SARDAR PATEL INSTITUTE OF TECHNOLOGY

B. Tech.

Department of Electronics and Telecommunication

Semester VII

ETL71: Mobile and Wireless Technology

Faculty in Charge: Prof. Anand Mane

Experiment No. 03

Direct Sequence Spread Spectrum

Name: Rajas Chodankar	**UID: 2018120011**
Batch: A	**Date: 21/09/2021**

Aim: To implement Algorithm for Spread Spectrum Modulation.

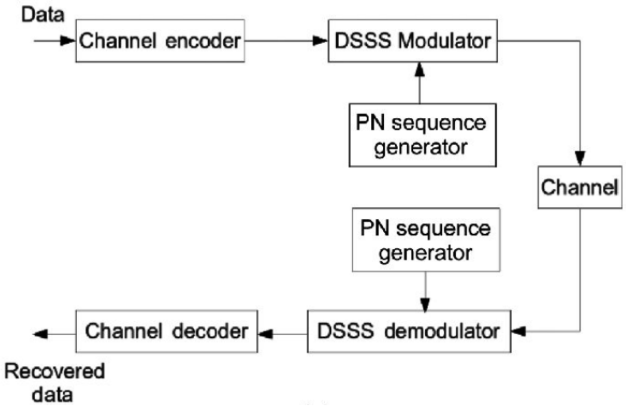
Theory:

1. In telecommunications, the direct-sequence spread spectrum is a spread-spectrum modulation technique primarily used to reduce overall signal interference. The direct-sequence modulation makes the transmitted signal wider in bandwidth than the information bandwidth.
2. DSSS significantly improves protection against interfering (or jamming) signals, especially narrowband and makes the signal less noticeable. It also provides the security of transmission if the code is not known to the public.
3. These reasons make DSSS very popular in the military. In fact, DSSS was first used in the 1940s by the military.
4. When transmitting a DSSS spread spectrum signal, the required data signal is multiplied with what is known as a spreading or chip code data stream. The resulting data stream has a higher data rate than the data itself.
5. Often the data is multiplied using the XOR (exclusive OR) function. Each bit in the spreading sequence is called a chip, and this is much shorter than each information bit. The spreading sequence or chip sequence has the same data rate as the final output from the spreading multiplier. The rate is called the chip rate, and this is often measured in terms of a number of M chips/sec.
6. The baseband data stream is then modulated onto a carrier and in this way, the overall signal is spread over a much wider bandwidth than if the data had been simply modulated onto the carrier. This is because signals with high data rates occupy wider signal bandwidths than those with low data rates.
7. To decode the signal and receive the original data, the CDMA signal is first demodulated from the carrier to reconstitute the high-speed data stream. This is multiplied with the spreading code to regenerate the original data. When this is done, then only the data that was generated with the same spreading code is regenerated, all the other data that is generated from different spreading code streams are ignored.

Benefits of DSSS:

1. It avoids intentional interference such as jamming effectively.
2. It uses both time and frequency planes for transmission of information bits, the effect of interference and fading can be minimized to a great extent.
3. It has the ability to share a single channel among multiple users.
4. It supports a higher coverage range due to the low SNR requirement at the receiver.
5. The performance of the DSSS system in the presence of noise is better.

Block Diagram:



Algorithm:

1) Take input for length of bit sequence
2) Generate random bit sequence of 0's and 1's as original bit sequence
3) Generate random bit sequence of 0's and 1's as pseudorandom bit sequence
4) Find multiplied sequence by taking exclusive OR of original bit sequence and pseudorandom bit sequence.
5) Take input for spread bits
6) Find chip sequence using multiplied sequence and spread bits.
7) Plot BPSK modulation according to chip sequence.

Code:

1) Input and Logic

```
clc
clear all;
len=input("Enter Length of a sequence: ");
input_seq  = randi([0 1],1,len);
fprintf("Input Sequence:");
disp(input_seq);
pn_sig_gen = round(rand(1,len)); % generate random 0 and 1 for the length of input signal
fprintf("Pseudorandom Sequence:")
disp(pn_sig_gen);
total_data = 1:length(input_seq); % 1 to len of input
total_pn = 1:length(pn_sig_gen); % 1 to length of pn
spread_bits = input("Enter spread bits: ");
mul_seq = bitxor(input_seq, pn_sig_gen); % bitwise xor of input and pr sequence
fprintf("Multiplied Sequence:")
disp(mul_seq);
chip = spreading(mul_seq,spread_bits); % chip sequence
fprintf("Chip Sequence:")
disp(chip);
t=0:0.1:2*pi;
carrier_wave = sin(t);
bpsk = [];
for i = 2:length(chip)
    if chip(i) == 1
        bpsk = cat(2, bpsk, carrier_wave); % positive cycle
    else
        bpsk = cat(2, bpsk, -carrier_wave); % negative cycle
    end
    %=[bpsk bpsk1];
end
```

