Performance Analysis of FHSS Transceiver Model in MATLAB

Pintukumar Yadav[1], Prof.Usha Neelakantan[2]

[1] PG Student, Electronics and Communication, L.D.College of Engineering Ahmedabad, Gujarat, India
[2] Prof. Usha Neelakantan, HOD of E.C. Department, L.D.College of Engineering Ahmedabad, Gujarat, India

---

Abstract - *FHSS is part of spread spectrum technology. FHSS uses Industrial, Scientific and Medical(ISM) frequency band for communication which is license free. FHSS Transceiver model provide secure communication over the path of communication. Its robustness against third party interception is due to use of PN sequence generator .FHSS providing Communication channel here is Additive White Gaussian Noise (AWGN) channel. Transmitted data get received at receiver side and Bit Error Rate (BER) gets checked. BER comparison for different frequency band is also discussed. This Whole model designed and simulated in MATLAB- SIMULINK environment.*

Key Words: Spread Spectrum, FHSS, PN Sequence Generator, AWGN Channel, BER.

1. INTRODUCTION

The spread spectrum communication scheme is based on Shannon Information Theory. Frequency Hopping (FH) communication system is a branch of spread spectrum communication system for its outstanding advantages of strong anti-jamming and anti multi-path fading. It is widely used in military and civilian applications for its excellent performances. The spread spectrum technology has lots of advantages such as anti-jamming, anti multipath fading, anti-capturing, and secret; it is widely used in civil fields and plays a more important part in military fields [1].

Frequency hopping spread spectrum (FHSS) is a transmission technique where the carrier hops from frequency to frequency. Here, The FHSS transceiver is implemented for TDMA system. It uses the PN sequence for hopping from one carrier frequency to other carrier frequency. FHSS uses Industrial, Scientific and Medical(ISM) band, which is divided in several smaller frequency bands [2].

1.1 FHSS

In FHSS systems the spreading code is applied to the frequency domain rather than to the time domain. Therefore, the system hops after a certain amount of time, called dwell time, to another frequency. Important parameters of an FHSS system are the number of channels, the dwell time (T_h) and if the system is a slow hopping or a fast hopping system. A system is considered to be slow hopping if the hopping rate is smaller than the data-rate. When the hopping rate is faster than the data rate the system is called fast hopping. A simplified block diagram of an FHSS system is given in Fig.1.

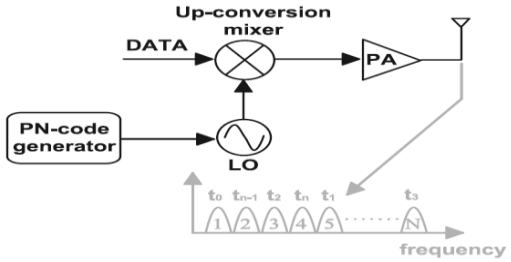

Fig.1: Schematic diagram of FHSS Transmitter

FHSS needs PN synchronization. To successfully recover the transmitted data the receiver needs to hop coherently with the transmitter. Any FHSS is, therefore, a secure system against intentional jammers trying to steal any information [3]. Channel scheme is shown in fig.2.

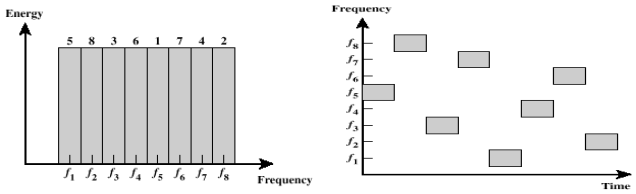

Fig.2: Channel Scheme for FHSS

1.2 Design Flow

Flow diagram for the Transceiver Model is shown in Fig.3.

