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Modeling of SpectrumPeak based Technique for Spectrum Sensing

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Abstract- The detection of modulated signals and analysis has been verified under white Gaussian noise channel for different signal to noise ratiolevels.The up gradations of detection performance and reliability have been enhanced under white Gaussian noise channel using spectrum analysis method. In this paper we have developed different models and performed simulation using Mat lab version 2014a by spectrum analysis method for several digital modulated mobile signals commonly used in today's communication world. The proposed spectrum method is based on modified Periodogarm algorithm is superior in simplicity of computation to detect the presence of mobile modulated signals efficiently at low SNR which can be used to sense spectrum effectively to solve the problem of spectrum scarcity.

Index Terms- Spectrum sensing, Power Spectral Density(PSD), A White Gaussian Noise(AWGN), Signal Processing, Digital Modulation, Signal to Noise Ratio(SNR), Total Harmonic Distortion(THD).

I. INTRODUCTION

Spectrum is a very essential commodity in today's day to day communication. Most of the today's wireless communication adopts fixed spectrum allocated policy[1].Proper planning and utilization of spectral resources are allocated & controlled by each countries governmental departments. Federal communication commission's (FCC) frequency charts[2] shows the poor utilization of spectral resources. Now with n number of users, n number of frequency channels & with this many number of secondary multitasking applications been attached to the same mobile devices a proper spectrum sensing technique is needed to detect and analyze the mobile signal [3]or user. In general the signal can be analyzed and measured using various techniques which include constellation scope technique [4] , trajectory scope technique, synchronization diagram technique[5] & [8] .The advantages of these existing methods is they are good for analysis at signal dominating situations where as they are not suitable at noise dominating over signal situations i.e at low SNR. Signal detection is very poor & suffers from a bad performance. Spectrum based peak method measurement [6] has been introduced to solve the problem of efficient detection of modulated mobile signals specially at low SNR, which uses the modified periodogram algorithm to estimate the power spectrum [7]. Applying this method for spectrum sensing can realise fast, accurate & reliable searching of signals. The simulinkmodels has been developed with filter & without filter to analyse the detection of signals at various SNR. Finally the spectrum based simlink models has been introduced to analyze the signals effeciently.The paper is being organized as follows: Section II defines the development of sim link models for spectrum sensing. The related simulated results are showed in section III .In order to fulfil the efficient detection we modelled & simulated the transmitter & receiver using Raised Cosine Filter and discussion & analysis is being done in the same section .Finally section IV gives the conclusion.

II.DEVELOPMENT OF MODELS FOR SPECTRUM SENSING

For efficient detection of signals, various simulink models developed & analysis has been done using Raised cosine FIR filter & without using filters. Signals has been detected using two dimensional frequency domain representation. The performance of detection can be improved by developing models specially using a spectral analyser tool at low SNR conditions for spectral peak measurements. Various models developed are shown below. The filter used is raised cosine transmit filter which filters the signal using normal raised cosine FIR Filter or Square root raised cosine FIR Filter. The models using spectrum scope been developed to analyse spectral peak and Power Spectral Density at various Gaussian channel , Total Harmonic Distortions & Channel Capacity etc .Total harmonic value represent the ratio of power in the harmonics 'D' to the power of fundamental frequency 'S'. If the noise power is too high in relation to the harmonics the total Harmonic Distortion THD value is not accurate. In this case lower the resolution band width or select a different spectral window .THD = 10 $\log_{10}(D/S)$.

