IJSRD - International Journal for Scientific Research & Development| Vol. 2, Issue 03, 2014 | ISSN (online): 2321-0613

Performance Improvement of Software Radio Networks By Automatically Varying The Modulation Techniques With The Varying Input Noise Level

Dhaivat Shukla[1]
[1]M.E. student
[1]Department of Electronics & Communication
[1]Darshan Institute of Engg. & Tech. (DIET) Gujarat, India Gujarat Technological University (GTU)

Abstract— This paper aims to study and simulate an automatic detection of the change in an input noise level and then the sudden change of different digital modulation techniques in accordance to the change of the noise level by establishing MATLAB/Simulink model for the Noise Level Detection.

I. INTRODUCTION

When we are dealing with wireless Base-Band (or even RF) transmission and reception,we have to deal with a channel noise. This channel noise has few other names like Uniform Random Variable, Additive White Gaussion Noise etc. According to different different environmental conditions, the channel noise level gets affected and that also affects the performance of the communication receiver.

The noise can be internal as well as external. The internal noise generally regarded as an in-circuit noise and the external noise is called channel noise as discussed in above paragraph. The internal noise may have less chances to harm the information signal as compared to external noise.

In this paper, a Uniform Random Source generates a randomly changing amplitude signal, the value of which at a specific time, decides the output modulation schemes to be transmitted ahead. I have used three modulation schemes for this model. Those are ASK, BPSK and QPSK respectively.

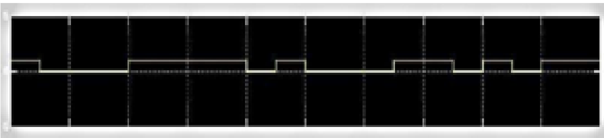

Fig. 1: Ideally received data-bits

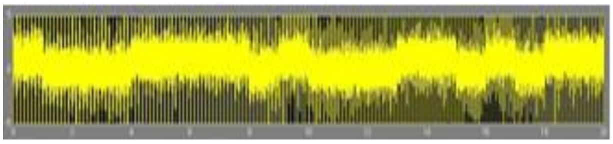

Fig. 2: ASK demodulated noisy data-bits

It is already proved that the ASK is more prone to noise as compared to BPSK, and BPSK is more prone to noise compared to QPSK modulated signal. At the similar noisy environmental conditions, the SNR (Es/No) of ASK signal is worst compared to two others and that of BPSK is worse than QPSK. I am comparing the received data-bits of all three modulation techniques here and getting the BPSK as the Better technique and QPSK as the Best one.

The 4 figures in this section compare the Es/No of all the three signals when Es/No of the input noise signal is given as 30 dB. The first figure describes the original received data-bits i.e. without any noise effect. And other three figures shows us the ASK demodulated, BPSK demodulated and QPSK demodulated data-bits respectively.

Fig. 3: BPSK demodulated noisy data-bits

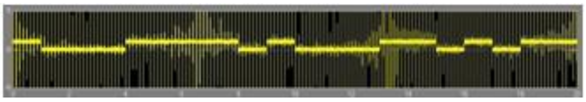

Fig. 4: QPSK demodulated noisy data-bits

the ASK received data-bits where we face problems to separate out which are binary 0s and which are 1s, BPSK and QPSK received waveforms looks a kind of more similar, as we can easily and clearly separate out the values either they are 0s or 1s. But as BPSK having 1 bit/symbol and QPSK with 2 bits/symbol, QPSK is far more better and robust than BPSK when error correcting mechanism comes into the picture.

So, from above figures, it can be concluded that ideal data-bits can be properly or more nearly achieved more with QPSK, then BPSK and it is very much difficult to achieve by ASK modulation/demodulation scheme.

It should be noted here, that the above figures describe the received data-bits at the receiving side of the model not at the transmitting side, and in upcoming sections, I am going to prove the effect of noise signal at the transmitting side of the model.

II. NOISE DETECTION

Then how to detect an input noise signal? A big question. In upcoming paragraphs I would be describing this thing. I would be using a UNIFORM RANDOM NUMBER block as a noise source, which is stayed inside the Sources library of Simulink environment.

Carefully observe the figure 5. The block having RED outlines is the Random Noise Source. The block with BLUE outlines is the Noise Level Detector block. It has given the name as 'Noise Level Method' because, it is used to detect the noise level changing in the input side of the modular blocks. Other blocks in this model are modulation blocks, a mode selection switch, a display block which displays 1,2 or 3 according to the input noise level change and modulation technique selection, and scope for output waveforms' observation.

A. Noise Detection Block

The Noise Detection Block contains 4 Quantizers for fixing and converting the detected floating noise levels to the integer noise levels and also 2 constant blocks and one Add and one Divide block to maintain only three necessary output integer levels (1,2 and 3) at the output port of the Divide block.

