

EE301 Lab5

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```

clc;
clear all;
close all;

%Q1 (a)
t = linspace(-0.5, 2, 1000);
plot(t,cos(linspace(-7.5,27,1000)), 'k:');

grid on;

% The amplitude is equal to 1
% s(t)=A*cos(2*pi*f*t+phi) when t is equal to 0
% s(t)=Acos(phi)
% s(0)=0.7209=A*cos(phi)
% phi=cos^-1(0.7209)=0.7657
% rad = 43.8 degrees

phi=acosd(0.7209)

% t1=0.043
% t2=0.4985
% Period = T = 0.4985-0.043 = 0.4555 s
% f = 1/T = 1/0.4555 = 2.1954 Hz

% A*exp(j*phi), where the value of A=1
% phi=0.7657 rad
% s= 1*exp(j*0.7657), which is polar form
% s= cos(0.7657)+j*sin(0.7657) = 0.721+j*0.693

Rectangual= 1*exp(j*0.7657)

%Q1 (b)
A = 1;
phi = 0.7657;
frq = 2.1954;
new = A*cos(2*pi*frq.*t-phi);

hold on
plot(t, new)
title('Graph1');
xlabel('Time');
ylabel('Amplitude');
legend('Plot a', 'Plot b');

%Q2 (a)

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t_test = 0:99;
s_test = 1.3*cos(t_test*pi/10 + 2.8);

% Amplitude is equal to 1.3
% A*cos(w*t+phi) = -1.225 when t equals to 0
% A*cos(phi) = -1.225
% phi = cos^-1(-1.225/1.3) = 2.8 rad = 160.44 degrees

phi=acosd(-1.225/1.3)

% 2*pi*f*t = t_test*pi*1/10
% -> 1/10 = 2*f -> f = 1/20

%Q2 (b)
t_test = 0:99;
s_test = 1.3*cos(t_test*pi/10 + 2.8);
figure
plot(t_test,s_test)
title('Graph2');
xlabel('Time');
ylabel('Amplitude');
grid on

[A,phi]=apc(s_test, t_test, 1/20);

%Q2 (c)

% w = 200*pi = 2*pi*f where f is equal to 100

load('lab5_data.mat')
figure
plot(t_samp,s_samp)
xlabel('Time');
ylabel('Amplitude');
title('samp signal');
[A,phi] = apc(s_samp, t_samp, 100);
hold on
new = A*cos(2*pi.*t_samp*100+phi);
plot(t_samp,new,'r')

%Q2 (d)

apc_support = 0:80;
apc_test = cos(apc_support*pi/15+0);

% The amplitude is equal to 1
% The phase is equal to 0
% The frequency is equal to 1/30

[A,phi]=apc(apc_test, apc_support, 1/30);
figure
plot(apc_support, apc_test)
hold on

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new=A*cos(2*pi.*apc_support*1/30+phi);
plot(apc_support,new,'r')
title('Graph4');
xlabel('Time');
ylabel('Amplitude');
legend('Plot a(apc_test)','Plot b(new)');

% The fundamental period, in this case,
% is 30 seconds.
% There are 2.75 periods included in apc_test

abs(new - apc_test)
sum(abs(new - apc_test))

%Q2 (e)

A = ones(1,500);
phi = (zeros(1,500));

for i = 10:500

apc_support = 0:i;
apc_test = cos(apc_support*pi/15+0);
[A(i),phi(i)] = apc(apc_test, apc_support, 1/30);
end

i = 1:500;
figure
amplitude_error=abs(A-1);
subplot(2,1,1)
plot(i,amplitude_error)
xlabel('Time');
ylabel('amplitude error');
title('amplitude error');
subplot(2,1,2)
plot(i,phi)
xlabel('Time');
ylabel('phase error');
title('phase error');

% For this particular case the amplitude estimates to the value of zero
% always.
% This will result in the amplitude never becoming one.

%Q3 (a)

[frq,A,phi,X]=fape(s_test,t_test)
new = real(A*exp(j*(2*pi*frq.*t_test+phi)));

figure
plot(t_test,s_test)
grid
hold on

```

```

plot(t_test, new, 'r');

% f = 1/20 = 0.05 Hz
% Amplitude is equal to 1.3
% s(t) = A*cos(2*pi*f*t+phi) where t is equal to 0
% s(t) = A*cos(phi)
% s(0) = -1.225 = A*cos(phi)
% phi = cos^-1(-1.225) = undefined. The angle is approximately pi/2 because
% that is the value where cosine is undefined.
% Yes, the estimates are correct.

%Q3 (b)

[frq,A,phi,X]=fape(fape_test_s,fape_test_t)
new = real(A*exp(j*(2*pi*frq.*fape_test_t+phi)));

figure
plot(fape_test_t,fape_test_s)
grid
hold on
plot(fape_test_t, new, 'r');

% The accuracy of estimates is not accurate. The phase is different in the
% actual signal.

```