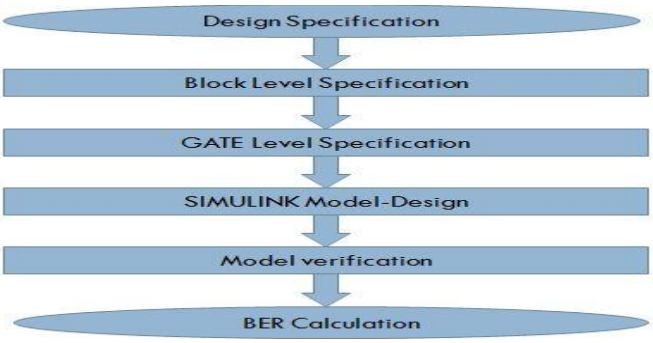

Fig.3: Flow diagram of FHSS Transceiver Model

2. FHSS Transceiver Model

The FHSS SIMULINK model is as show in fig. 4, the input data is generated by using Bernoulli binary generator. The Bernoulli binary generator generates the binary values i.e. 0's and 1's by using the Bernoulli expression. The output of binary generator is encoded by using the cyclic encoder and the form a binary 0's and 1's to a frame in order to make the transmission easier [4]. The binary values are modulated using FSK which uses frequency hopping signal as carrier, then the signal is transmitted over Additive white Gaussian noise (AWGN)channel. And the transmitter output is obtained using FFT scope. At the receiver side synchronization is provided by using same frequency hopping signal and then received frames get disassembled ,cyclic decoder is used to decode the signal, BER is calculated using error calculator and displayed in BER display.

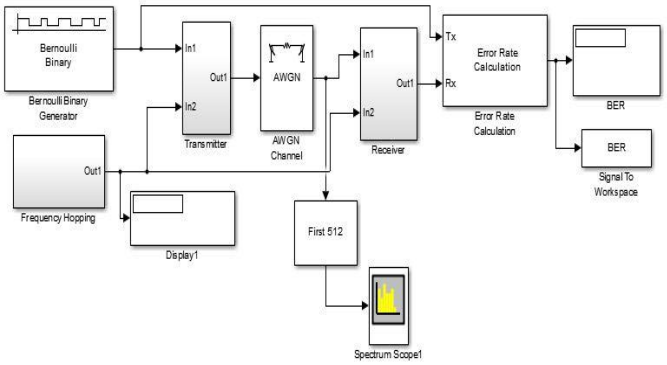

Fig.4: FHSS Transceiver Model

FHSS Transceiver in detail shown below:

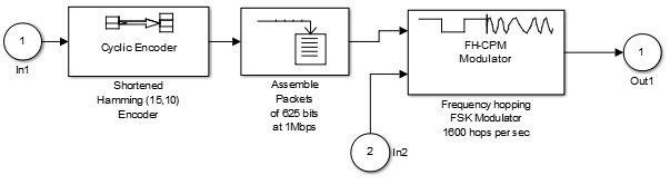

Fig.5: FHSS Transceiver

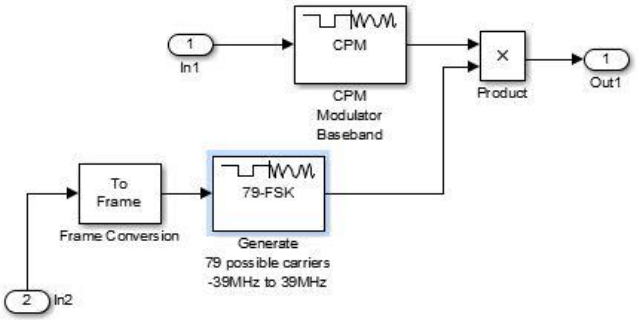

Fig.6: FHSS modulator

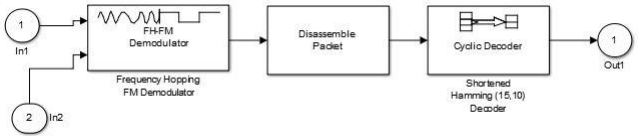

Fig.7: FHSS Receiver

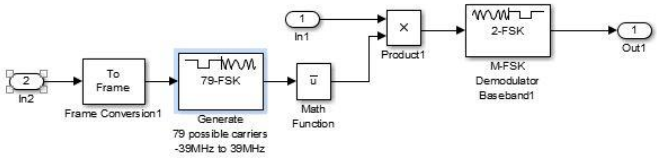

Fig.8: FHSS Demodulator

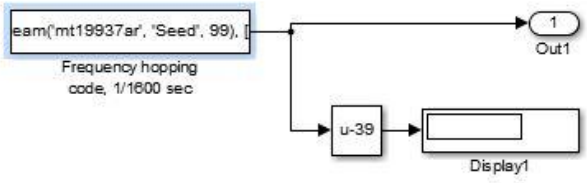

Fig.9: FHSS Frequency Hopping Signal Generator

2.1 Results

FHSS transmitter in presence of AWGN channel shown in Fig.10 below:

