Performance of SDR Transceiver Using Different Modulation Techniques

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Abstract—*The paper describes about the design and performance of transceiver for the software defined radio (SDR).The sensible solution for reconfiguring radio is the SDR. It uses identical hardware platform to perform various tasks.The design is simulated using MATLABSimulink and performance is analyzed based on the error rate against signal to noise ratio.The design is investigated with 40MHz intermediate frequency transmission.*

Keywords— SDR, Modulation,MATLAB Simulink.

I. INTRODUCTION

SDR is a radio which is defined in software and behavior of physical layeris ought to be affected through the modifications made to its software. Therefore, identical piece of hardware can be re-utilized forrealizationof variety of applications by making changes in software. In communication system design, different programmable hardware modules are used at different levels.So an open system architecture based on software can be built. Here many of transfer functions such as gain stages, frequency conversion, filtering, modulation anddemodulation may be combined on to one platform thus, resulting in the increment of radio functions.SDR offers reliability and enhancements for the satisfactory requirements.

The popularity of wireless communication is raised due to advent of cellular communications. The increased growth in technology and development gives raise for reliable communication and the interest in modulation technique is stimulated by the need for reliable high datarate transmission. Various modulation techniques has to be used to achieve different throughputs by sending different bits per symbol.Themain technique used in building wireless communication networking is adaptive modulation due to increase in shortage of wireless communication channels.

QAM is used as one of the key technique in adaptive modulation as it is power and bandwidth efficient. The effective bandwidth is duplicated by combining two amplitude modulated signals into single channel. By switching different modulation techniques according to varying instances, the adaptive modulation helps to increase rate of transmission,therefore justifying popularity for future high –rate wireless applications and fading and interferences can be overcome by the system.

For understanding of transceiver system in a better waya MATLAB/Simulink –based communication systemtoolbox is used.In the simulation model the parameter settings for the different blocks of communication system are provided. The performance is evaluatedbased on error rates versus signal to noise ratio.

II. SIMULINK MODEL

The transmitter and receiver sections of the model is designed and simulated by using communication toolbox in MATLAB SIMULINK to alleviate the performanceof the model by channel noise.

The model comprises of designing a transmitter consisting of modulation technique, interpolator, pulse shaping filter followed by the design of receiver comprising of pulse shaping, decimation and demodulation.

Complete model of proposed model is shown below in figure(1)

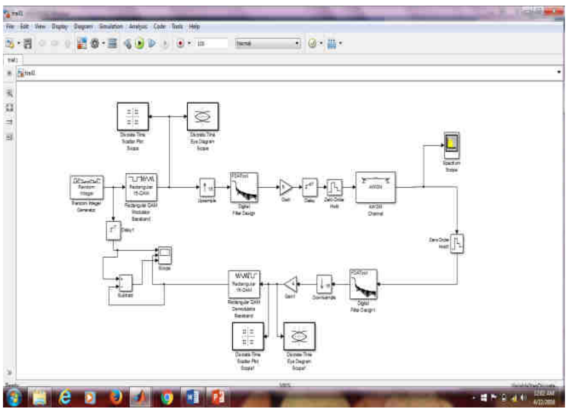

Fig.1:SDR Model

2.1 Design of transmitter

The signal generated from the random integer generator in transmitter is modulated by the M-QAM modulator having a baudrate of 2.5Msymbols/second. The signal which is modulated is then up sampled by a factor of 16 and then allowed to pass through RRC filter for pulse shaping purpose.

2.1.1 Interpolation

In digital signal processing, for the purpose of obtaining desired speed of an existing signal, the up sampling or interpolation is carried out. Thus increasing the sampling rate of a signal.The interpolation sequence is generated by sampling the continuous curve passing through old samples by new sample rate.The intermediate values of factor M, M-1 is calculated for obtaining new sampling rate.

In the proposed system, the baseband signal generated by M-QAM is interpolated by an integer 16 which produces anew sampling rate of40Msymbols/second. The inherent amplitude loss factor of M produced by the interpolator is compensated by using suitable gain stage to attain gain of one betweensamples.

2.1.2 RRC

The transmitter and receiver pulse shaping filters play a major role in design of any wireless communication system. The design requirements for the RRC filter is shown below in the table 1.

Table 1.RRC design parameters

Nyquist frequency	2.5MHz
Sampling rate	40MHz
Stop band attenuation	-40dB
Roll-off factor	0.35
Phase response	linear
status of stability	stable

The above mentioned requirements are satisfied by considering a FIR filter using Kaiser Window. The raised cosine response is associated with 3 major frequencies mentioned as Nyquist frequency or center frequency, stopband frequency, passband frequency. These frequencies are obtained by

$$f_{stop} = (1+\beta)f_{center} = (1+0.35)2.5MHz = 3.375MHz$$

$$f_{pass} = (1-\beta)f_{center} = (1-0.35)2.5MHz = 1.625MHz$$

The response of the filter is shown below which implies that the filter is non distorting.

2.2 Design of receiver

The signal affected by noise is converted down to intermediate frequency in the receiver path. The signal is then pulse shaped by using RRC at 40MHz sample rate and then decimated by an integer value 16.The gain stage overcomes the amplitude loss due to down sampler.