```

phi =

    43.8712

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```

Rectangular =

    0.7209 + 0.6930i

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```

phi =

    160.4428

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```

correlation =

   -47.1289

```

```

cos0 =

   -0.9521

```

correlation =

-0.0500

cos0 =

-1.0050

correlation =

41.6436

cos0 =

1.0411

ans =

Columns 1 through 7

0.0405	0.0982	0.1517	0.1984	0.2366	0.2643	0.2806
--------	--------	--------	--------	--------	--------	--------

Columns 8 through 14

0.2845	0.2760	0.2555	0.2238	0.1823	0.1329	0.0776
--------	--------	--------	--------	--------	--------	--------

Columns 15 through 21

0.0189	0.0405	0.0982	0.1517	0.1984	0.2366	0.2643
--------	--------	--------	--------	--------	--------	--------

Columns 22 through 28

0.2806	0.2845	0.2760	0.2555	0.2238	0.1823	0.1329
--------	--------	--------	--------	--------	--------	--------

Columns 29 through 35

0.0776	0.0189	0.0405	0.0982	0.1517	0.1984	0.2366
--------	--------	--------	--------	--------	--------	--------

Columns 36 through 42

0.2643	0.2806	0.2845	0.2760	0.2555	0.2238	0.1823
--------	--------	--------	--------	--------	--------	--------

Columns 43 through 49

0.1329	0.0776	0.0189	0.0405	0.0982	0.1517	0.1984
--------	--------	--------	--------	--------	--------	--------

Columns 50 through 56

0.2366	0.2643	0.2806	0.2845	0.2760	0.2555	0.2238
--------	--------	--------	--------	--------	--------	--------

Columns 57 through 63

0.1823	0.1329	0.0776	0.0189	0.0405	0.0982	0.1517
--------	--------	--------	--------	--------	--------	--------

Columns 64 through 70

0.1984	0.2366	0.2643	0.2806	0.2845	0.2760	0.2555
--------	--------	--------	--------	--------	--------	--------

Columns 71 through 77

0.2238	0.1823	0.1329	0.0776	0.0189	0.0405	0.0982
--------	--------	--------	--------	--------	--------	--------

Columns 78 through 81

0.1517	0.1984	0.2366	0.2643
--------	--------	--------	--------

ans =

14.5994

correlation =

4.6064

cos0 =

0.9213

correlation =

5.0542

cos0 =

0.9189

correlation =

5.7087

cos0 =

0.9514

correlation =

6.5432

cos0 =

1.0067

correlation =

7.5000

cos0 =

1.0714

correlation =

8.5000

cos0 =

1.1333

correlation =

9.4568

cos0 =

1.1821

correlation =

10.2913

cos0 =

1.2107

correlation =

10.9458

cos0 =

1.2162

correlation =

11.3936

cos0 =

1.1993

correlation =

11.6436

cos0 =

1.1644

correlation =

11.7391

cos0 =

1.1180

correlation =

11.7500

cos0 =

1.0682

correlation =

11.7609

cos0 =

1.0227

correlation =

11.8564

cos0 =

0.9880

correlation =

12.1064

cos0 =

0.9685

correlation =

12.5542

cos0 =

0.9657

correlation =

13.2087

cos0 =

0.9784

correlation =

14.0432

cos0 =

1.0031

correlation =

15.0000

cos0 =

1.0345

correlation =

16

cos0 =

1.0667

correlation =

16.9568

cos0 =

1.0940

correlation =

17.7913

cos0 =

1.1120

correlation =

18.4458

cos0 =

1.1179

correlation =

18.8936

cos0 =

1.1114

correlation =

19.1436

cos0 =

1.0939

correlation =

19.2391

cos0 =

1.0688

correlation =

19.2500

cos0 =

1.0405

correlation =

19.2609

cos0 =

1.0137

correlation =

19.3564

cos0 =

0.9926

correlation =

19.6064

cos0 =

0.9803

correlation =

20.0542

cos0 =

0.9783

correlation =

20.7087

cos0 =

0.9861

correlation =

21.5432

cos0 =

1.0020

correlation =

22.5000

cos0 =

1.0227

correlation =

23.5000

cos0 =

1.0444

correlation =

24.4568

cos0 =

1.0633

correlation =

25.2913

cos0 =

1.0762

correlation =

25.9458

cos0 =

1.0811

correlation =

26.3936

cos0 =

1.0773

correlation =

26.6436

cos0 =

1.0657

correlation =

26.7391

cos0 =

1.0486

correlation =

26.7500

cos0 =

1.0288

correlation =

26.7609

cos0 =

1.0098

correlation =

26.8564

cos0 =

0.9947

correlation =

27.1064

cos0 =

0.9857

correlation =

27.5542

cos0 =

0.9841

correlation =

28.2087

cos0 =

0.9898

correlation =

29.0432

cos0 =

1.0015

correlation =

30.0000

cos0 =

1.0169

correlation =

31.0000

cos0 =

1.0333

correlation =

31.9568

cos0 =

1.0478

correlation =

32.7913

cos0 =

1.0578

correlation =

33.4458

cos0 =

1.0618

correlation =

33.8936

cos0 =

1.0592

correlation =

34.1436

cos0 =

1.0506

correlation =

34.2391

cos0 =

1.0375

correlation =

34.2500

cos0 =

1.0224

correlation =

34.2609

cos0 =

1.0077

correlation =

34.3564

cos0 =

0.9958

correlation =

34.6064

cos0 =

0.9888

correlation =

35.0542

cos0 =

0.9874

correlation =

35.7087

cos0 =