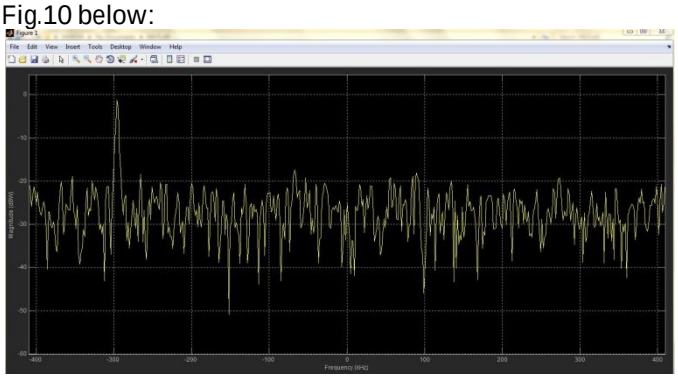

Fig.10: FHSS Transmitter Signal

BER comparison for various frequency range given below:
(a)77 MHz

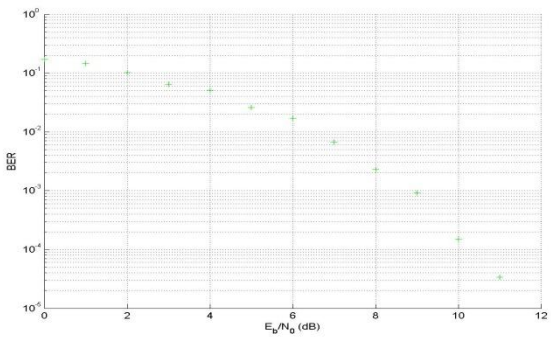

Fig.11: BER versus Eb/No

(b) 78 MHz

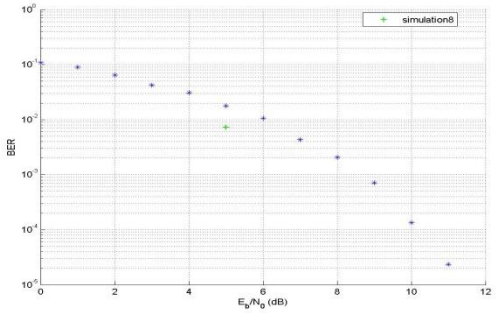

Fig.12: BER versus Eb/No

(c) 79MHz

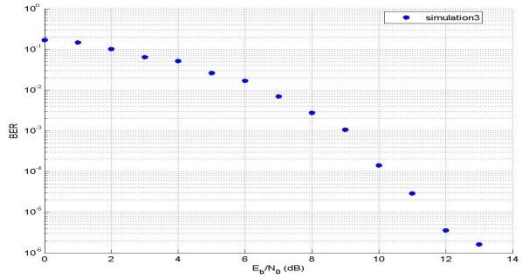

Fig.13: BER versus Eb/No

(d) 80MHz

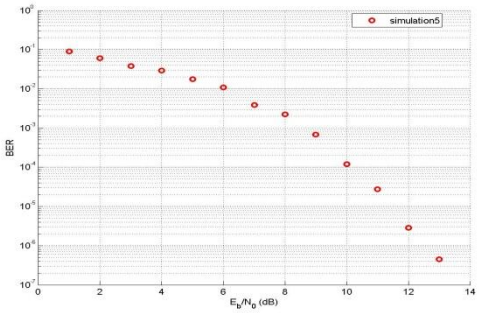

Fig.14: BER versus Eb/No

3. CONCLUSIONS

Here, we implemented Frequency Hopping Transceiver Model in SIMULINK environment. In presence of AWGN channel we analyzed performance of model and calculated BER. We also analyzed BER for different frequency band and from that we can conclude that for the given SNR as we increase frequency range BER get reduced.

REFERENCES

[1] Yu Zhang, Xuehe Zheng, Kuangyi, Qiao, *Modeling and Performance Analysis of Frequency Hopping Spread Spectrum Communication System,* Beijing, China,IEEE,2010.

[2] Mr. Ravi Badiger, *Analysis, Design and Testing of Frequency Hopping Spread Spectrum Transceiver Model Using MATLAB-Simulink.* IJAREEIE. Vol. 3, Issue 2, February 2014.

[3] Dantong Na, *Analysis and Design of Jamming System for Frequency Hopped Communications using BFSK based on Simulink.* US Government work not protected by U.S. copyright.

[4] ZHANG Huaqing, *Design and performance analysis of frequency hopping sequences with given minimum gap,* Beijing, China, IEEE,2010.

BIOGRAPHIES

Mr.Pintukumar Yadav Pursuing M.E.(CSE) form L.D.College of Engineering,Ahmedabad,Gujarat,India

Prof.Usha Neelakantan is Head of Electronics and Communication Department at L.D.College of Engineering,Ahmedabad,Gujarat,India.

