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Original scientific paper

ROBUST COMMUNICATION STRATEGY FOR OVERCOMING NARROWBAND JAMMING IN LOW-FREQUENCY CDMA-DSSS SYSTEM USING MATLAB

Tanajit Manna[1], Arabinda Das[2], Bidrohi Bhattacharjee[3], Shibabrata Mukherjee[2]

[1]Electronics & Communication Engineering Department, Pailan College of Management & Technology, Kolkata, India
[2]Electrical Engineering Department, Jadavpur University, Kolkata, India
[3]Electrical Engineering Department, Indian Institute of Technology (ISM Dhanbad), Dhanbad, Jharkhand, India

ORCID iDs:		
	Tanajit Manna	NA
	Arabinda Das	https://orcid.org/0000-0001-5710-2030
	Bidrohi Bhattacharjee	https://orcid.org/0000-0001-7622-8034
	Shibabrata Mukherjee	https://orcid.org/0000-0002-9561-5504

Abstract. *This work presents a method for efficient communication in the case of a Direct Sequence Spread Spectrum (DSSS) single user system to reduce jamming under restricted band in Code Division Multiple Access (CDMA) systems. Improvement-based, narrowband-frequency communication is in significant demand in the security sector. The research presents an experimental and analytical comparison of the Power Spectral Density (PSD) of CDMA under narrowband frequency with and without jamming situation. An optimal system is shown, backed by the Bit Error Rate (BER) and Signal to Noise Ratio (Eb/N) curve, by varying the signal power and Barker code.We can obtain both jamming-free PSD and low narrowband jamming through experimental variations in signal power. Barker Code-supported variations in the spreading factor show the benefits of the system's optimised model in the case of narrow band jamming. The coding-based MATLAB® platform is used to implement the aforementioned novel approach for the CDMA-DSSS system design, modeling, and performance analysis.*

Key words: *CDMA, DSSS, PSD, BER, MATLAB*

1. INTRODUCTION

The modern DS-CDMA communication system requires optimal performance from both the transmitter and the receiver. This is because the system's benefits in real-time

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Corresponding author: Bidrohi Bhattacharjee
Electrical Engineering Department, Indian Institute of Technology (ISM Dhanbad), Dhanbad, Jharkhand, India
E-mail:onlybidrohi@gmail.com

practical applications are leading to an increase in the system's application areas. Improving the performance of a DSSS-CDMA communication system in the face of a narrowband jamming environment is the aim of modelling. This work has demonstrated unequivocally that altering the signal's power can greatly improve a DSSS-CDMA receiver system's performance against narrowband jamming [1-3]. The optimization approach illustrates the variation of spreading factor with specified security or barker code.

1.1. Related Work

In the DS-CDMA system, jamming minimization in the extremely low frequency bandis a very hard job. Since around 2000, the first blueprint in the relevant sector was the anti-jamming permission in CDMA [1].The implementation of a specific subspace junction model enabled the employment to flourish in the tangible domain [2]. According to the arsenal of uncommitted a specific band [5].The majority of cabalistic work in the near-far field DS-CDMA detection approach [6-8].

2. System Design and Modelling

We presented a MATLAB programming basis modelling and jamming mitigates methodology in this way. We take into account a spreading factor with a given value in order to ingredient the problem. generates a barker code based on the spreading factor model. In order to generate the Barker code, we rely on the following algorithm and formula:component analysis [4][11-16], this research project was critically important in the CDMA sector. Meanwhile, FM technology offered the jamming idea for the abdication of

$$(C_V)^n = \sum N - v + 1_{a_j} + v^n a_{j^n} \tag{1}$$

Where, $(Cv)^n \leq 1$ for all $1 \leq v \leq N+1$.

The autocorrelation function-based equation above. The following model was employed to account for the Barker generation.