0.9919

correlation =

36.5432

cos0 =

1.0012

correlation =

37.5000

cos0 =

1.0135

correlation =

38.5000

cos0 =

1.0267

correlation =

39.4568

cos0 =

1.0383

correlation =

40.2913

cos0 =

1.0465

correlation =

40.9458

cos0 =

1.0499

correlation =

41.3936

cos0 =

1.0479

correlation =

41.6436

cos0 =

1.0411

correlation =

41.7391

cos0 =

1.0306

correlation =

41.7500

cos0 =

1.0183

correlation =

41.7609

cos0 =

1.0063

correlation =

41.8564

cos0 =

0.9966

correlation =

42.1064

cos0 =

0.9907

correlation =

42.5542

cos0 =

0.9896

correlation =

43.2087

cos0 =

0.9933

correlation =

44.0432

cos0 =

1.0010

correlation =

45.0000

cos0 =

1.0112

correlation =

46.0000

cos0 =

1.0222

correlation =

46.9568

cos0 =

1.0320

correlation =

47.7913

cos0 =

1.0389

correlation =

48.4458

cos0 =

1.0418

correlation =

48.8936

cos0 =

1.0403

correlation =

49.1436

cos0 =

1.0346

correlation =

49.2391

cos0 =

1.0258

correlation =

49.2500

cos0 =

1.0155

correlation =

49.2609

cos0 =

1.0053

correlation =

49.3564

cos0 =

0.9971

correlation =

49.6064

cos0 =

0.9921

correlation =

50.0542

cos0 =

0.9912

correlation =

50.7087

cos0 =

0.9943

correlation =

51.5432

cos0 =

1.0008

correlation =

52.5000

cos0 =

1.0096

correlation =

53.5000

cos0 =

1.0190

correlation =

54.4568

cos0 =

1.0275

correlation =

55.2913

cos0 =

1.0335

correlation =

55.9458

cos0 =

1.0360

correlation =

56.3936

cos0 =

1.0347

correlation =

56.6436

cos0 =

1.0299

correlation =

56.7391

cos0 =

1.0223

correlation =

56.7500

cos0 =

1.0134

correlation =

56.7609

cos0 =

1.0046

correlation =

56.8564

cos0 =

0.9975

correlation =

57.1064

cos0 =

0.9932

correlation =

57.5542

cos0 =

0.9923

correlation =

58.2087

cos0 =

0.9950

correlation =

59.0432

cos0 =

1.0007

correlation =

60.0000

cos0 =

1.0084

correlation =

61.0000

cos0 =

1.0167

correlation =

61.9568

cos0 =

1.0241

correlation =

62.7913

cos0 =

1.0294

correlation =

63.4458

cos0 =

1.0316

correlation =

63.8936

cos0 =

1.0305

correlation =

64.1436

cos0 =

1.0263

correlation =

64.2391

cos0 =

1.0197

correlation =

64.2500

cos0 =

1.0118

correlation =

64.2609

cos0 =

1.0041

correlation =

64.3564

cos0 =

0.9978

correlation =

64.6064

cos0 =

0.9939

correlation =

65.0542

cos0 =

0.9932

correlation =

65.7087

cos0 =

0.9956

correlation =

66.5432

cos0 =

1.0007

correlation =

67.5000

cos0 =

1.0075

correlation =

68.5000

cos0 =

1.0148

correlation =

69.4568

cos0 =

1.0214

correlation =

70.2913

cos0 =

1.0262

correlation =

70.9458

cos0 =

1.0282

correlation =

71.3936

cos0 =

1.0272

correlation =

71.6436

cos0 =

1.0235

correlation =

71.7391

cos0 =

1.0176

correlation =

71.7500

cos0 =

1.0106

correlation =

71.7609

cos0 =

1.0036

correlation =

71.8564

cos0 =

0.9980

correlation =

72.1064

cos0 =

0.9946

correlation =

72.5542

cos0 =

0.9939

correlation =

73.2087

cos0 =

0.9960

correlation =

74.0432

cos0 =

1.0006

correlation =

75

cos0 =

1.0067

correlation =

76

cos0 =

1.0133

correlation =

76.9568

cos0 =

1.0193

correlation =

77.7913

cos0 =

1.0236

correlation =

78.4458

cos0 =

1.0254

correlation =

78.8936

cos0 =

1.0246

correlation =

79.1436

cos0 =

1.0212

correlation =

79.2391

cos0 =

1.0159

correlation =

79.2500

cos0 =

1.0096

correlation =

79.2609

cos0 =

1.0033

correlation =

79.3564

cos0 =

0.9982

correlation =

79.6064

cos0 =

0.9951

correlation =

80.0542

cos0 =

0.9945

correlation =

80.7087

cos0 =

0.9964

correlation =

81.5432

cos0 =

1.0005

correlation =

82.5000

cos0 =

1.0061

correlation =

83.5000

cos0 =

1.0121

correlation =

84.4568

cos0 =

1.0176

correlation =

85.2913

cos0 =

1.0215

correlation =

85.9458

cos0 =

1.0232

correlation =

86.3936

cos0 =

1.0224

correlation =

86.6436

cos0 =

1.0193

correlation =

86.7391

cos0 =

1.0145

correlation =

86.7500

cos0 =

1.0087

correlation =

86.7609

cos0 =

1.0030

correlation =

86.8564

cos0 =

0.9983

correlation =

87.1064

cos0 =

0.9955

correlation =

87.5542

cos0 =

0.9949

correlation =

88.2087

cos0 =

0.9967

correlation =

89.0432

cos0 =

1.0005

correlation =

90.0000

cos0 =

1.0056

correlation =

91.0000

cos0 =

1.0111

correlation =

91.9568

cos0 =

1.0161

correlation =

92.7913

cos0 =

1.0197

correlation =

93.4458

cos0 =

1.0213

correlation =

93.8936

cos0 =

1.0206

correlation =

94.1436

cos0 =

