Study of Fast Frequency Hopping Spread Spectrum and Jamming Systems

Er.Nilesh Agrwal, Er.Navendu Nitin**, Manjay Yadav***

**Faculty and *PG Student ECE Department SHIATS-DU Allahabad India 211007
manjayyadav2010@gmail.com

Abstract- Frequency hopping spread spectrum is an efficient technique to combat jamming. . In this paper we analysis the effect of partial band noise jamming in Fast Frequency hopping spread spectrum system. We consider a communication system that transmits MFSK over a channel. The partial band noise interference is model as AWGN Channel using the phase analysis method. We consider (ρ) as a worst case partial band noise fraction and Pb is bit error rate probability for given m and signal to noise ratio.

Index Terms- Frequency hopping spread spectrum, interference, partial band noise, AWGN

I. INTRODUCTION

In frequency hopping spread spectrum the signal is broad cost over a random series of a radio frequency hopping from Frequency to Frequency speech untrue a receiver. A receive hopping between frequency in synchronization with the transmitter, piece of the message signal attain to 'jam'. It is a method of transmitting radio signal by radio rapidly switching a carrier among many frequency channels, using a pseudorandom sequence known to both transmitter and receiver. It is utilized as a multiple access method in the frequency hopping code division multiple access (FH-CDMA) Scheme. In FH-SS, the total available band width of the system is dividing into many smaller bandwidth Pulse guard spaces b/w each band width. Each band width represents channel. Transmitter and receive stay on one of these channel at one time & them hop on to another channel. Larger numbers of frequencies are used in FH-SS system. So that spread spectrum signal band width (WS) is much larger than original signal band width. Jamming is usually defined as a group of hostile communication or intentional interferers that attempt to disrupt the communication of targeted users by transmitting an interfering signal over the same communication range Additive white Gaussian Noise channel is a channel model in which the only impairment to communication is a linear addition of wideband or white noise with a constant spectral density and a Gaussian distribution of a amplitude.

II. SYSTEM MODEL

In the Fast Frequency hopping system the hopping rate is higher then user data rate. Therefore there are many hopes per frequency bit. It is given the block diagram of frequency hopping spread spectrum Transmitter & receiver.

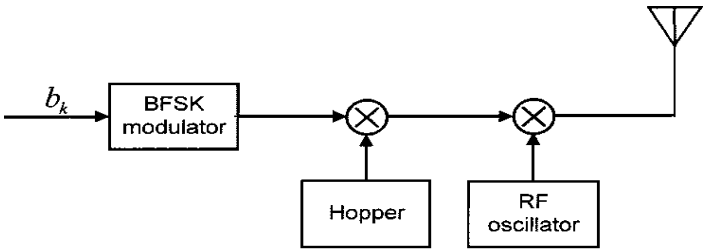

Fig. 1 Frequency hoping transceiver

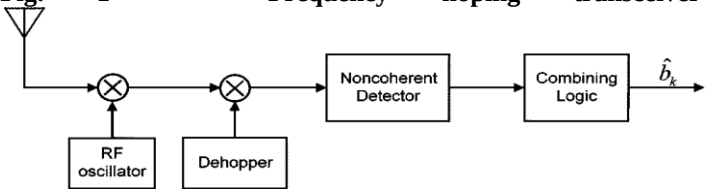

Fig. 2 Frequency hoping receiver

A model of FFH-SS and Jamming system a partial band noise jamming transmits noise over a fraction of the total spread spectrum signal band spread noise of total power J evenly over some frequency range of band width Wj. We define fraction (ρ) [1] as the ratio

$$\rho = \frac{w_j}{W_{ss}} \quad \text{.....(1)}$$

Where ρ is (0,1) which is the fraction of the total spread spectrum band and Ws is a subset the total spread band width.

$$\frac{J}{W_J} = \frac{J}{W_{ss}} - \frac{W_0}{W_J} = N_j IP$$

$$N_J = N_J / P \quad \text{.....(2).(3)}$$

Suppose a Gaussian noise jammer choose to restrict its total power σ to a fraction ρ of the full ss band width Wss .

$$\frac{E_b}{N_t} = \frac{E_b}{N_t} \quad \text{.....(4)}$$

It is assumed in Figure that the jammer hops the jammed band over Wss, relation to the FH dwell time 1/Rh, but often enough to deny the FH system the opportunity to detect that it is being jammed in a specific portion of Wss and take remedial action

$$P_b = \frac{1}{2(M-)}\sum_{i=2}^{M}(-1)^i\binom{M}{i}e-(KpE_b/N_J)(1-1/i) \quad .(5)$$

$$P_b = pP_b\frac{pE_b}{N_J} \quad \text{……..(6)}$$

From equation 4 and 5 the resulting average performance can be expressed as.

$$\max_{0<p\le 1}\left[\frac{p}{2(M-1)}\sum_{i=2}^{M}(-1)^1\binom{M}{i}e^{-(KpE_b/N_J)(1-1/i)}\right] \quad .(7)$$