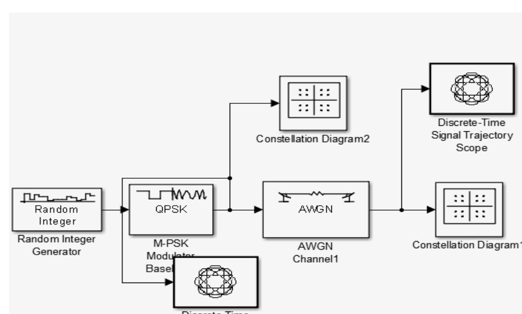

Figure1 Signal Detection model without filter

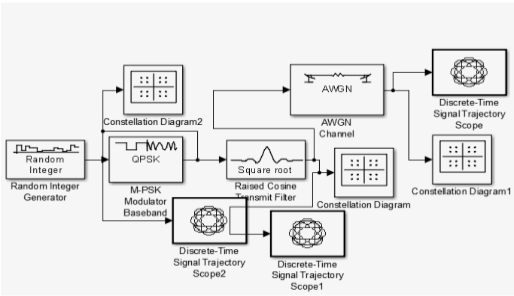

Figure2 Signal Detection model with filter

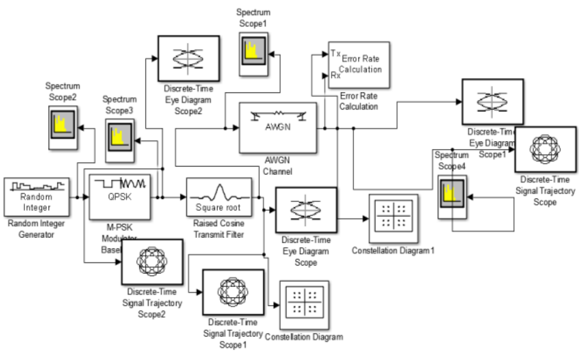

Figure 3 Signal Detection with spectrum model

III.SIMULATION ENVIRONMENT & RESULTS

The simulations were carried out to the different signals with white Gaussian noise channel characteristics at various signal to noise values. In order to get suitable spectral functions of various digital modulated signals that are most commonly used in today's mobile communications and classify them according to constelled points, trajectory regions & spectrum, we have simulated the signals & passed them through the constellation scope, spectrum scope by using Modified Periodogram Algorithm and the following detection plots are shown in fig3 – fig9.

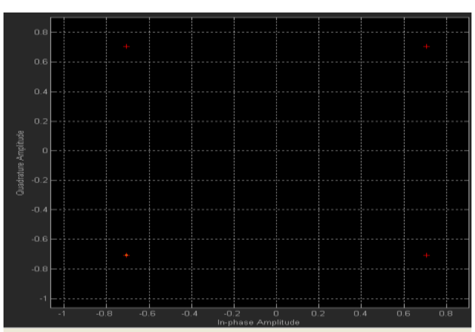

Figure 4 constellation diagram at the input side

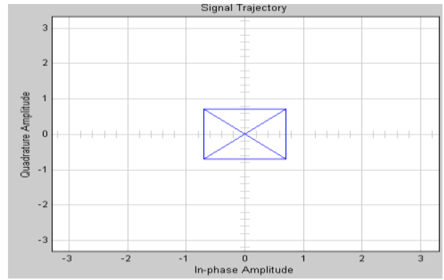

Figure 5 Trajectory diagram at the input side

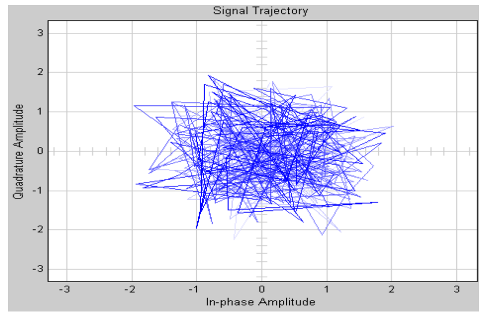

Figure 6 Trajectory diagram at the output side (low SNR)without filter

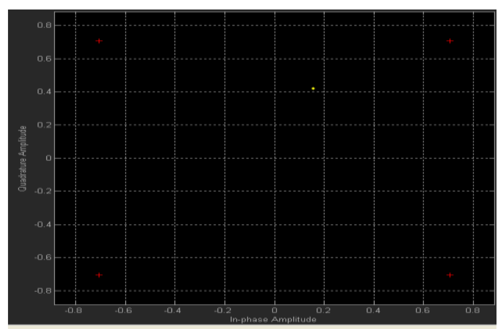

Figure 7 constellation diagram at the output side (low SNR) without filter.

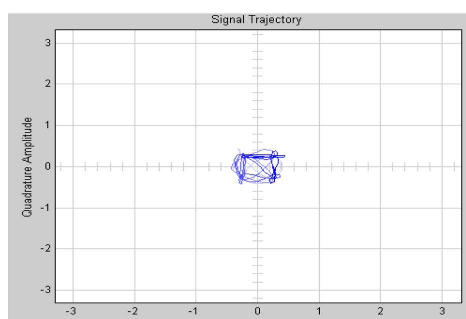

Figure 8 Trajectory diagram at the output side with filter (low SNR)

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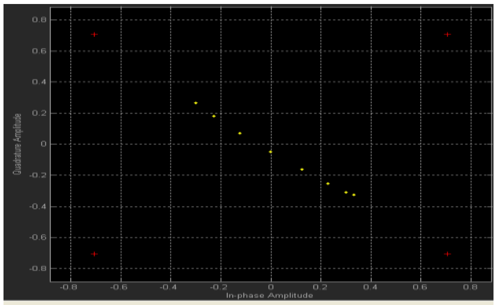

Figure 9 constellation diagram with filter(low SNR)