1.0178

correlation =

94.2391

cos0 =

1.0133

correlation =

94.2500

cos0 =

1.0080

correlation =

94.2609

cos0 =

1.0028

correlation =

94.3564

cos0 =

0.9985

correlation =

94.6064

cos0 =

0.9959

correlation =

95.0542

cos0 =

0.9953

correlation =

95.7087

cos0 =

0.9970

correlation =

96.5432

cos0 =

1.0004

correlation =

97.5000

cos0 =

1.0052

correlation =

98.5000

cos0 =

1.0103

correlation =

99.4568

cos0 =

1.0149

correlation =

100.2913

cos0 =

1.0182

correlation =

100.9458

cos0 =

1.0197

correlation =

101.3936

cos0 =

1.0190

correlation =

101.6436

cos0 =

1.0164

correlation =

101.7391

cos0 =

1.0123

correlation =

101.7500

cos0 =

1.0074

correlation =

101.7609

cos0 =

1.0026

correlation =

101.8564

cos0 =

0.9986

correlation =

102.1064

cos0 =

0.9962

correlation =

102.5542

cos0 =

0.9957

correlation =

103.2087

cos0 =

0.9972

correlation =

104.0432

cos0 =

1.0004

correlation =

105.0000

cos0 =

1.0048

correlation =

106.0000

cos0 =

1.0095

correlation =

106.9568

cos0 =

1.0138

correlation =

107.7913

cos0 =

1.0169

correlation =

108.4458

cos0 =

1.0183

correlation =

108.8936

cos0 =

1.0177

correlation =

109.1436

cos0 =

1.0153

correlation =

109.2391

cos0 =

1.0115

correlation =

109.2500

cos0 =

1.0069

correlation =

109.2609

cos0 =

1.0024

correlation =

109.3564

cos0 =

0.9987

correlation =

109.6064

cos0 =

0.9964

correlation =

110.0542

cos0 =

0.9960

correlation =

110.7087

cos0 =

0.9974

correlation =

111.5432

cos0 =

1.0004

correlation =

112.5000

cos0 =

1.0045

correlation =

113.5000

cos0 =

1.0089

correlation =

114.4568

cos0 =

1.0129

correlation =

115.2913

cos0 =

1.0158

correlation =

115.9458

cos0 =

1.0171

correlation =

116.3936

cos0 =

1.0165

correlation =

116.6436

cos0 =

1.0143

correlation =

116.7391

cos0 =

1.0107

correlation =

116.7500

cos0 =

1.0065

correlation =

116.7609

cos0 =

1.0022

correlation =

116.8564

cos0 =

0.9988

correlation =

117.1064

cos0 =

0.9967

correlation =

117.5542

cos0 =

0.9962

correlation =

118.2087

cos0 =

0.9975

correlation =

119.0432

cos0 =

1.0004

correlation =

120.0000

cos0 =

1.0042

correlation =

121.0000

cos0 =

1.0083

correlation =

121.9568

cos0 =

1.0121

correlation =

122.7913

cos0 =

1.0148

correlation =

123.4458

cos0 =

1.0160

correlation =

123.8936

cos0 =

1.0155

correlation =

124.1436

cos0 =

1.0134

correlation =

124.2391

cos0 =

1.0101

correlation =

124.2500

cos0 =

1.0061

correlation =

124.2609

cos0 =

1.0021

correlation =

124.3564

cos0 =

0.9988

correlation =

124.6064

cos0 =

0.9969

correlation =

125.0542

cos0 =

0.9964

correlation =

125.7087

cos0 =

0.9977

correlation =

126.5432

cos0 =

1.0003

correlation =

127.5000

cos0 =

1.0039

correlation =

128.5000

cos0 =

1.0078

correlation =

129.4568

cos0 =

1.0114

correlation =

130.2913

cos0 =

1.0139

correlation =

130.9458

cos0 =

1.0151

correlation =

131.3936

cos0 =

1.0146

correlation =

131.6436

cos0 =

1.0126

correlation =

131.7391

cos0 =

1.0095

correlation =

131.7500

cos0 =

1.0057

correlation =

131.7609

cos0 =

1.0020

correlation =

131.8564

cos0 =

0.9989

correlation =

132.1064

cos0 =

0.9970

correlation =

132.5542

cos0 =

0.9966

correlation =

133.2087

cos0 =

0.9978

correlation =

134.0432

cos0 =

1.0003

correlation =

135.0000

cos0 =

1.0037

correlation =

136.0000

cos0 =

1.0074

correlation =

136.9568

cos0 =

1.0108

correlation =

137.7913

cos0 =

1.0132

correlation =

138.4458

cos0 =

1.0143

correlation =

138.8936

cos0 =

1.0138

correlation =

139.1436

cos0 =

1.0120

correlation =

139.2391

cos0 =

1.0090

correlation =

139.2500

cos0 =

1.0054

correlation =

139.2609

cos0 =

1.0019

correlation =

139.3564

cos0 =

0.9990

correlation =

139.6064

cos0 =

0.9972

correlation =

140.0542

cos0 =

0.9968

correlation =

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1.0078

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correlation =

251.6436

cos0 =

1.0066

frq =

0.0505

correlation =

-43.9669

cos0 =

-0.8882

frq =

0.0505

A =

1.2995

phi =

2.6643

X =

0.0004 + 0.0010i
0.0017 + 0.0023i
0.0051 + 0.0046i
0.0166 + 0.0112i
-0.4441 - 0.2394i
-0.0277 - 0.0124i
-0.0177 - 0.0068i
-0.0143 - 0.0048i
-0.0127 - 0.0037i
-0.0117 - 0.0031i
-0.0111 - 0.0026i
-0.0107 - 0.0023i
-0.0103 - 0.0020i
-0.0101 - 0.0018i
-0.0099 - 0.0017i
-0.0098 - 0.0015i
-0.0097 - 0.0014i