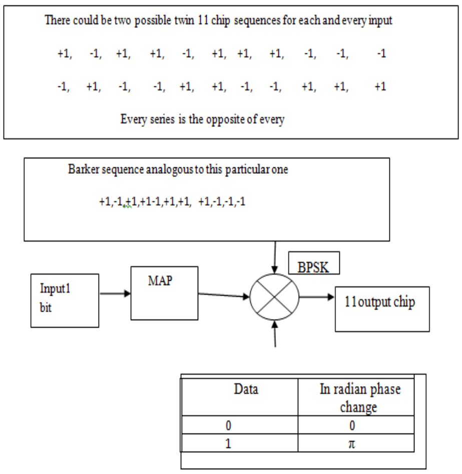

Fig. 1 Barker Code Generation

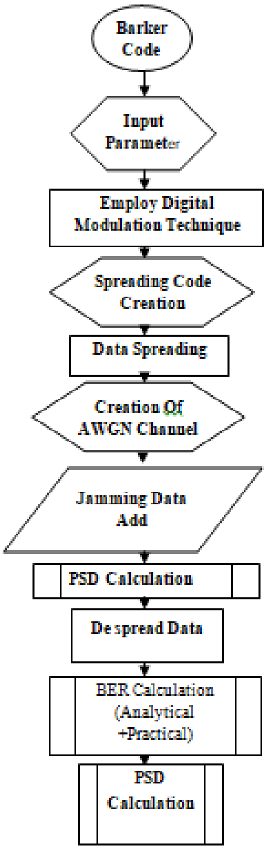

Fig. 2 Algorithm for the suggested model

Following the construction of the barker code, a modulation method such as QPSK is chosen for use. Subsequently, we generate data jamming followed by channel. We disseminate the data based on the spreading code. The proposed system virtually eliminated the noise, and the generation of Additive White Gaussian Noise (AWGN) channel greatly improved the system's noise level. During the detection phase, the signal is dispersed using the same chip. We capture the PSD at the receiver edge in order to assess the jamming amount.

We build the system using the suggested algorithm based on the Barker Code:
In order to reach our objective, compute the bit error rate and power spectrum density as shown below. Our formula for Power Spectral Density was as follows.

$$S_x(f) = \lim_{T \to \infty} \left(\frac{mean[x(f)^2]}{2} \right) \tag{2}$$

T is the time period. In order to program in MATLAB, we must change equation (2) as shown below.

$$S_x(f) = \lim_{T \to \infty} \frac{1}{T} \left(\int \int_{-\frac{T}{2}}^{\frac{T}{2}} C(t_1) C(t_2) mean(n(t_1) n(t_2)) e^{\frac{-j2\Pi f}{(t_1 - t_2)}} dt_1 dt_2 \right. \quad (3)$$

The mean ($n(t)$) product and $C(t)$ are considered as noise in (3). Consequently, the intermediate PSD is handled as noise, increasing the security of both systems. The deterministic signal, $C(t)$, and the Gaussian, $n(t)$, with zero mean, are represented in the equation above.

$$S_x(f) = \lim_{T \to \infty} \left(\frac{mean[x(f)^2}{2} \right)$$

Interpretation of Bit Error Rate[17-22]:

$$P_b = Q\left(\frac{B_{\max}}{2}\right) \quad (4)$$

$$B_{\max} = \sqrt{\left[\frac{2}{N} \int_0^{T_b} [p(t) - q(t)] dt\right]} \quad (5)$$

P_b is used here to represent Bit Error Rate. Difference between p(t) and q(t) describes a filter matched pulse.
Tb stands for time frame.

The application of the Barker code is distinct in the near-far dilemma, while problem solutions through SNR fluctuation are widely recognized.

3 RESULTS AND DISCUSSION

We took into account four different experimental data changes to lessen the jamming. We use 13 as the spreading factor value for all phases. We use a 5dB SIR value for the first section. Figure 3 shows that there is no jamming data in the PSD. Analysis of Fig. 4 shows that jamming reflected between 0 and 2.5 Hz in frequency. Figures 3 and 4 make it evident that a jamming is signaled with a polarity swing from 10^{-1} to 10^{1} for every frequency scaling.

