भारतीय प्रौद्योगिकी संस्थान तिरुपति

TIRUPATI

LAB SHEET 07

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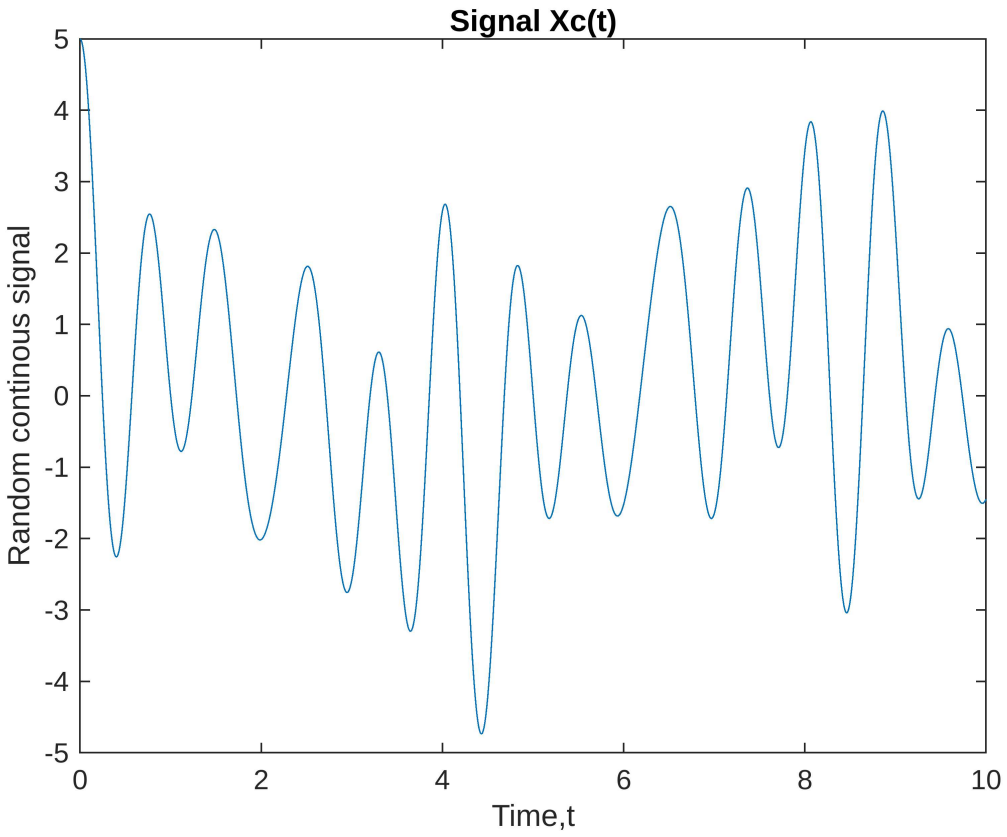
INCREASING SAMPLING RATE USING INTERPOLATOR

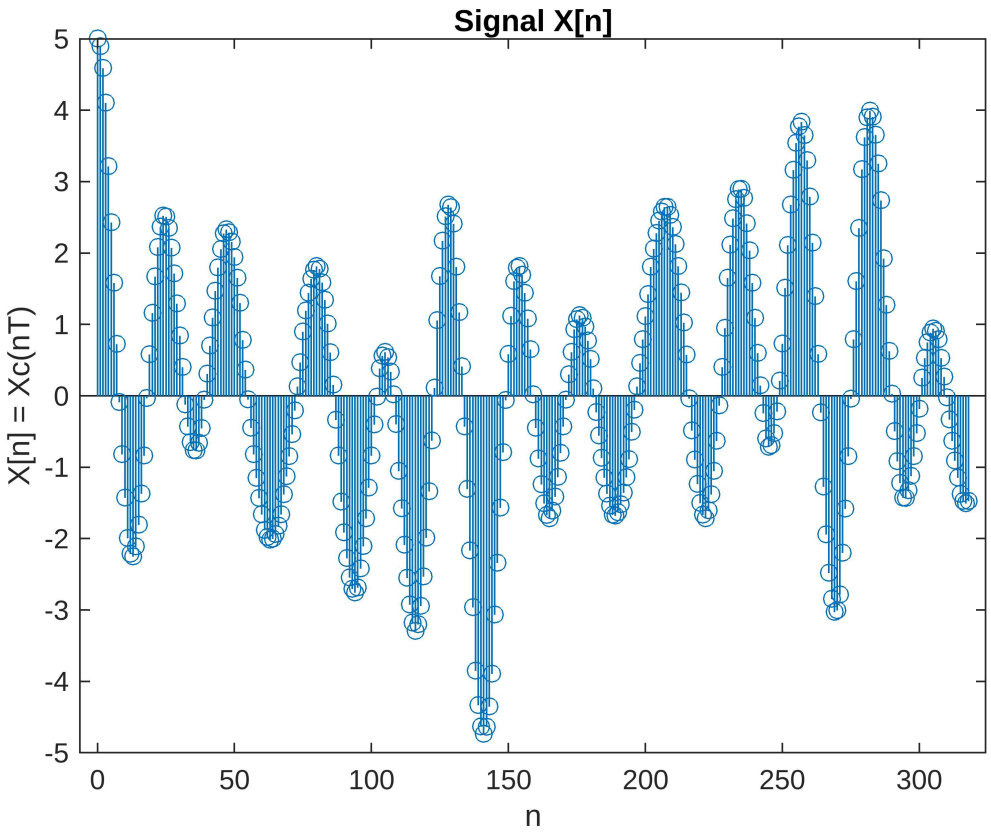
Question 1

```
omegaN = 10;
I = 5;
deltat = 0.01;
Tmax = 10;
t = 0:deltat:Tmax;
omega_i = omegaN * rand(1, I);
xc = sum(cos(omega_i' * t));
plot(t,xc);
xlabel("Time,t");
ylabel("Random continous signal");
title("Signal Xc(t)");
```