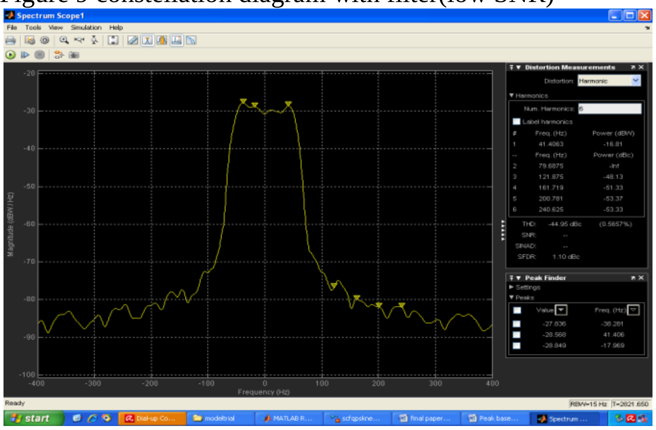

Figure10 Peak based spectrum at Transmitter with filter

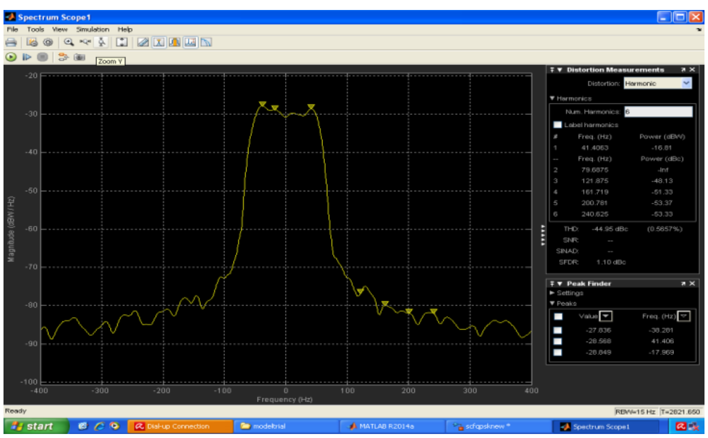

Fig11 Peak based spectrum at receiver (at low SNR)

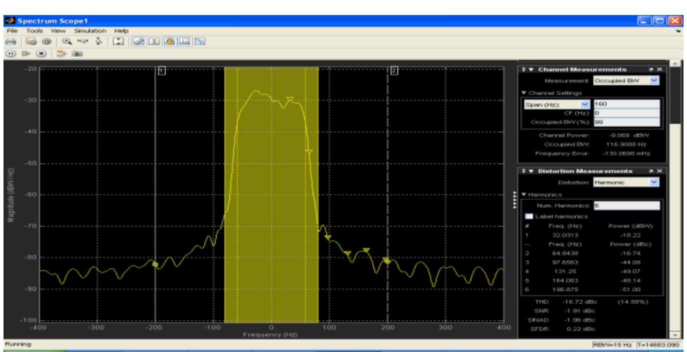

Figure 12.Distortion measurement at transmitter.

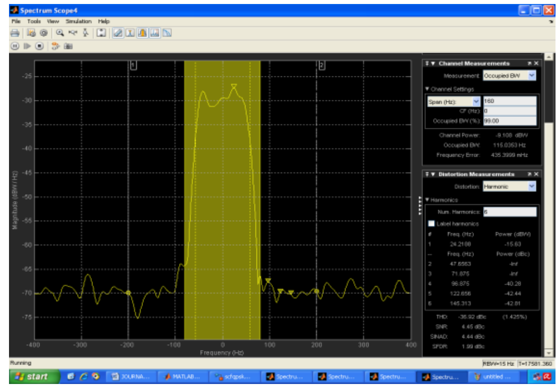

Figure 13.Distortion measurement at receiver (at low SNR)

From Fig 10-13, it is clear that the percentage of missed detections of modulated mobile signals is very less.It shows the measurement of power spectral
density vs various frequency very clearly. Here we have applied modified periodogram algorithm to estimate the spectrum. Also at low SNR it is found better detection compared to any other previous methods. Distortions measurements have been done very clearly at harmonics upto six numbers. So the spectrum based on modified periodogram algorithm is proved to realize high detection accuracy at low SNR. The results reveals the good accuracy & high reliability can be achieved using this algorithm.

IV. CONCLUSIONS

In this paper we showed that peak based spectrum detection method for spectrum sensing can be used to increase the spectrum efficiency in wireless network and analyze the signal in a better way. Compared to previous methods modulated signals has been analyzed in this paper by using spectrum analysis for a white Gaussian noise channel measurement using PSD helps to observe the waveforms Signals are being analysed at different SNR's.We performed Matlab Simulations of Spectral functions of digital modulated signals commonly used for mobile radio communications.Spectral Density Functions, Spectral Peak Power Measuement,Channel Band width & Channel powers are measured for different values of SNR with Filter & Without filter for Gaussian Noise channel. This has been compared and analysed with previous techniques & the results proved that Spectrum technique gives better solutions. Maximum spectral peak values versus frequency has been measured at low SNR & medium range of SNR very clearlyDistortions measurement can be efficiently done up to higher order harmonics so that efficiency in detections can be increased in detection of signals which in turn helps to solve the scarcity of spectrum problem faced in today's mobile communication. Channel band width & channel capacity can be measured efficiently which solves spectrum wastage in most of the cities. We believe that proposed measurement technique is important for the proper utilization of spectrum and more attention needs to be devoted to such areas.Our future work is directed towards enhancement of this spectrum measurement using 3-Dimentional approach, specially at low SNR condition to get detections better, which would also lead to lower computational complexity & processing delay.

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