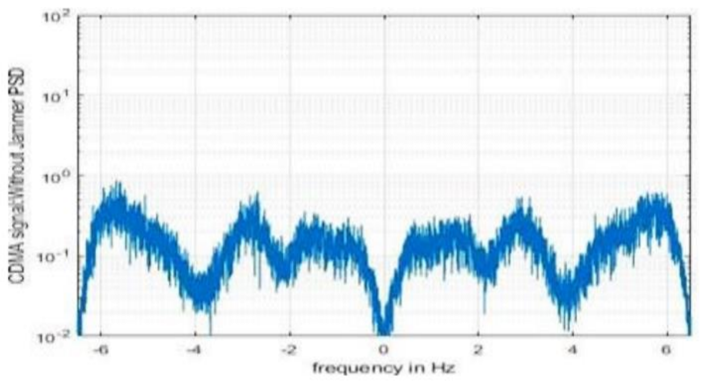

Fig. 3 DS-CDMAPSD with no jamming

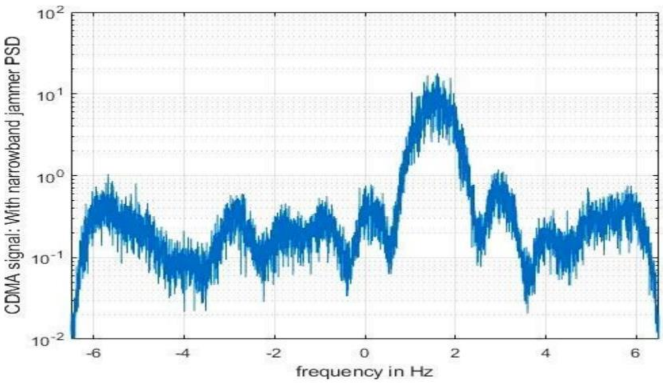

Fig. 4 Jamming PSD in DS-CDMA

As shown in Fig. 5, 13 spreading factor value and 5dB SIR are insufficient to eliminate narrowband jamming. The analytical BER is depicted by a smooth line in Figure 5, and the jamming data is represented by a line with a bubble.

As shown in Fig. 5, 13 spreading factor value and 5dB SNR are insufficient to eliminate

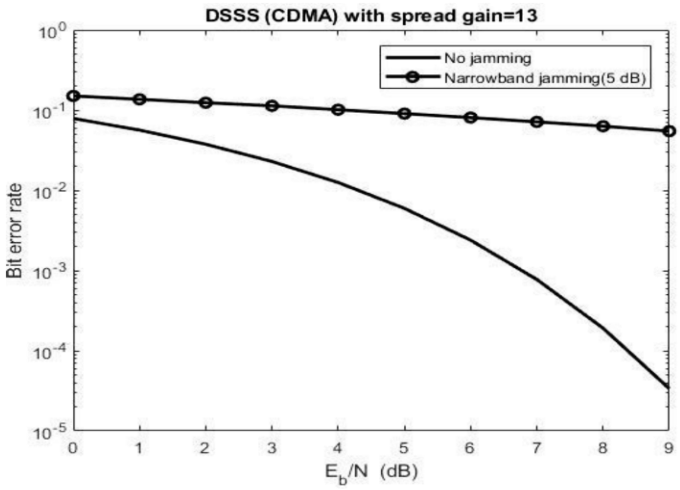

Fig. 5 Bit Error Rate with and without Jamming

Narrowband jamming. Figure 5 shows a line with a bubble representing the BER with jamming data and a smooth line representing the analytical BER.

The signal to interference ratio in the second stage is 8 dB. Results under this scenario are shown in Figures 6, 7, and 8. Figure 6 delimits the jamming notion without any PSD, while Figure 7 delimits the jamming concept with PSD. According to the BER representation, the jamming value decreased in Figure 8. In comparison to Fig. 5, the bit error rate was partially minimized.