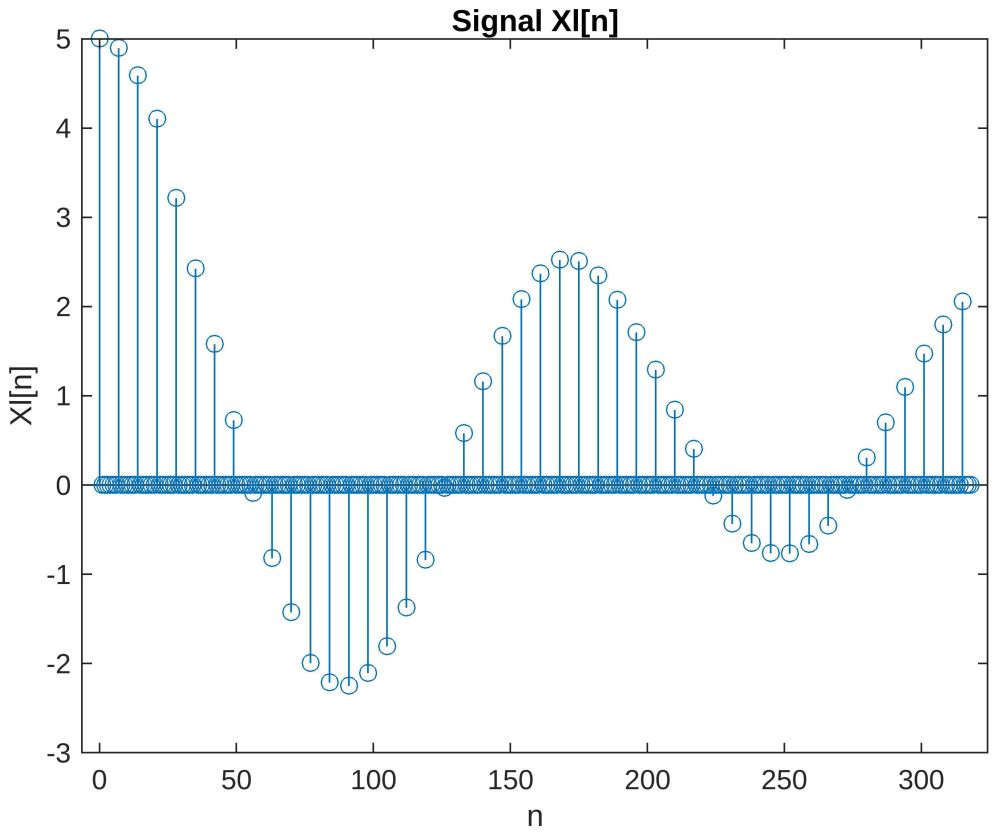
Question 2

```
T = pi / (10 * omegaN);
n = 0:floor(Tmax / T);
indices = round(n * T / deltat) + 1;
indices(indices > length(xc)) = length(xc);
x_n = xc(indices);
stem(n,x_n);
xlabel("n");
ylabel("X[n] = Xc(nT)");
title("Signal X[n]");
```



