EE 401: DSSS Final Project

This script aims at generating an information signal from intelligent data and transfer the data using DSSS and recreating the data and comparing the original signal to the final signal.
Developers Note:

There was not enough time to create a DSB–LC AM signal that was optimized for digital I/O transmission with minimal data loss. It is not in any calculations or figures.

```matlab
clear all; close all; clc;
format short

% Create DSSS signal
run DSSS_signal_generation;

filt_order = round(length(mod_sig)/3-1);

% Bandlimit the signal

Wn = [50,700]*2/fs;
filter = fir1(filt_order,Wn,'bandpass');
figure('Color',[1 1 1]);
freqz(filter);
xlim([0 fs/2]);
blmod_sig = filtfilt(filter,1,mod_sig);

[X f] = ComputeSpectrum(blmod_sig,fs,2^16);

figure('Color',[1 1 1]);
subplot(2,1,1);
plot(t,blmod_sig,'r');
title('Bandlimited Signal');
ylim([0 2]);
subplot(2,1,2);
plot(f,X,'b');
title('Bandlimited Signal');

% Modulate the signal
fc = 1000; % 1 MHz
[tc Tp] = create_signal(fc,fs,len);
A = abs(max(encode));
carrier = cos(2*pi*tc/Tp);
carrier = carrier(1:length(encode));

A = abs(max(encode));
dsblc_mod_sig = (mod_sig + A).*carrier;

% Create Comparision DSB–LC AM signal

dsblc = (encode + A).*carrier;

[X f] = ComputeSpectrum(dsblc_mod_sig,fs,2^16);

figure('Color',[1 1 1]);
plot(f,X);
```

```
title('DSB-LC Modulate Signal Spectrum');
xlabel('Frequency (Hz)');
ylabel('|X(f)|');
ylim([0 500]);
saveas(gcf,'./images/mod_sig','png');

output = SYNCH_DEMOD(t,dsblc_mod_sig,blmod_sig,carrier,fs,700,50,1000,filt_order);

% Receive the signal and analyze it for errors

info_sig = Despread(t,output,prbn,encode,bitres,true);

% message = binaryVectorToASCII(info_sig);

% Generate DSB-LC AM signal for comparision

run AWGN;

run Jamming
```

```
The standard error was 1110 bits or 14.9515 percent
AWGN_DSSS with Noise at 1
The standard error was 1522 bits or 20.5011 percent
AWGN_DSSS with Noise at 2
The standard error was 2099 bits or 28.2732 percent
AWGN_DSSS with Noise at 3
The standard error was 2556 bits or 34.4289 percent
AWGN_DSSS with Noise at 4
The standard error was 2856 bits or 38.4698 percent
AWGN_DSSS with Noise at 5
The standard error was 3027 bits or 40.7732 percent
The standard error was 1381 bits or 18.6018 percent
```

AWGN

Synchronous Detection Signal

Synchronous Detection Signal Spectrum

100	200	300	400	500	600	700	800	900	1000

Frequency (Hz)

Magnitude (dB)

Normalized Frequency (×π rad/sample)

Phase (degrees)

Normalized Frequency (×π rad/sample)

Filtered Synchronous Detection Signal

Amplitude

Time (sec)

Filtered Synchronous Detection Signal Spectrum

Amplitude

Frequency (Hz)

Comparison of Two Signals

○ Demod
— Original

Frequency (Hz)

Comparison of Two Signals

Amplitude

○ Demod
— Original

Time (sec)

Comparison of Two Signals in the Frequency Domain

Amplitude

○ Demod
— Original

Frequency (Hz)

Compare Output Signal

Compare Output Signal

Information Signal

Synchronous Detection Signal

Synchronous Detection Signal

Synchronous Detection Signal Spectrum

Filtered Synchronous Detection Signal

Normalized Frequency (×π rad/sample)

Filtered Synchronous Detection Signal

Filtered Synchronous Detection Signal Spectrum

Comparison of Two Signals

Comparison of Two Signals in the Frequency Domain

Time (μ s)

Information Signal

Synchronous Detection Signal

Amplitude

Time (sec)

Synchronous Detection Signal Spectrum

Amplitude

Frequency (Hz)

Magnitude (dB)

Frequency (Hz)

Filtered Synchronous Detection Signal

Filtered Synchronous Detection Signal Spectrum

Comparison of Two Signals

Frequency (Hz)

Comparison of Two Signals

Comparison of Two Signals in the Frequency Domain

Compare Output Signal

Frequency (Hz)

Compare Output Signal

Amplitude

5
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0

0   0.2   0.4   0.6   0.8   1   1.2   1.4   1.6   1.8   2

Time (μ s)

Information Signal

2
1.8
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0

0   100   200   300   400   500   600   700   800   900   1000

Synchronous Detection Signal

6

4

2

0

Amplitude

Synchronous Detection Signal

Synchronous Detection Signal Spectrum

Filtered Synchronous Detection Signal

Normalized Frequency (×π rad/sample)

Filtered Synchronous Detection Signal

Filtered Synchronous Detection Signal Spectrum

Frequency (Hz)

Comparison of Two Signals

○ Demod
— Original

Comparison of Two Signals in the Frequency Domain

○ Demod
— Original

Time (μ s)

Information Signal

Synchronous Detection Signal

Amplitude

Time (sec)

Synchronous Detection Signal Spectrum

Amplitude

Frequency (Hz)

agnitude (dB)

Frequency (Hz)

Filtered Synchronous Detection Signal

Filtered Synchronous Detection Signal Spectrum

Comparison of Two Signals

Frequency (Hz)

Comparison of Two Signals

Time (sec)

Comparison of Two Signals in the Frequency Domain

Amplitude

Frequency (Hz)

Compare Output Signal

Frequency (Hz)

Compare Output Signal

Time (μ s)

DSSS Demoluated w/ SNR of 1

Time (s)

DSSS Demoluated w/ SNR of 2

Time (s)

DSSS Demoluated w/ SNR of 3

Time (s)

DSSS Demoluated w/ SNR of 4

Time (s)

DSSS Demoluated w/ SNR of 5

Time (s)

DSSS Signal with Jamming

Frequency(Hz)

Magnitude (dB)

Normalized Frequency (×π rad/sample)

Phase (degrees)

Normalized Frequency (×π rad/sample)

Filtered Synchronous Detection Signal

Amplitude

Time (sec)

Filtered Synchronous Detection Signal Spectrum

Amplitude

Frequency(Hz)

Comparison of Two Signals

○ Demod
— Original

100   200   300   400   500   600   700   800   900   1000
Frequency (Hz)

Comparison of Two Signals

Comparison of Two Signals in the Frequency Domain

Compare Output Signal

Compare Output Signal

Information Signal