III. RESULTS

The simulation results are analyzed using scatter plots.Asthe SNR values are increased in particular modulation technique, the noise margin start to close out and the error decreases.The eye diagram reveals less distortion if the eye opening is more defined.Scrambling of bits in the scatter plot decreases as SNR is increased.For the higher order modulation techniquesScrambling of bits increases.

The figure(3) ,figure(4) below shows constellationdiagram of 16QAM for 10 and 20dB

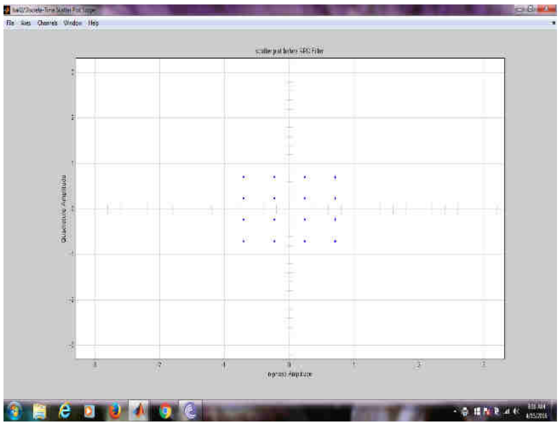

Fig.2:ideal plot

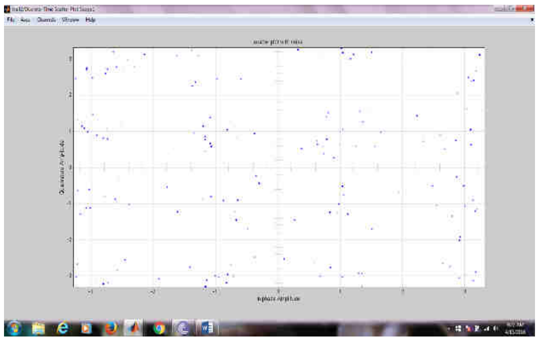

Fig.3:scatter plot with 10dB SNR

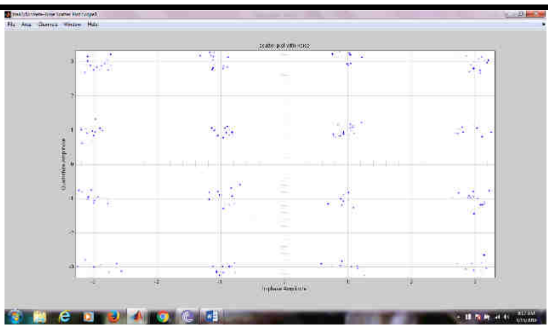

Fig.4:scatter plot with 20 dB SNR

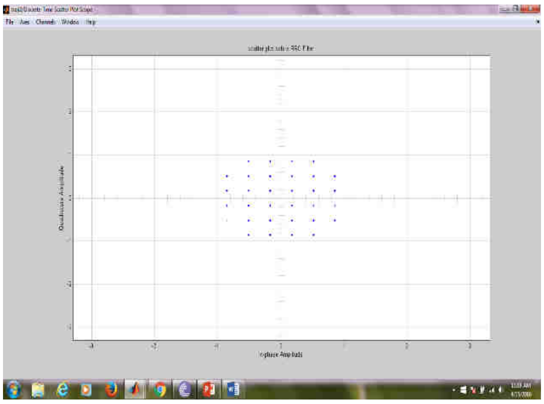

Fig.5:ideal plot for 32 QAM

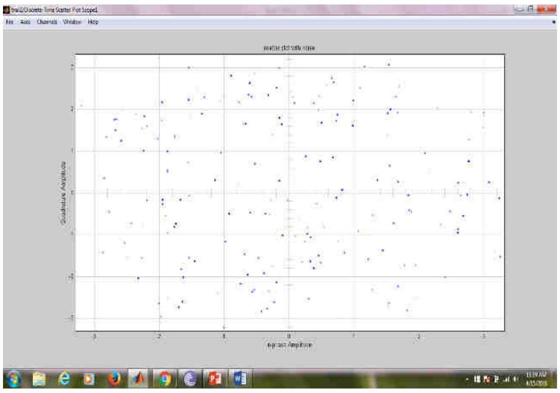

Fig.6:scatter plot with 10 dB SNR

REFERENCES

[1] Pedro and Nuno, "Multi-Mode Receiver for Software Defined Radio", Institute of Telecommunication – University of Aveiro – Portugal, online available: http://www.anacom.pt/render.jsp?contentId=761239, 2008.

[2] Pallavi, "Frame Work for the Design and Implementation of Software Defined Radio based Wireless Communication System", M.Sc. thesis, University of AAkron: http://etd.ohiolink.edu/view.cgi/Mannar%20Manna, 2005.

[3] J. Mitola, "The Software Radio Architecture", in *IEEECommunications Mag.*, vol. 33, no. 5, pp. 26-38, May 1995.

[4] Logan Scott, "Directions 2008: Software-Defined Radio Role to Grow", *GPS World Magazine*, December 1, 2007.

[5] Ho, W. S., "Adaptive modulation (QPSK, QAM), " www.intel.com/netcomms/technologies/wimax/303788.pdf, accessed on December 30, 2007.

[6] Rappaport, T. S., .Wireless Communications: Principles & Practice, 2nd edition,Prentice Hall, 2003.