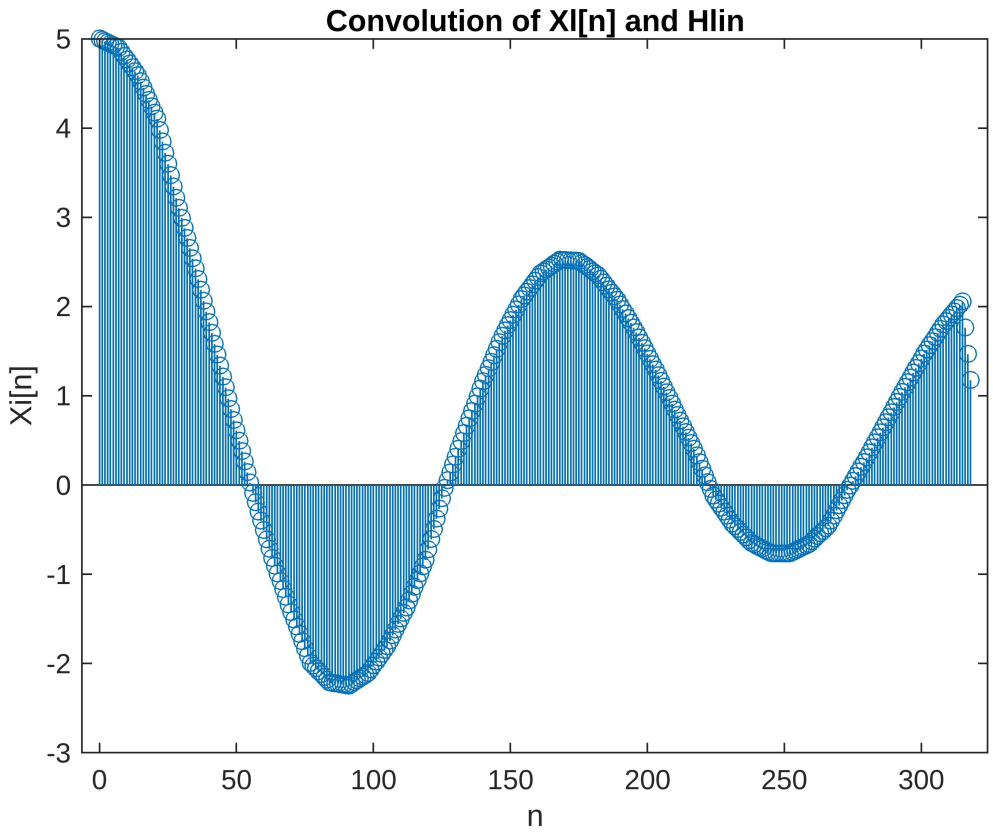
Question 3

```
L = 7;
xl_n = zeros(size(n));
xl_n(1:L:end) = x_n(1:floor(length(x_n)/L) + 1);
stem(n, xl_n)
xlabel("n");
ylabel("Xl[n]");
title("Signal Xl[n]");
```



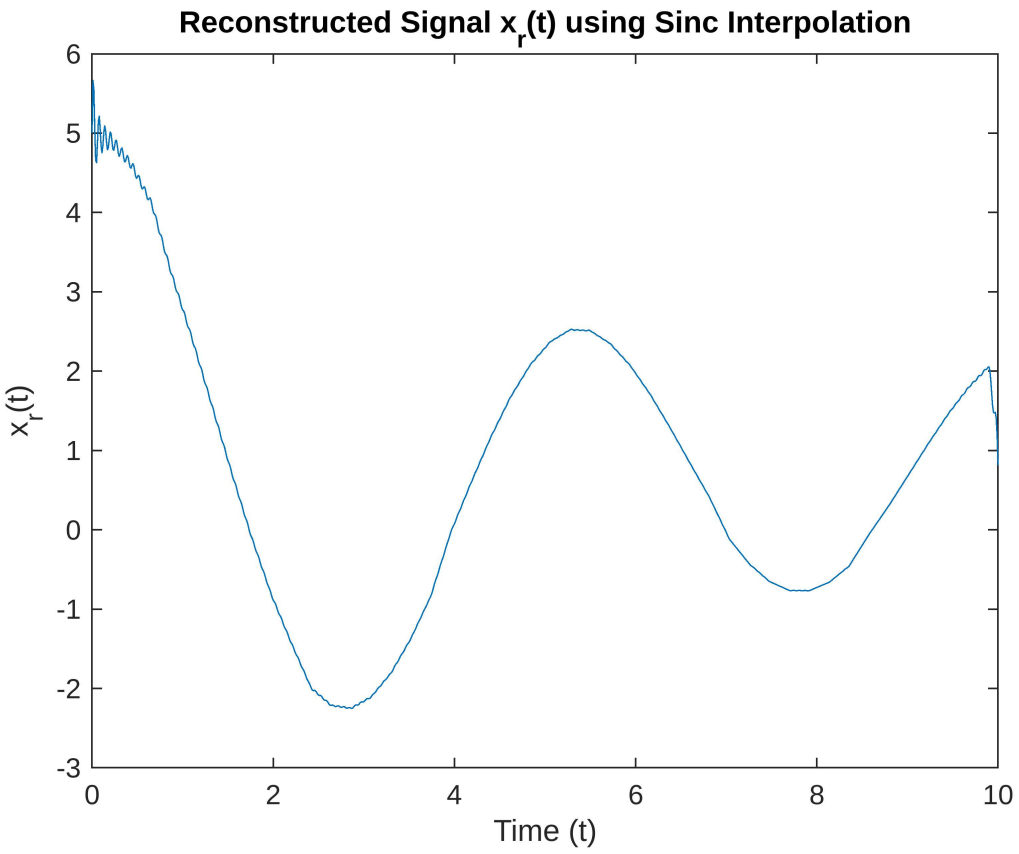
Question 4

```
h_n = @(n) (1 - abs(n) / L) .* (abs(n) <= L);
n_h = -L:L;
h = h_n(n_h);

xi_n = conv(xl_n, h, 'same');
stem(n, xi_n);
xlabel("n");
ylabel("Xi[n]");
title("Convolution of Xl[n] and Hlin");
```



