Introduction to Communication Systems

ASSIGNMENT 1
MODULATION

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Introduction

Frequency modulation (FM) is the encoding of information in a carrier wave by varying the instantaneous frequency of the wave. The technology is used in telecommunications, radio broadcasting, signal processing, and computing.

The carrier is higher in frequency than the modulation signal. The purpose of modulation is to impress the information on the carrier wave, which is used to carry the information to another location. The modulated carrier is transmitted through space as a radio wave to a radio receiver. At the destination end, the carrier signal is demodulated to extract the information bearing modulation signal.

Assignment

- Using the **modulate ()** function, generate the frequency modulated output. Following inputs to be considered

- Carrier frequency Fc = 10KHz

- Sampling Frequency Fs = 23KHz

- Modulating signal frequency Fm = 500Hz

- Modulation Index =10

  Plot the Modulating signal and the modulated signal in time domain

Formulas used

$$y(t) = A_c \cos\left(2\pi f_c t + \frac{f_\Delta}{f_m} \sin(2\pi f_m t)\right)$$
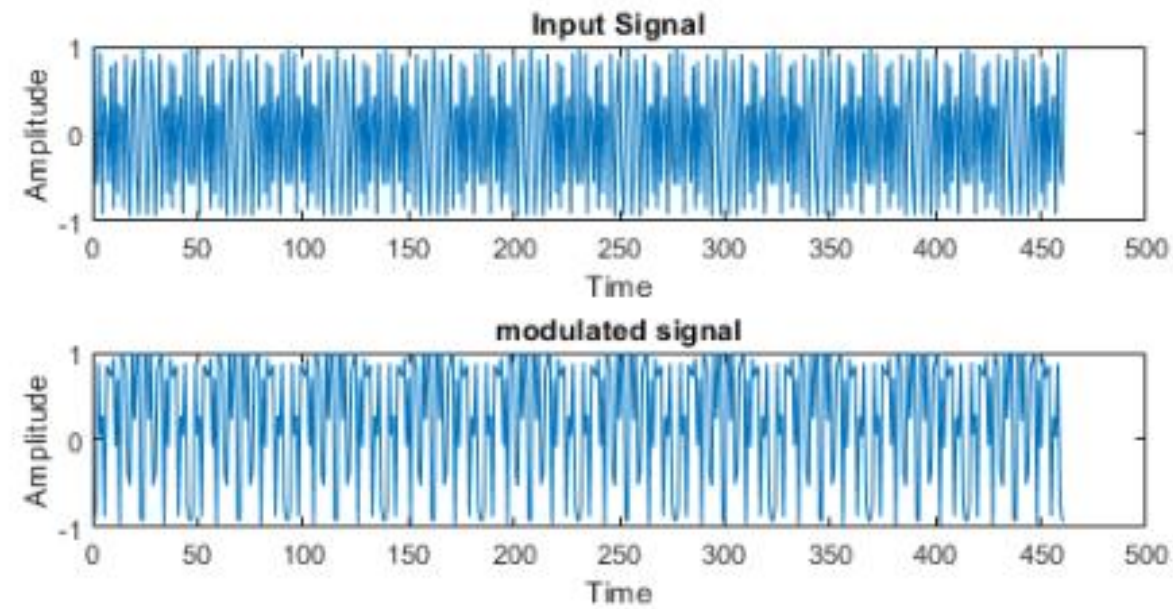
```
t = (0:1/fs:0.02)';
```

```
y = modulate(x,fc,fs,'fm')
```

Code

```
fc=10000;

fs=23000;

fm=500;

MI=10;

t = (0:1/fs:0.02)';

x=cos(2*pi*fc*t+MI*sin(2*pi*fm*t));

y = modulate(x,fc,fs,'fm')


subplot(3,1,1)

plot(x);

title('Input Signal')

xlabel('Time');

ylabel('Amplitude')

subplot(3,1,2)

plot(y);

title('modulated signal')

xlabel('Time');

ylabel('Amplitude')
```

Output

Input Signal

modulated signal

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ASSIGNMENT 2
DIGITAL MODULATION

Introduction

On–off keying (OOK) denotes the simplest form of amplitude-shift keying (ASK) modulation that represents digital data as the presence or absence of a carrier wave.

Presence of a carrier for a specific duration represents a binary one, while its absence for the same duration represents a binary zero.

On–off keying is most commonly used to transmit Morse code over radio frequencies

Assignment-II

Write a MATLAB script for Binary ON-OFF shift keying modulation.

• Consider the sinusoidal carrier frequency of 5KHz.

• An 8-bit random binary bit pattern as the base band modulating signal.

• Display the modulated signal and the information bit pattern

Formulas used

ec=sin(2*pi*fc*t)

b=mod(randperm(8),2)

```
for i=1:length(b)
    ook=[ook, b(i)*ec];
    bin=[bin, b(i)*ones(1,50)];
end
```

Code

```
 1 -     clear all;
 2 -     clf;
 3 -     fc=5000;
 4 -     t=linspace(0,1/5000,50);
 5 -     ec=sin(2*pi*fc*t);
 6 -     b=mod(randperm(8),2)
 7 -     n=['The binary data is\t' num2str(b)];
 8 -     n1=num2str(b)
 9 -     ook=[];
10 -     bin=[];
11 -  ┌ for i=1:length(b)
12 -  │      ook=[ook, b(i)*ec];
13 -  │      bin=[bin, b(i)*ones(1,50)];
14 -  └ end
15 -     tm=[0:length(ook)-1];
16 -     plot(tm,bin,'b--');
17 -     axis([-5 length(bin)+10 0 2]);
18 -     hold on;
19 -     plot(tm,ook,'r');
20 -     axis([-5 length(tm)+10 -2 2]);
21 -     text(150,-1.5,n1);
22 -     hold off;
23 -     xlabel('Time index');
24 -     ylabel('Amplitude');
25
26 -     legend('Random binary','OOK output');
27 -     title('Simulation of On-Off keying');
28
```