2) Plotting

```
figure(1);
subplot(5,1,1);
stairs([input_seq,input_seq(end)],'linewidth',2);
axis([1 len+5 -2 2]);
title('ORIGINAL BIT SEQUENCE b(t)');
subplot(5,1,2);
stairs([pn_sig_gen,pn_sig_gen(end)],'linewidth',2);
axis([1 length(pn_sig_gen)+5 -2 2]);
title('PSEUDORANDOM BIT SEQUENCE pr_sig(t)');
subplot(5,1,3);
stairs([mul_seq,mul_seq(end)],'linewidth',2);
axis([1 length(mul_seq)+5 -2 2]);
title('MULTIPLIED SIGNAL');
subplot(5,1,4);
stairs([chip,chip(end)],'linewidth',2);
axis([1 length(chip)+5 -2 2]);
title('CHIP SEQUENCE');
subplot(5,1,5);
plot(bpsk);
axis([1 length(bpsk)+5 -2 2]);
title('BPSK SIGNAL');

figure(2);
subplot(2,1,1)
stairs([chip,chip(end)],'linewidth',2);
axis([1 length(chip)+5 -2 2]);
title('CHIP SEQUENCE');
plot(bpsk);
axis([1 length(bpsk)+5 -2 2]);
title('BPSK SIGNAL');
```

3)Spreading Function

```
function cs = spreading(mul,inp)
    cs =[];
    for i = 1:length(mul)
        t = [];
        for j = 1:inp
            t = cat(2, t, mul(i)); % 2 for horizontal concatnation
        end
        cs = cat(2, cs, t);
    end
end
```

Results:

1) Command Window

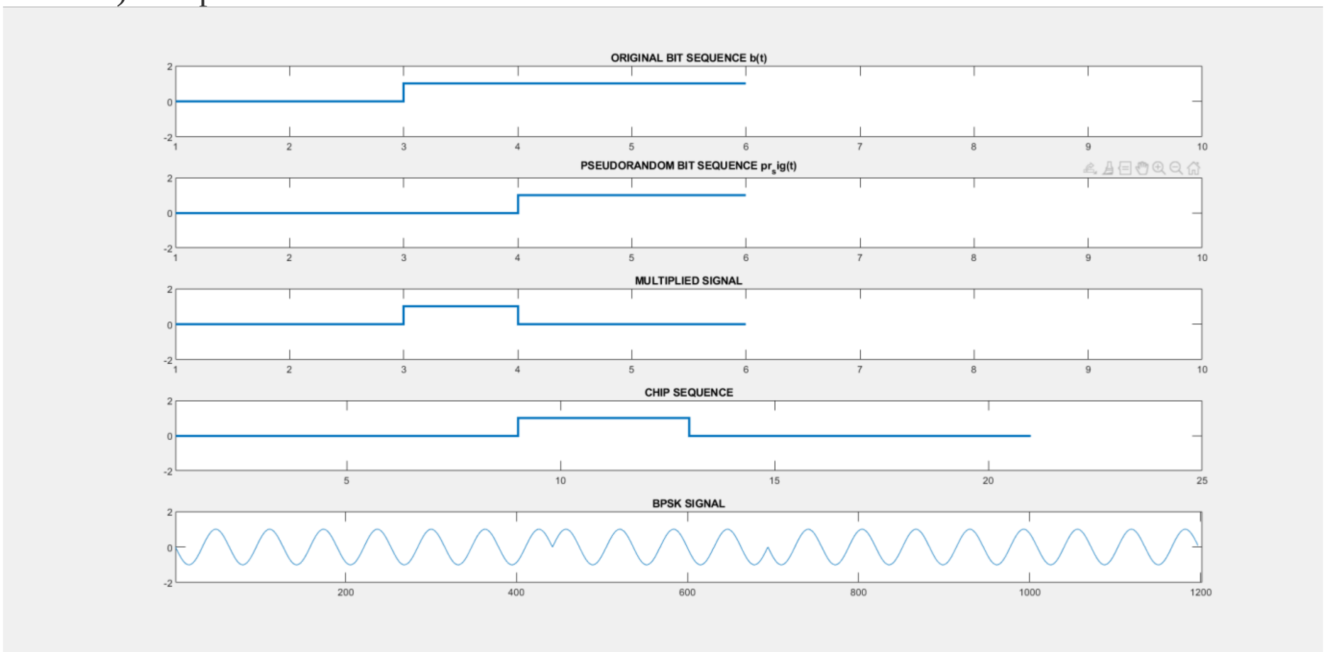
```
Command Window
Enter Length of a sequence: 5
Input Sequence:     0     0     1     1     1

Pseudorandom Sequence:     0     0     0     1     1

Enter spread bits: 4
Multiplied Sequence:     0     0     1     0     0

Chip Sequence:     0     0     0     0     0     0     0     0     1     1     1     1     0     0     0     0     0     0     0     0
```

2) Graph Window



Conclusion:

1) In the Direct Sequence Spread Spectrum (DSSS) modulation technique more bandwidth is occupied by the transmitted signal than the information signal that is being modulated.
2) In DSSS a sine wave is pseudo-randomly phase-modulated with a continuous string of pseudo-noise (PN) code symbols called “chips”.
3) In this experiment, we implemented the DSSS modulation scheme and visualized the modulation scheme with the help of graphs.
4) DSSS is used in various applications such as CDMA cell phone technology, a satellite-based navigation system, etc.