```
-0.0096 - 0.0013i
-0.0095 - 0.0012i
-0.0094 - 0.0011i
-0.0094 - 0.0010i
-0.0093 - 0.0010i
-0.0093 - 0.0009i
-0.0092 - 0.0008i
-0.0092 - 0.0008i
-0.0092 - 0.0007i
-0.0092 - 0.0007i
-0.0091 - 0.0006i
-0.0091 - 0.0006i
-0.0091 - 0.0006i
-0.0091 - 0.0005i
-0.0091 - 0.0005i
-0.0091 - 0.0005i
-0.0091 - 0.0004i
-0.0090 - 0.0004i
-0.0090 - 0.0004i
-0.0090 - 0.0003i
-0.0090 - 0.0003i
-0.0090 - 0.0003i
-0.0090 - 0.0002i
-0.0090 - 0.0002i
-0.0090 - 0.0002i
-0.0090 - 0.0002i
-0.0090 - 0.0001i
-0.0090 - 0.0001i
-0.0090 - 0.0001i
-0.0090 - 0.0001i
-0.0090 - 0.0000i
-0.0090 - 0.0000i
-0.0090 + 0.0000i
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correlation =

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cos0 =

-0.7660

frq =

1.0309

A =

4.2770

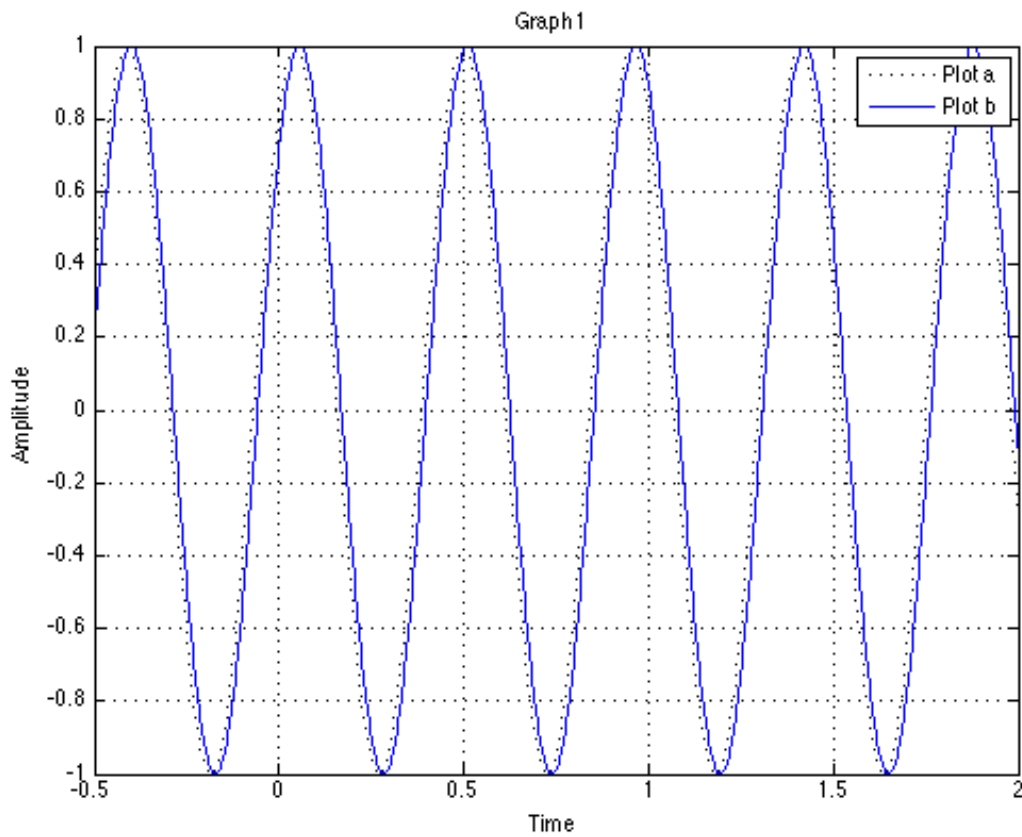
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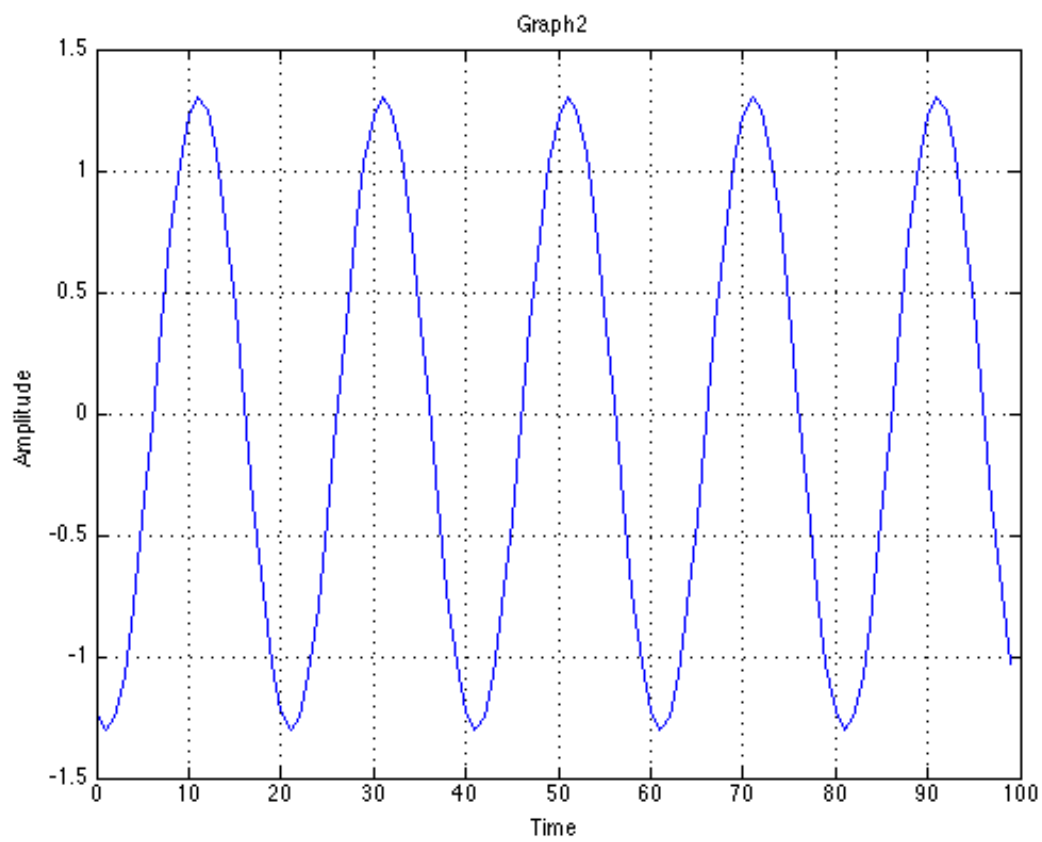
2.4434