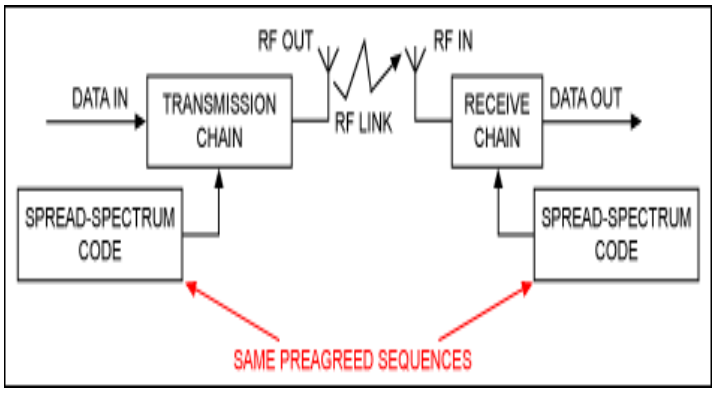

Figure 3: Frequency hopping spread spectrum with jamming.

III. RESULT OF DISTENSION

As mentioned equation that if ρ is reduced, the probability that an m-ary transmission is jammed is decreased. But jammed signals suffer a higher conditional error rate.

Variation of Pb (probability error) with different value of ρ Keeping M= 2

Table 1 Variation of P_b with different values of p.

EB/NJ	ρ =1	EB/Nj	ρ =.6	EB/NJ	ρ =.3
0.25	0.14	0.20	0.17	0.50	0.14
1.60	0.14	1.60	0.14	1.27	0.12
3.19	0.13	3.19	0.11	3.19	0.12
6.37	0.12	6.37	0.10	6.37	0.11
8.01	0.12	8.01	0.09	8.01	0.11
12.70	0.10	12.70	0.07	12.71	0.08
16.00	0.08	16.00	0.06	16.00	0.00

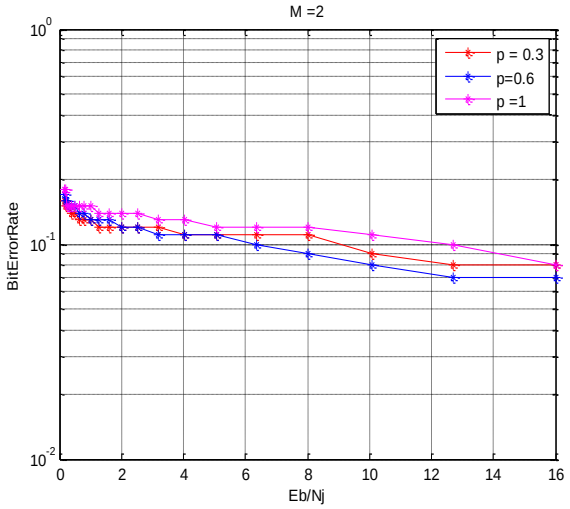

Fig. 4 Performance of FH/BFSK system in partial-band noise for several fixed values of *r* .

Table 2 Variation of P_b with different values of *p* keeping M=4

EB/NJ	ρ =1	EB/Nj	ρ =.6	EB/NJ	ρ =.3
0.25	0.88	0.25	0.84	0.25	0.84
1.60	0.72	1.01	0.76	1.27	0.80
3.19	0.64	5.06	0.76	3.19	0.72
4.01	0.72	4.01	0.68	4.01	0.72
5.06	0.64	6.37	0.68	5.06	0.72
8.01	0.64	8.01	0.68	8.01	0.68
16.00	0.56	16.00	0.68	16.00	0.60

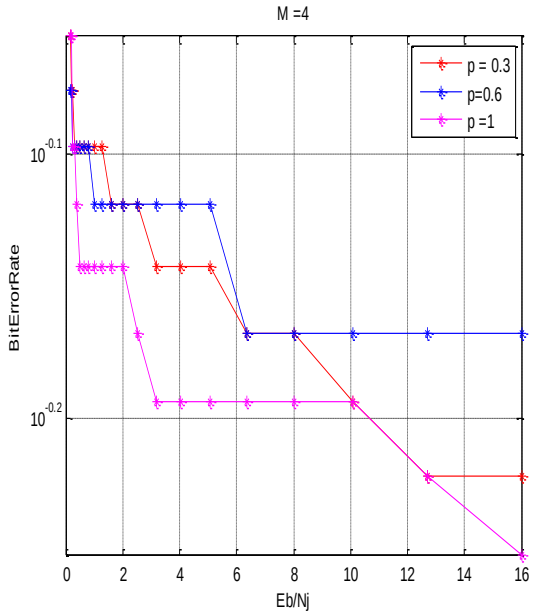

Figure 5: Degradatub in FH/MFSK performance due to worst case, PBNJ with *M=4*

Table 3: Variation of Pb with different values of p keeping m=8

EB/NJ	ρ =1	EB/Nj	ρ =.6	EB/NJ	ρ =.3
0.33	2.20	0.53	2.11	0.268	2.112
1.69	2.11	1.07	2.02	0.358	2.112
2.69	2.11	1.69	2.02	2.686	2.02
5.36	2.11	2.13	2.02	3,381	1.928
6.75	2.02	2.69	1.92	6.746	1.928
8.49	2.02	4.25	1.20	8.492	1.837
21.33	1.84	13.46	1.75	21.333	1.745

