KIE2002-LAB 4 SEM 4 2026/2027

EXPERIMENT CM9: DIGITAL MODULATION USING MATLAB

Related course: KIE2008 (Communication System)

OBJECTIVES:

1. To study digitally modulated signals using ASK, PSK, and FSK using MATLAB
2. To construct their constellation diagrams, baseband and passband forms

EQUIPMENT:

PC with MATLAB 2017a/b and after

INSTRUCTIONS:

1. Follow the procedure in this lab sheet
2. Copy all results into a Word document
3. Every student must submit the experiment results (in Word) and the simulation files (in MATLAB) to the lab course Spectrum before end of the experiment week

REFERENCES:

John G. Proakis, Masoud Salehi, “Fundamental of Communication Systems”, 2nd Ed., Prentice Hall, 2014

INTRODUCTION:

Digital modulation typically aims to transport digital data between two or more nodes. In radio communications this is usually achieved by adjusting a physical characteristic of a sinusoidal carrier, either the frequency, phase, amplitude. This is performed in real systems with a modulator at the transmitting end to impose the physical change to the carrier and a demodulator at the receiving end to detect the resultant modulation on reception. In this experiment, we will investigate three types of digital modulation schemes, namely Amplitude Shift Keying (ASK), Frequency Shift Keying (FSK) and Phase Shift Keying (PSK).

PROCEDURE:

1. Open a Matlab script and type the Matlab code given below.
2. Examine and then run the file.

   (Q1) Explain the code used for ASK, FSK and PSK by giving the equation.

   (Q2) For each modulation methods, identify the key parameters that affect the modulation and repeat the experiments by varying the value of these parameters.
3. Record the modulation results.

   (Q3) Analyse the results.
4. Confirm that the demodulation results are correct.

   (Q4) Explain the code used for demodulation.
5. Change the line x = [1 0 1 1 0 0 1]; to x = [1 1 0 1 0 1 0]; and repeat the whole experiment.
6. Include in your lab report, the general comments and a description of what you have learned from this experiment.

MATLAB CODE:

```
% Experiment CM9
% Prepared by Assoc. Prof. Ir. Dr. Chow Chee Onn
clc; clear all; close all

%Binary Information & Bit Period
x=[1 0 1 1 0 0 1];
bp=0.000001;
bit=[];
for n=1:1:length(x)
   if x(n)==1;
     se=ones(1,100);
   else x(n)==0;
      se=zeros(1,100);
   end
    bit=[bit se];
end

%Some common parameters
A=5;
br=1/bp;
f=br*10;
t2=bp/99:bp/99:bp;
ss=length(t2);

%ASK
A1=A;
A2=0.5*A;
m1=[];
for (i=1:1:length(x))
   if (x(i)==1)
      y=A1*cos(2*pi*f*t2);
   else
      y=A2*cos(2*pi*f*t2);
   end
   m1=[m1 y];
end

%FSK
f1=f;
f2=0.5*f;
m2=[];
for (i=1:1:length(x))
   if (x(i)==1)
      y=A*cos(2*pi*f1*t2);
   else
      y=A*cos(2*pi*f2*t2);
   end
   m2=[m2 y];
end
```

```
%PSK
m3=[];
for (i=1:1:length(x))
   if (x(i)==1)
      y=A*cos(2*pi*f*t2);
   else
      y=A*cos(2*pi*f*t2+pi);
   end
   m3=[m3 y];
end

%plot
t1=bp/100:bp/100:100*length(x)*(bp/100);
figure;
subplot(4,1,1);
plot(t1,bit,'lineWidth',2.5);grid on;
axis([ 0 bp*length(x) -.5 1.5]);
ylabel('amplitude(volt)');
xlabel('time(sec)');
title('transmitting information as digital signal');

t3=bp/99:bp/99:bp*length(x);
subplot(4,1,2);
plot(t3,m1);
xlabel('time(sec)');
ylabel('amplitude(volt)');
title('waveform for binary ASK modulation');

subplot(4,1,3);
plot(t3,m2);
xlabel('time(sec)');
ylabel('amplitude(volt)');
title('waveform for binary FSK modulation');

subplot(4,1,4);
plot(t3,m3);
xlabel('time(sec)');
ylabel('amplitude(volt)');
title('waveform for binary PSK modulation');
```

```
%Demodulation
%ASK
mn1=[];
for n=ss:ss:length(m1)
 t=bp/99:bp/99:bp;
 y=cos(2*pi*f*t);
 mm=y.*m1((n-(ss-1)):n);
 t4=bp/99:bp/99:bp;
 z=trapz(t4,mm);
 zz=round((2*z/bp));
 if(zz>(A1+A2)/2)
  a=1;
 else
  a=0;
 end
 mn1=[mn1 a];
end
disp('(ASK)Binary information at Reciver :');
disp(mn1);

%FSK
mn2=[];
for n=ss:ss:length(m2)
 t=bp/99:bp/99:bp;
 y1=cos(2*pi*f1*t);
 y2=cos(2*pi*f2*t);
 mm=y1.*m2((n-(ss-1)):n);
 mmm=y2.*m2((n-(ss-1)):n);
 t4=bp/99:bp/99:bp;
 z1=trapz(t4,mm);
 z2=trapz(t4,mmm);
 zz1=round(2*z1/bp);
 zz2= round(2*z2/bp);
 if(zz1>A/2)
  a=1;
 else(zz2>A/2)
  a=0;
 end
 mn2=[mn2 a];
end
disp('(FSK)Binary information at Reciver :');
disp(mn2);
```

```
%PSK
mn3=[];
for n=ss:ss:length(m3)
 t=bp/99:bp/99:bp;
 y=cos(2*pi*f*t);
 mm=y.*m3((n-(ss-1)):n);
 t4=bp/99:bp/99:bp;
 z=trapz(t4,mm);
 zz=round((2*z/bp));
 if(zz>0)
  a=1;
 else
  a=0;
 end
 mn3=[mn3 a];
end

disp('(ASK)Binary information at Reciver :');
disp(mn1);
disp('(FSK)Binary information at Reciver :');
disp(mn2);
disp('(PSK)Binary information at Reciver :');
disp(mn3);
```

END OF EXPERIMENT