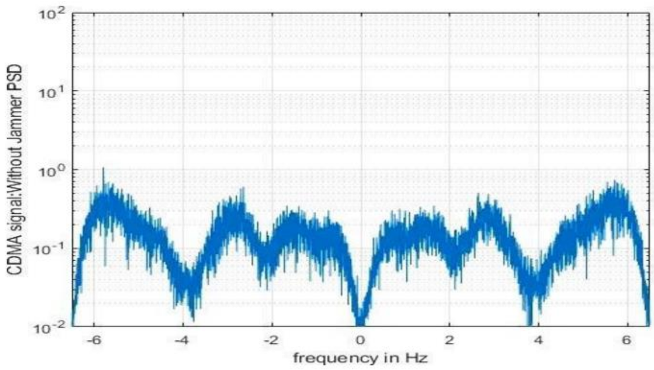

Fig. 6 DS-CDMA PSD without jamming

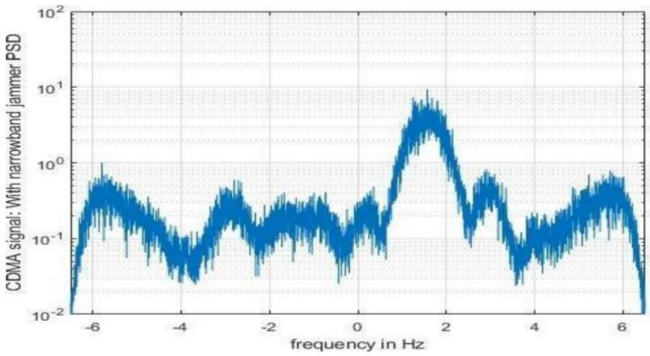

Fig. 7 DS-CDMA PSD with jamming

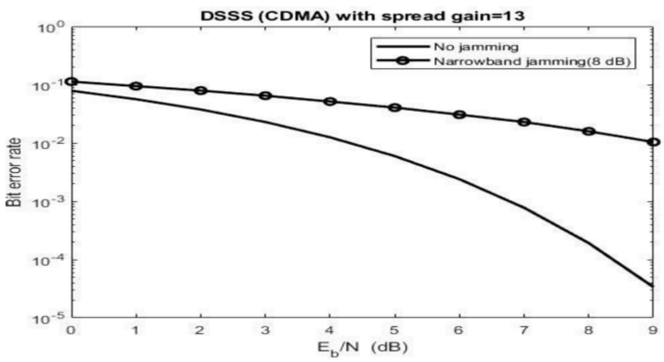

Fig. 8 Bit Error Rate with and without Jamming

Figures 9, 10, and 11 show the findings with a SIR value of 13dB. Figure 9 shows that there is no data jamming. Jamming mitigation was positively represented in Fig. 10. The distortion in the performance is also indicated here by the PSD plot's swing between the positive and negative halves. However, in practice, the distortion varies depending on the resolution. Jamming and non-jamming BERs are clearly closed to one another in Fig. 11.

