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Implementation of QPSK Modulation on MATLAB Simulation

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***Abstract*— In recent years development in the field of communication lead to the development of modulation techniques. Selection of modulation techniques depends on signal to noise ratio (SNR), bit error rate (BER), Low multipath propagation etc. For this purpose QPSK (Quardrature phase shift key) and QAM (Quardrature amplitude modulation) are considered. Comparison of both the techniques is done and result is calculated on the basis of better quality signal and greater efficiency.**

***Index Terms*—Adder, Demultiplexer, Modulation, NRZ Coder, QAM, QPSK.**

I. INTRODUCTION

A. Quardrature Phase Shift Key

Phase shift key modulation is a technique in which phase of carrier wave is varied in accordance with the modulating signal. **QPSK** (Quardrature phase shift key) or sometimes called as **4-PSK** is a digital modulation technique. Here 4 represents 4 phase (45,135,225,315), in which carrier is send (fig 1). QPSK has 4 possible states i.e. QPSK can encode 2 bit per symbol. It provide phase shift of Pi/2 (90°) multiple times.

Phase	Data
45°	00
135°	01
225°	11
315°	10

Table.1 shows 4 phase of QPSK technique in which carrier is send. It can encode 2 bit per symbol as shown above.

QPSK signal is generated using a binary bit stream; this stream is then given into demultiplexer which then gives two outputs (Fig 2). These outputs from demultiplexer undergo NRZ coding and get shifted by pi/2 phase shift and are finally added to give QPSK signal.

B. Quardrature amplitude modulation

Amplitude modulation is a technique in which amplitude of the carrier signal is varied in accordance with the modulating signal. **QAM** (Quardrature amplitude modulation) is both analog and digital modulation technique.

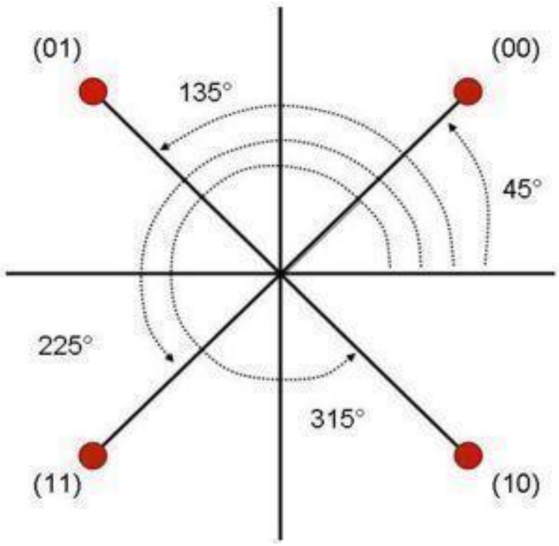

Fig.1 Shows constellation view of QPSK signal showing 4 possible phase i.e. 45°, 135°, 225° and 315°. Each symbol contains 2 bit as shown in above figure.

It is called quadrature because of two carrier wave that are out of phase with each other by 90° (Fig 3) .Thus after modulation, the signal that we get varies by both amplitude and phase.

As shown in fig 3. I and Q inputs individually are mixed with out of phase waves and then are finally added to give output QAM signal.

II. DIGITAL MODULATION TECHNIQUES

In digital modulation the modulated signal is a digital signal. It can be said as digital to analog conversion method. Various digital modulation schemes are:

A. ASK

In ASK (Amplitude shift key) amplitude of the carrier wave is varied in accordance with the modulating signal. As shown in figure 4 a digital data 1011010 is to be transmitted which is represented by a modulating signal, after modulating carrier signal according to the data given an ASK modulated signal is generated.

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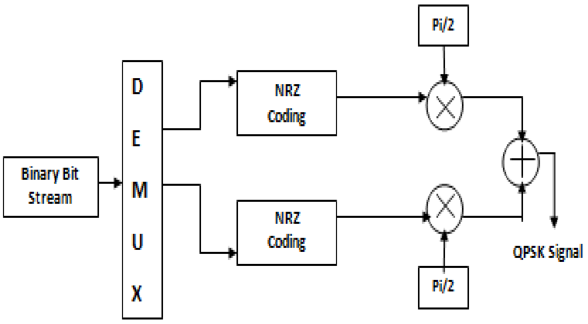

Fig.2 Shows block diagram of QPSK modulation technique with each blocks shown clearly.