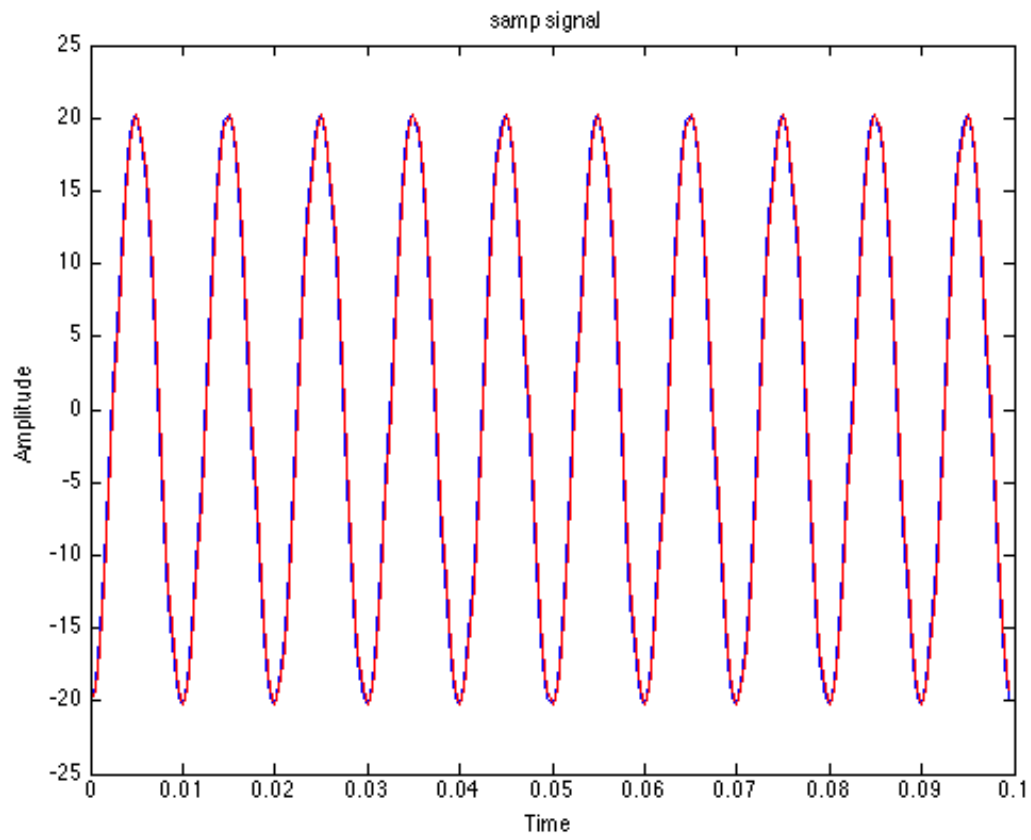
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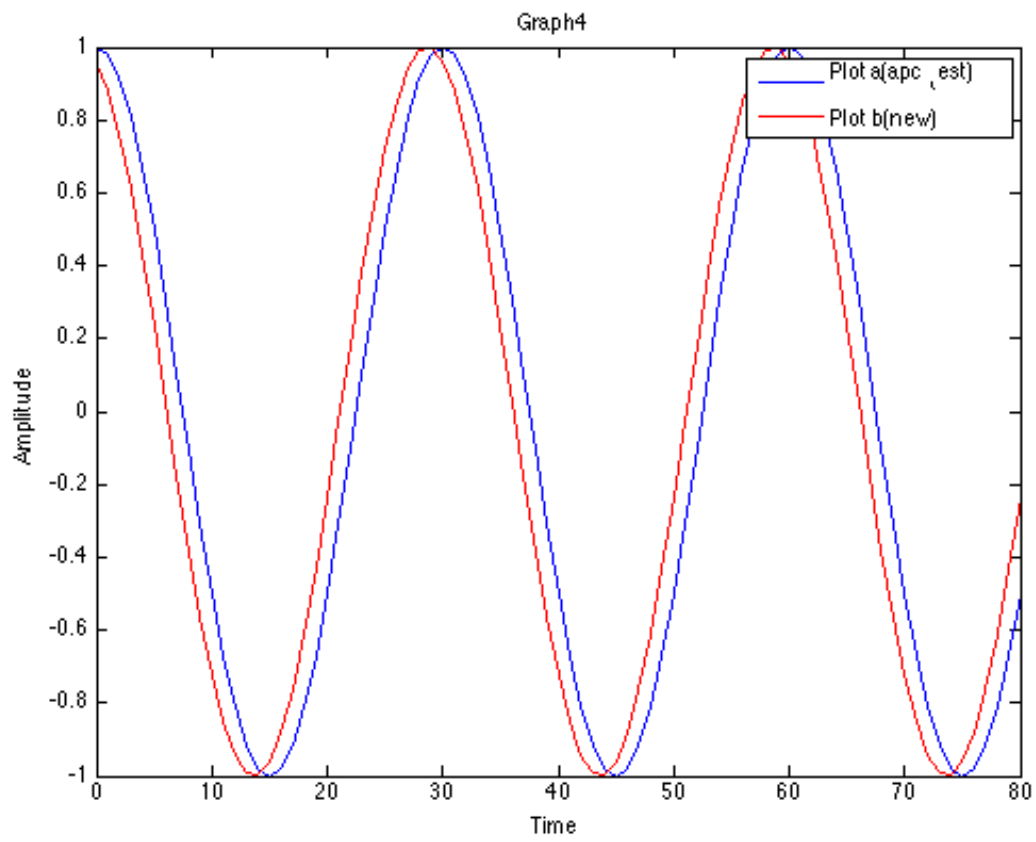
0.0544 - 0.0089i
0.0727 - 0.0233i
0.1531 - 0.0702i
-0.3830 + 0.2208i
-0.0771 + 0.0517i
-0.0418 + 0.0310i
-0.0287 + 0.0227i
-0.0220 + 0.0180i
-0.0180 + 0.0151i
-0.0154 + 0.0129i
-0.0136 + 0.0114i
-0.0123 + 0.0101i
-0.0114 + 0.0091i
-0.0106 + 0.0083i
-0.0100 + 0.0076i
-0.0096 + 0.0069i
-0.0092 + 0.0064i
-0.0089 + 0.0059i
-0.0086 + 0.0055i
-0.0084 + 0.0051i
-0.0082 + 0.0048i
-0.0080 + 0.0045i
-0.0079 + 0.0042i
-0.0077 + 0.0039i
-0.0076 + 0.0036i
-0.0075 + 0.0034i
-0.0074 + 0.0032i
-0.0074 + 0.0030i
-0.0073 + 0.0028i
-0.0073 + 0.0026i
-0.0072 + 0.0024i
-0.0072 + 0.0022i
-0.0071 + 0.0021i
-0.0071 + 0.0019i
-0.0070 + 0.0018i
-0.0070 + 0.0016i
-0.0070 + 0.0015i
-0.0070 + 0.0013i
-0.0069 + 0.0012i