Figure 6 describes the detailed subsystem architecture of the Noise Detection Technique. A fixed period clock input signal generates the square wave with duty cycle of 0.5 at every 5 seconds. It means that, by doing this, I want to detect the input noise level at every 5 seconds. The Sample and Hold block samples the input Random Noise signal at every 5 seconds and carry forwards the detected level to the bank of Quantizers, an Adder and a Divider.

B. Modulation Blocks

All the three modulation blocks i.e ASK Mod, BPSK Mod and QPSK Mod takes the input bit-stream from MATLAB workspace with the Variable name called 'Dhaivat'. These all bits are modulated with the fixed frequency of 1 Hz and the modulated output frequency is carry forwarded to the Modulation Scheme Selector block, which functions similar to the conventional Multi-plexer (MUX) which outputs the selected port according to the Selection signal from 'Noise Level Method' block is given to it.

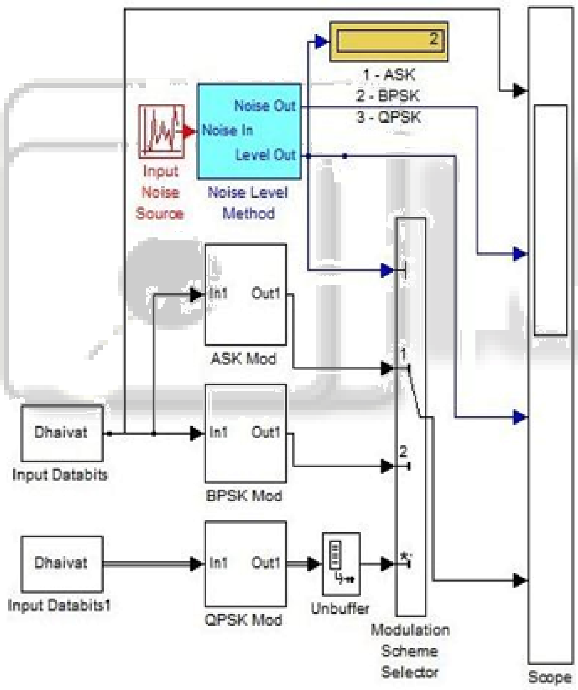

Fig. 5: Complete Simulink Model For The Pre-described Topic

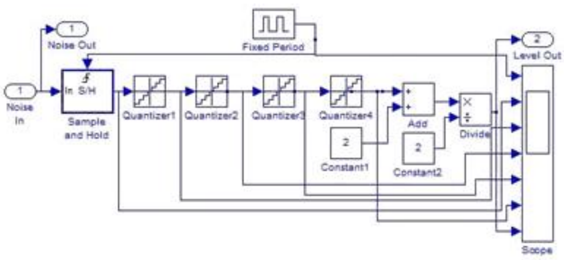

Fig. 6: Noise Level Detection Subsystem Block

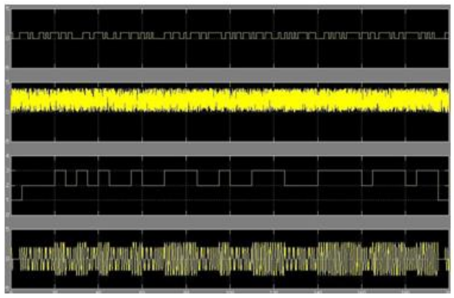

Fig. 7: Changing of Modulation with Changing of Noise Level

III. CHANGE OF MODULATION

Figure 7 describes the output waveforms of the whole model, containing 4 different kinds of waveforms. The first waveform is the input bit-stream from the variable 'Dhaivat'. Second waveform is the input random noise given to the model. Third waveform describes one of the three output noise levels that changes the modulation scheme according to its value. I have given the noise level situated between 1 and 4. The last waveform is the varying output modulation technique of the three modulation techniques.

Noise Level	Modulation Type
1	ASK
2	BPSK
3	QPSK

Fig. 8: Modulation Type Selection

The figure 8 describes the output modulation type that is defined by the current input noise level. In the output waveform 4 of the figure 7 we can observe the change of modulation scheme according to the detected input noise level. It should be noted that, as due to long total observation time-frame (200 seconds) of the scope, BPSK and QPSK waveforms are looking bit similar here. So I have differentiated them by different output amplitudes. We can observe that the QPSK has the slightly higher amplitude level then that of BPSK, so that we can separate each.

IV. CONCLUSION AND FUTURE WORK

In this paper we have studied and simulated the time-wise detection of the input noise signal and changing of modulation scheme according to the currently detected input noise level. The future work can be extended to adding more number of modulation schemes and adding more complex noise sources and detecting the particular levels of noise.

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