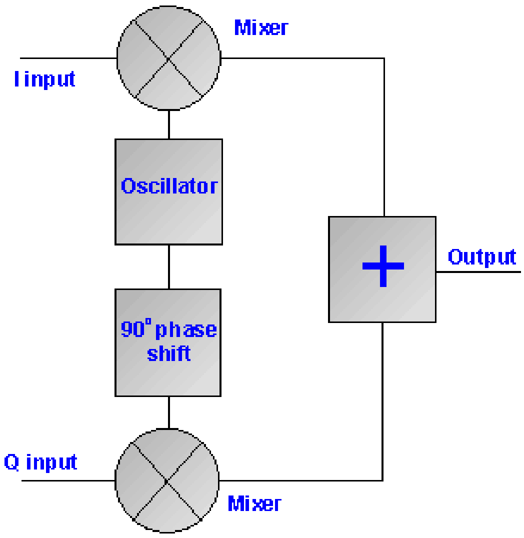

Fig.3 shows block diagram of QAM modulation technique. I and Q inputs individually are mixed with out of phase waves and then are finally added to give output QAM

B. FSK

In FSK (Frequency shift key) frequency of carrier wave is varied in accordance with the modulating signal. Figure 5 shows a carrier wave and a digital data 1011010 which is modulated to give frequency modulated wave.

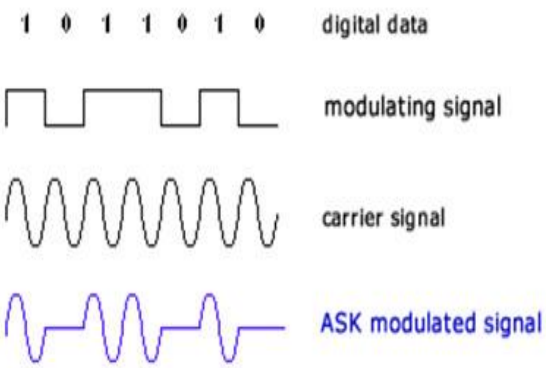

Fig.4 Shows ASK modulation technique in which a digital data 1011010 is to be transmitted using ASK modulation

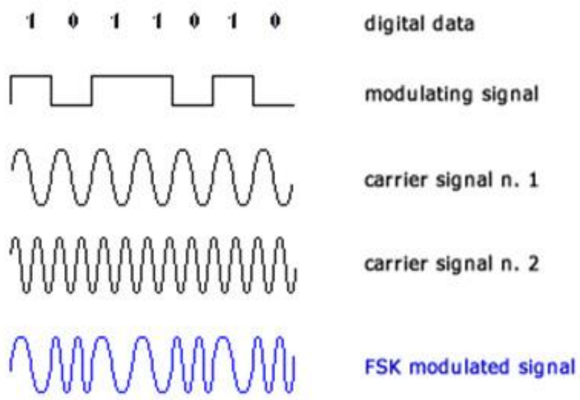

Fig.5 shows FSK modulation technique. A digital data 1011010 is to be transmitted using FSK modulation

C. PSK

In PSK (Phase shift key) phase of the carrier wave is varied in accordance with the modulating signal. Figure 6 shows a signal 1011010 and a carrier signal which after modulation gives a PSK modulated signal. A PSK further includes QPSK, BPSK and DPSK techniques.

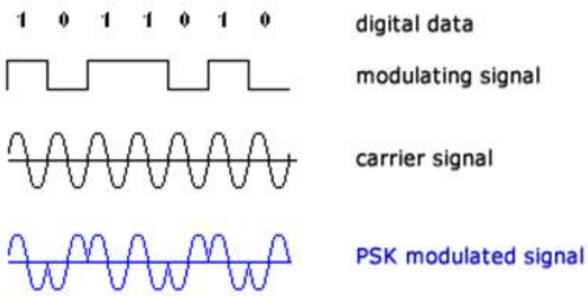

Fig.6 Shows PSK modulation technique. A digital data 1011010 and a carrier signal which after modulation gives a PSK modulated signal.

III. IMPLEMENTING QPSK USING MATLAB

Firstly an integer generator is used to generate random uniformly distributed integer in the range [0, M-1], where m is the M-ary number (Fig 7).

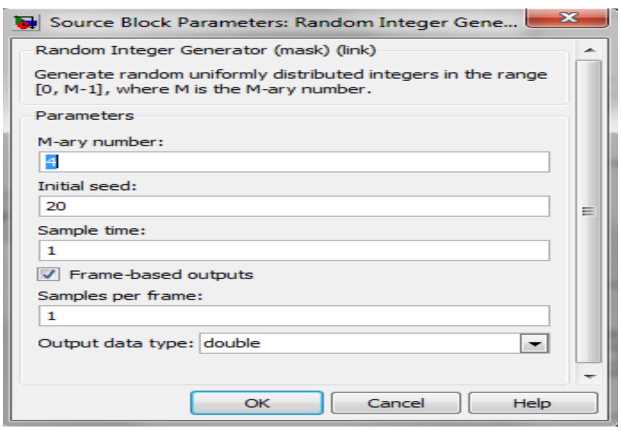

Fig.7 Shows source block parameter of random integer generator with M-ary no and initial speed.

