally from the defense advanced research projects agency program taken together the contributions impart a sense of progress and constitute a first look at achievements from this very ambitious program of research in augmented cognition in addition they convey results that range from improved instrumentation and methodology to demonstrations of enhanced performance under experimentally manipulated conditions

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