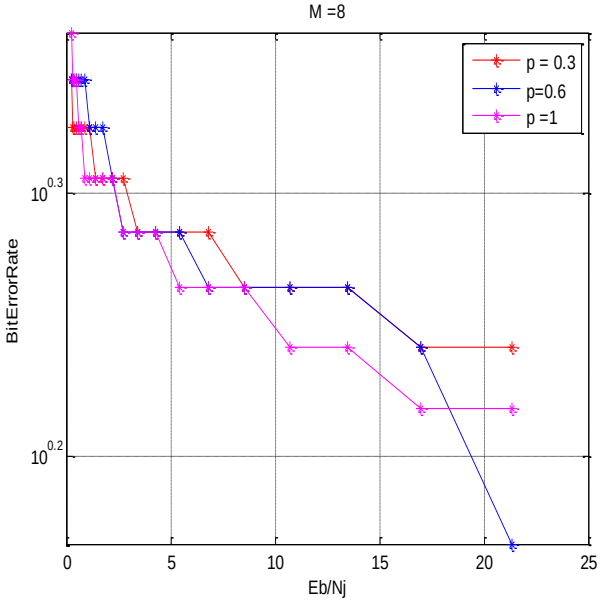

Figure 6 Degradation in FH/MFSK performance due to worst case, PBNJ with *M*=8

Table No. 4 Variation of P_b with different values of *p* keeping M=10

EB/NJ	ρ =1	EB/Nj	ρ =.6	EB/NJ	ρ =.3
0.30	2.788	0.48	2.667	0.76	2.666
0.38	2.667	1.207	2.556	1.20	2.556
1.519	2.667	1.519	2.556	3.817	2.556
3.03	2.556	6.049	2.444	4.805	2.444
6-049	2.444	7.615	2.444	15.19	2.333
15.19	2.333	15.19	2.333	24.06	2.222
24.08	2.11	24.08	2.333		

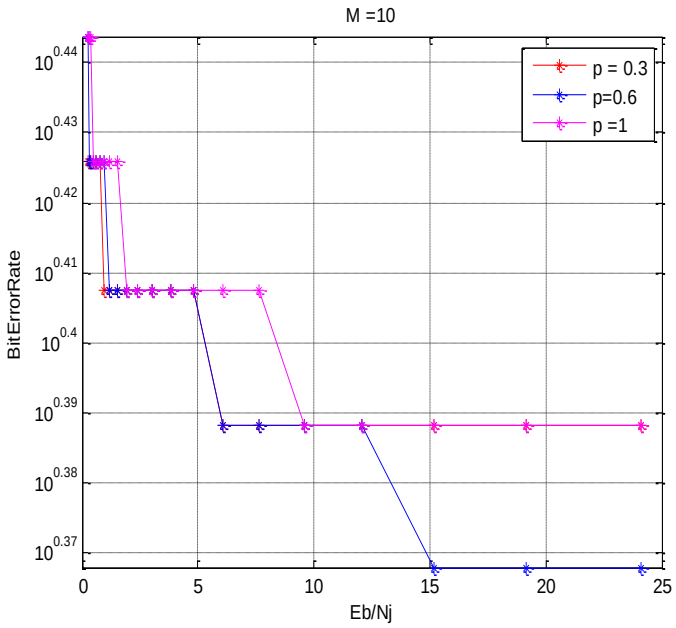

Figure 7 Degradation in FH/MFSK performance due to worst case, PBNJ with M=10

IV. CONCLUSION

This paper provide the study of fast frequency hopping spread spectrum operating in the presence of partial band noise jamming. The result has been presented for several cases. This improves the system performance in all cases. Particular it increases the value ρ of more drastically than it decrease the value of Eb/Nj.

REFERENCES

[1] Hussain S. and Barton S., "Non-Coherent Detection of FSK Signals in the Presence of Oscillator Phase Noise in an AWGN Channel," in Proceedings of the 7th IEE European Conference Mobile Personal Communications, Brighton, Proceedings 387, pp. 95-98, 1993.

[2] Massaro M., "Error Performance of M-ary No coherent FSK in the Presence of CW Tone Interference," IEEE Transactions Commununication, vol. 23, pp. 1367-1369, 1975[3] Husain S. and Barton S., "Non-Coherent Detection of FSK Signals in the Presence of Oscillator Phase Noise in an AWGN Channel," in Proceedings of the 7th IEE European Conference Mobile Personal Communications, Brighton, Proceedings 387, pp. 95-98, 1993.

[3] S. W. Houston, "Modulation Techniques for Communication, Part I: Tone and Noise Jamming Performance of Spread Spectrum M-ary FSK and 2,4-ary DPSK Waveforms," in Proc.IEEE NAECON, 1975, pp. 51-58.

[4] Hussain, S. and Button, S. K.; "Non-coherent Detection of FSK signals in the Resence of Oscillator Phase Noise in an AWGN Channel", Seventh IEE Erumpent Confine on Mobile Personal Comtnunica'ons, (Proc No. 383, Brighton, 13-15 Dec 1993, pp.95-98.