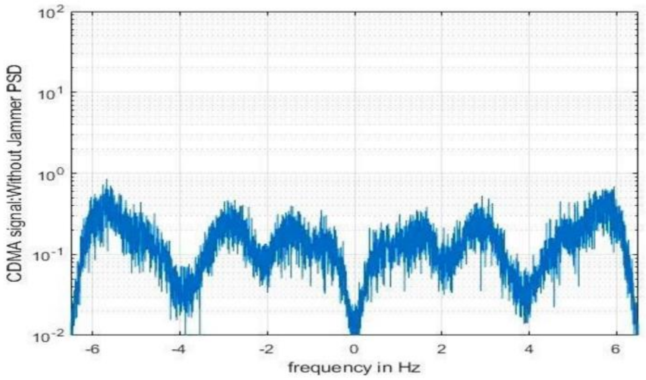

Fig. 9 DS-CDMAPSD without jamming

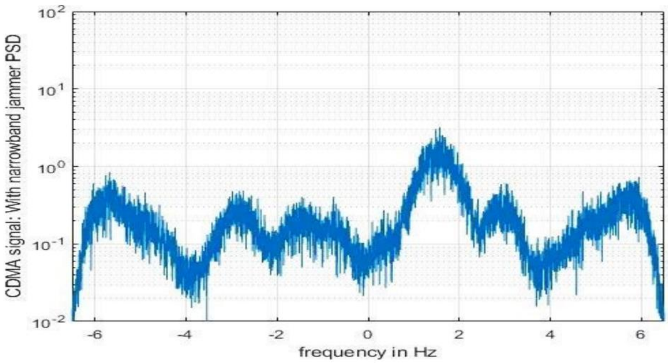

Fig.10 DS-CDMA PSD with jamming

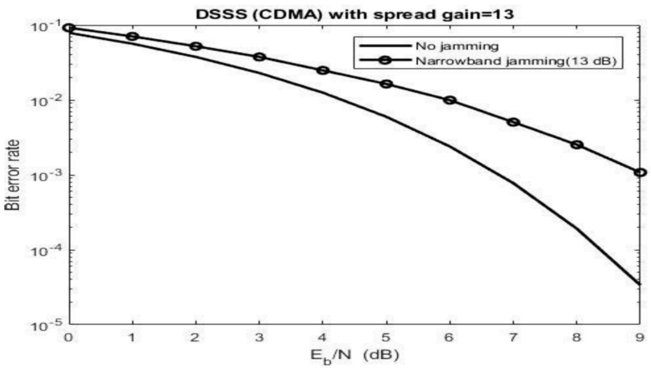

Fig. 11 Bit Error Rate with and without Jamming

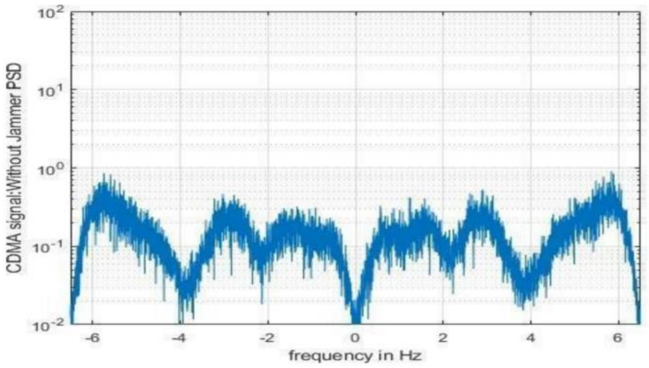

Fig.12 DS-CDMA PSD without jamming

The spreading factor value of 13 and the SIR value of 20 dB are now connected to the figures 12, 13, and 14. Figures 12 and 13 show exactly the same information, showing that all jamming was eliminated in this piece of data. The results were clearly in favor of no jamming, as shown in Fig. 14.

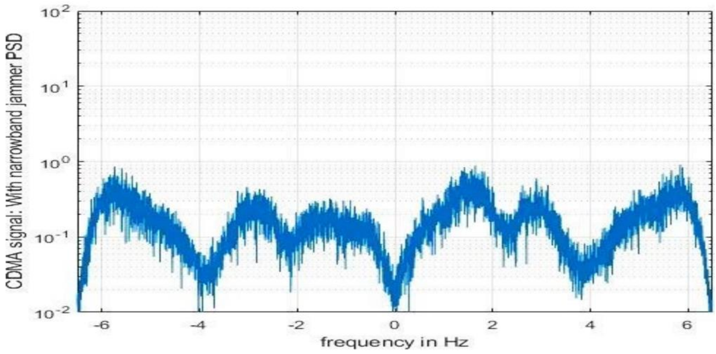

Fig. 13 DS-CDMA PSD with jamming

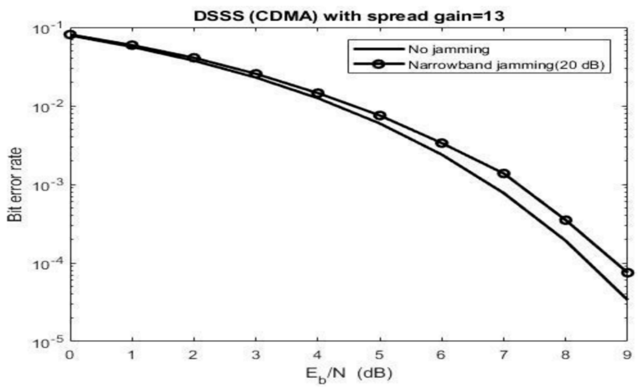

Fig.14 Bit Error Rate with and without Jamming

5. Conclusion & Future Development

We compute every parameter under spreading factor 13 according to Table 1. It is evident that a high SIR yields nearly jam-free PSD at the same spreading factor. However, PSD quality is excellent in low SIR but affected by narrow band jamming. It is determined that distortion results from resolution rather than practical factors based on PSD plots.

Table 1 Parameter Analysis

Performance analysis data					
Spreading Factor	SNR (dB)	Swing Range of Jamming portion of PSD	PSD without jamming	PSD with jamming	BER
13	5	10^{-1}to10^{1}	good	good	10^{-3}
13	8	$10^{-1}$to $10^{0.7}$	good	good	10^{-2}
13	13	10^{-5}to10^{+5}	Merely distorted	Merely distorted	10^{-1}
13	20	Below10^{0}	Merely distorted	Merely distorted	Almost over lapped

The barker code creation process is shown in Fig. 1. Quantum computing has the potential to replace circuit or block development in the future, strengthening the section's security era.

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