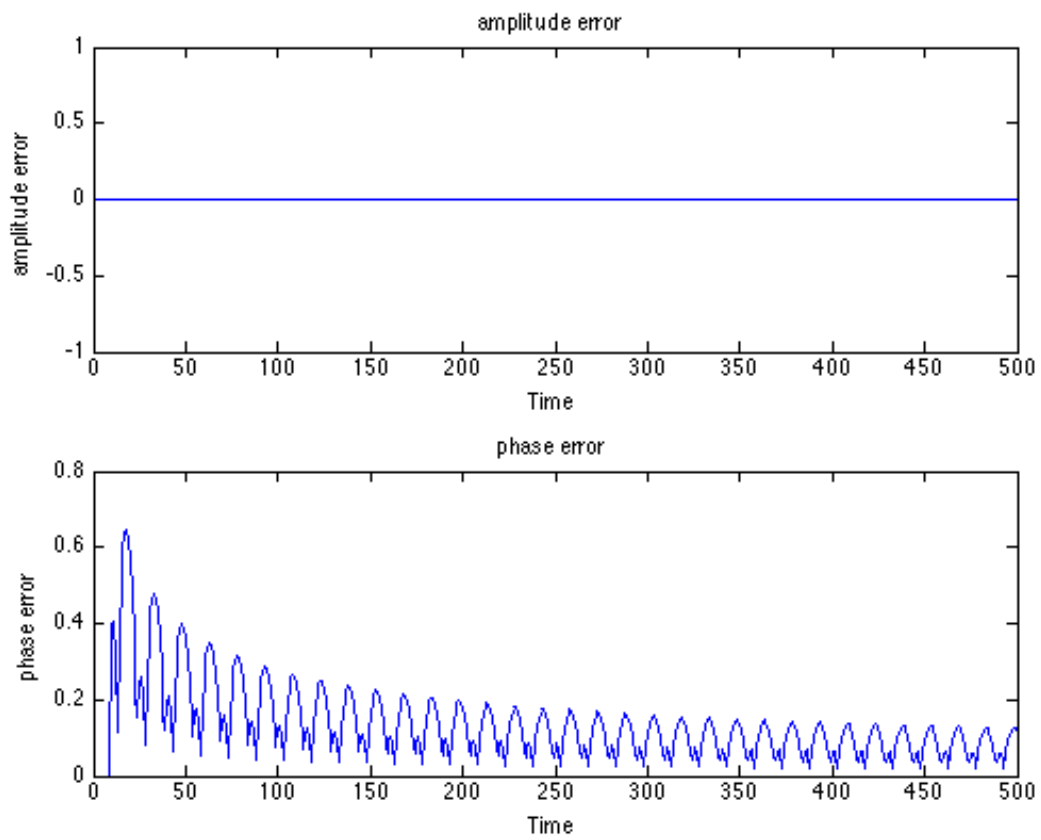
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-0.0069 + 0.0009i
-0.0069 + 0.0008i
-0.0069 + 0.0007i
-0.0069 + 0.0006i
-0.0069 + 0.0004i
-0.0069 + 0.0003i
-0.0069 + 0.0002i
-0.0069 + 0.0001i
-0.0069 - 0.0001i