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Output from integer generator gets converted into bit, by integer to bit converter (Fig 8).

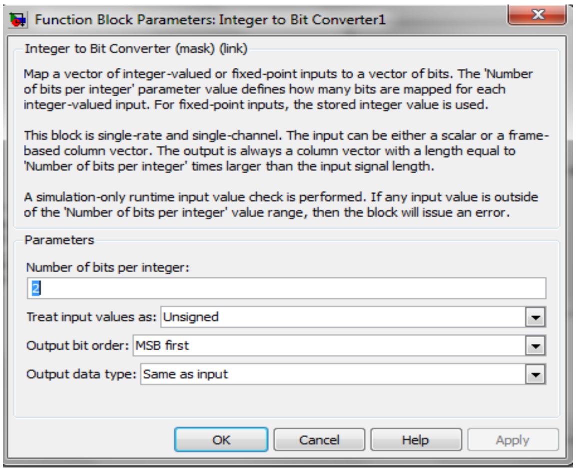

Fig.8 Functional block parameters of integer to bit converter showing number of bits per integer and other parameters.

A demultiplexer convert's single input into multiple output which then goes to NRZ coding with 0.5 constant value. Here we have 2 NRZ coders (fig 9).

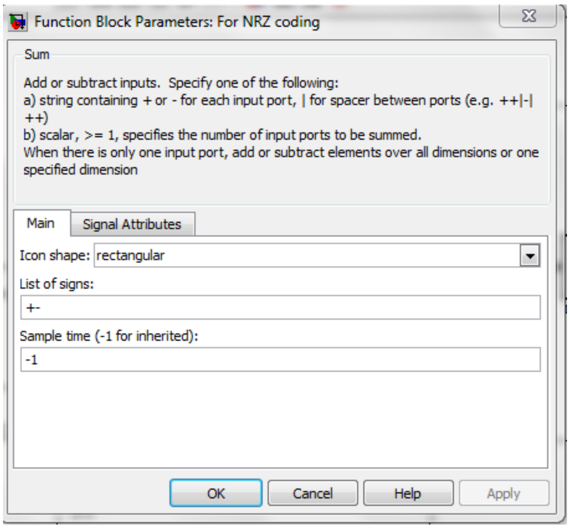

Fig.9 Shows functional block parameters of NRZ coding with sampling time and other parameters.

The output of **NRZ coders** is a real/imaginary image and need to get converted into a complex image. This is done by a real/imaginary to complex converter (fig 10). There after final output can be viewed on a Discrete- time scatter plot.

A **Discrete-time scatter plot** is used to reveal the modulation characteristics, such as pulse shaping or channel distortions of the signal (Fig 13).

Outputs of both the NRZ coders after a phase shift of 0*pi and pi/2 is given to product block and product block 1 respectively, which are then added and can be viewed through scope block (Fig 14).Output of both the NRZ coding blocks can also be viewed through a scope block 2 without a phase shift (Fig 15).

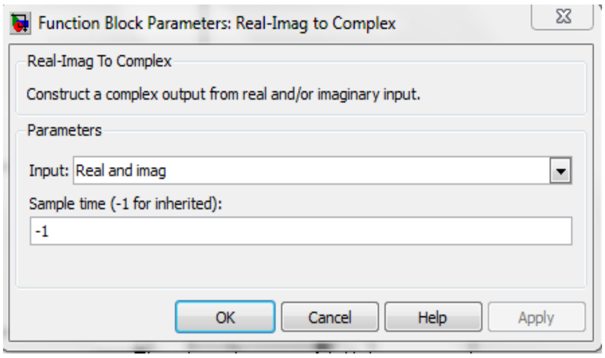

Fig. 10 Shows a real image to complex convertor parameters with input and sampling time

Implementation of QPSK using MATLAB is shown in figure 11.

IV. EXPERIMENTAL RESULTS

The final output is shown in fig 13. Sample per symbol of Discrete-Time Scatter Plot Scope is set to 1.offset is set to 0 and points displayed are 10000. New points per display are 8 (Fig 12).

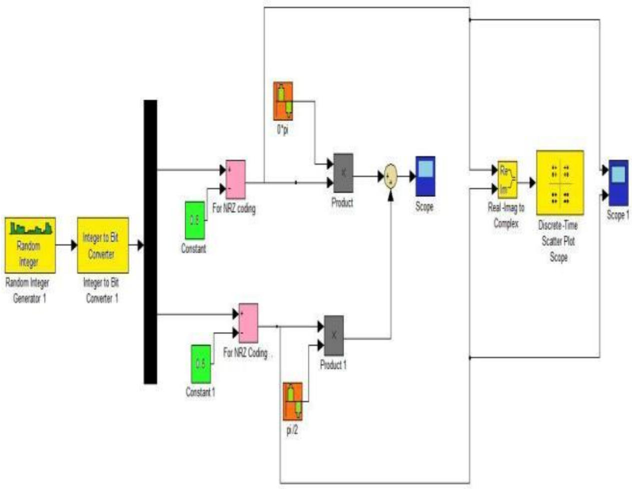

Fig.11 shows implementation of QPSK using MATLAB Simulink. Output signal is plotted on discrete time scatter plot as shown in figure.

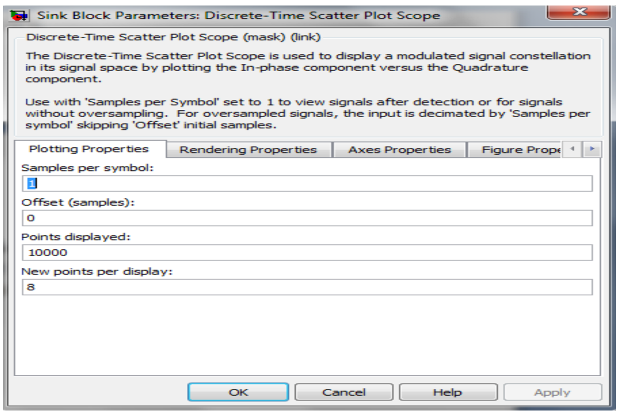

Fig. 12 showing parameters of discrete time scatter plot with points displayed, new points displayed and other parameters shown.

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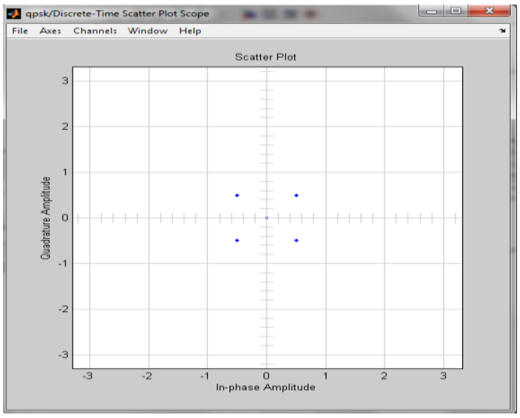

Fig.13 shows Scatter plot of 4 bit QPSK. Discrete plot is plotted between quadrature amplitude and in-phase amplitude as shown in figure. 4 dots represent 4 bits of QPSK modulation.

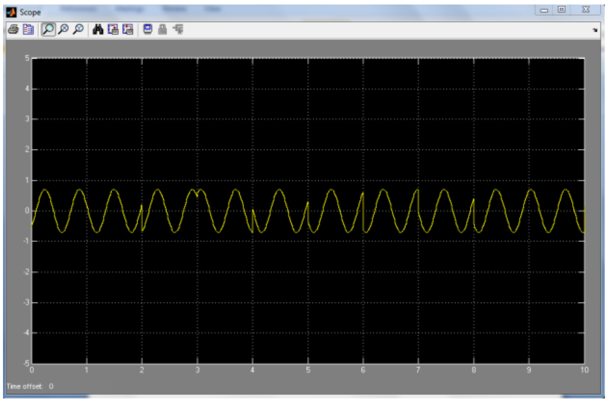

Fig.14 scope output of QPSK which is product of two blocks whose phase is 0 radian and pi/2 respectively with frequency 10 rad/sec and amplitude 1

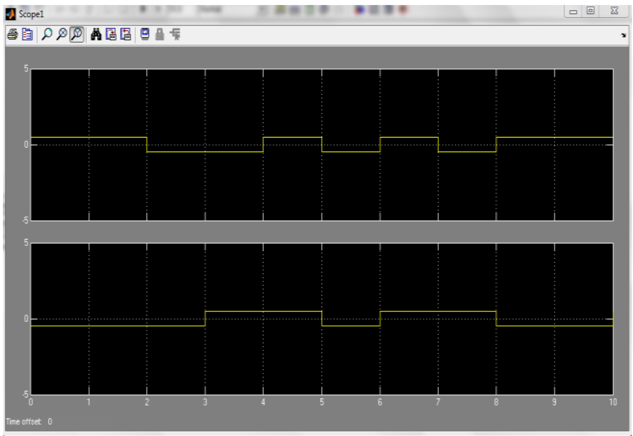

Fig.15 Scope output 1 of QPSK which shows two signals coming from two NRZ blocks.

V. FUTURE WORK

The different modulation technique can be implemented and we can compare the result of all the modulation technique. Also in future we are going to implement the higher modulation techniques such as QAM for 128/256 bit.

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