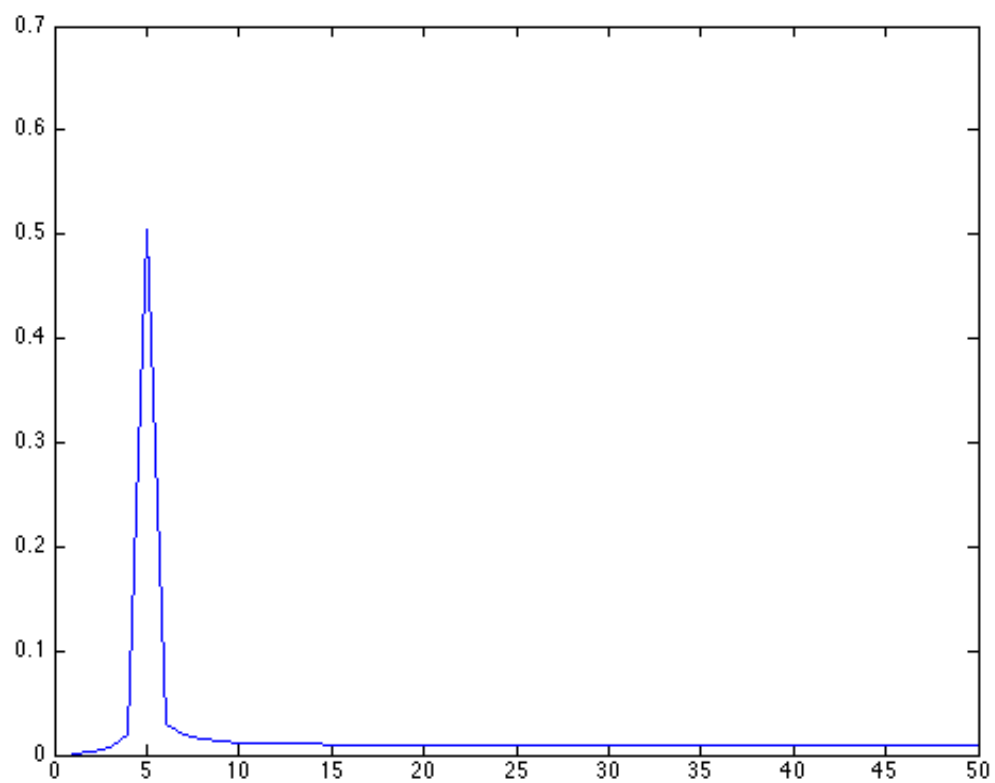


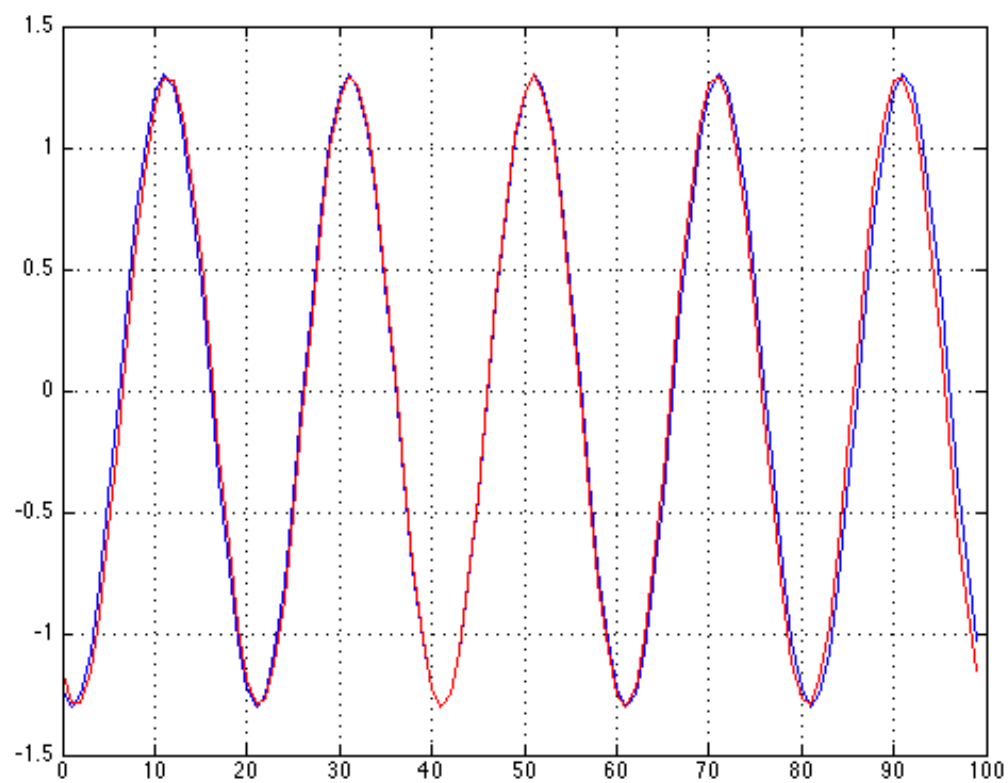


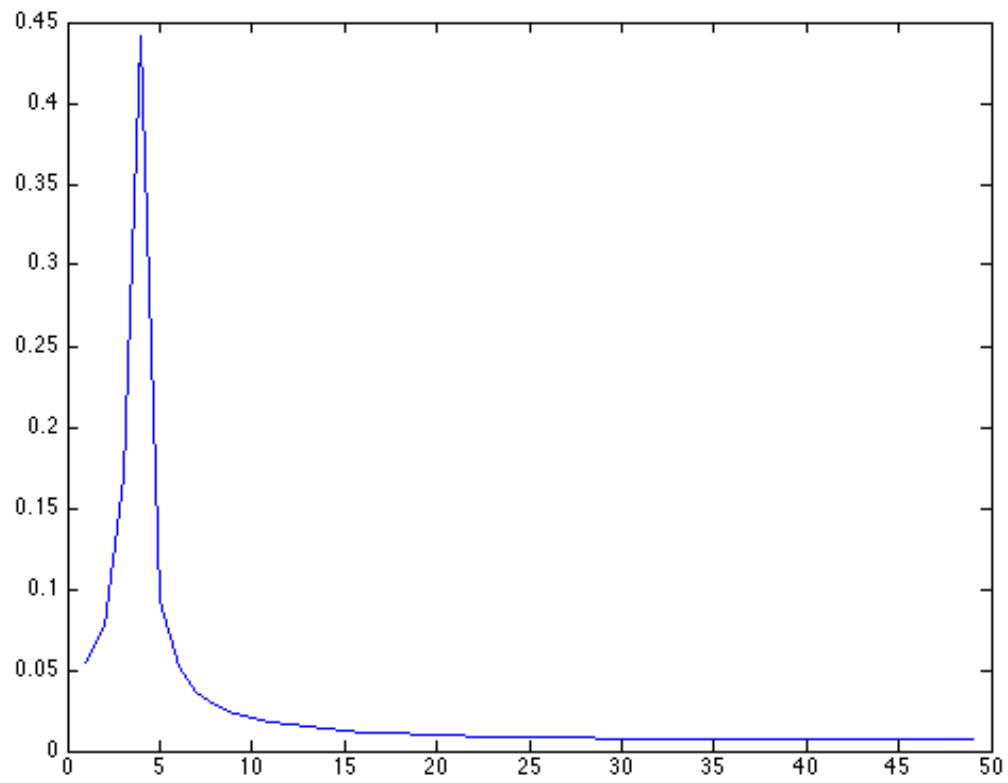


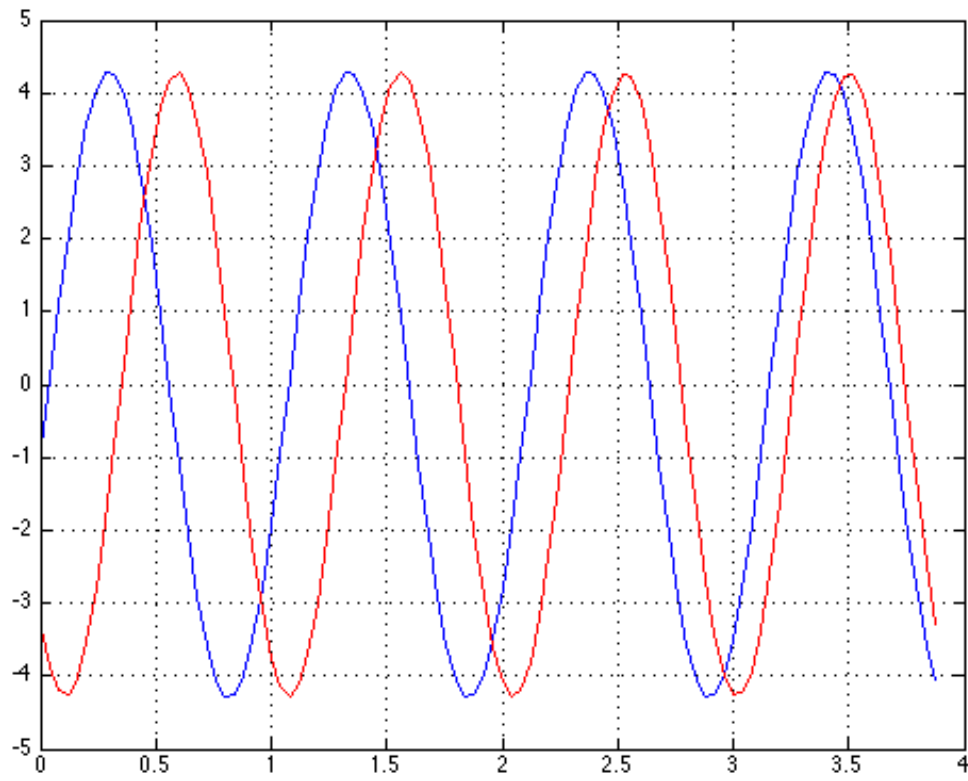












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