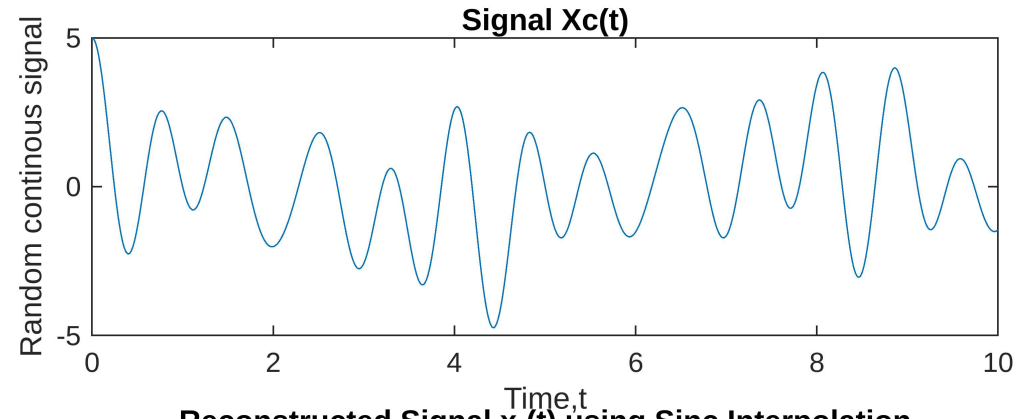
Question 5,6

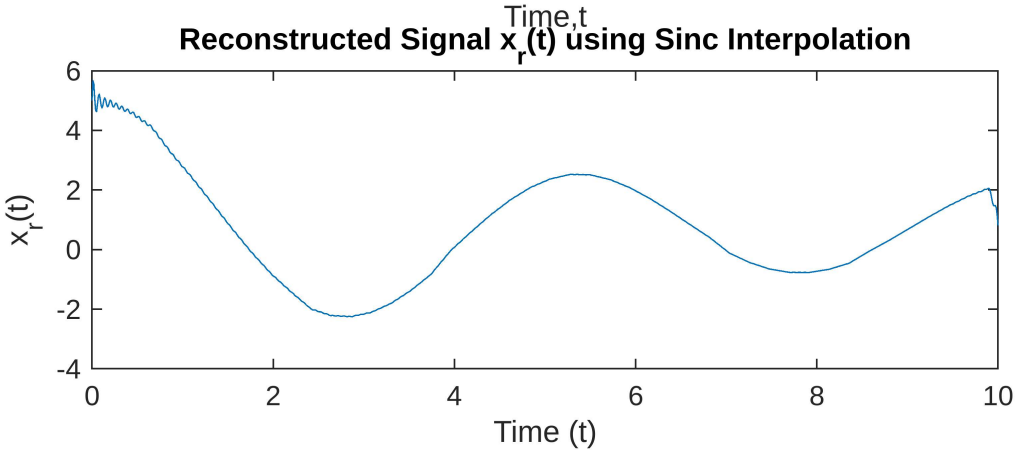
```
x_r = zeros(size(t));
for i = 0:length(xi_n)-1
    x_r = x_r + xi_n(i+1) * sinc((t - i * T) / T);
end
plot(t, x_r);
xlabel('Time (t)');
ylabel('x_r(t)');
title('Reconstructed Signal x_r(t) using Sinc Interpolation');
```



Question 7

```
subplot(2,1,1);
plot(t,xc);
xlabel("Time,t");
ylabel("Random continous signal");
title("Signal Xc(t)");
subplot(2,1,2);
plot(t, x_r);
xlabel('Time (t)');
ylabel('x_r(t)');
title('Reconstructed Signal x_r(t) using Sinc Interpolation');
```

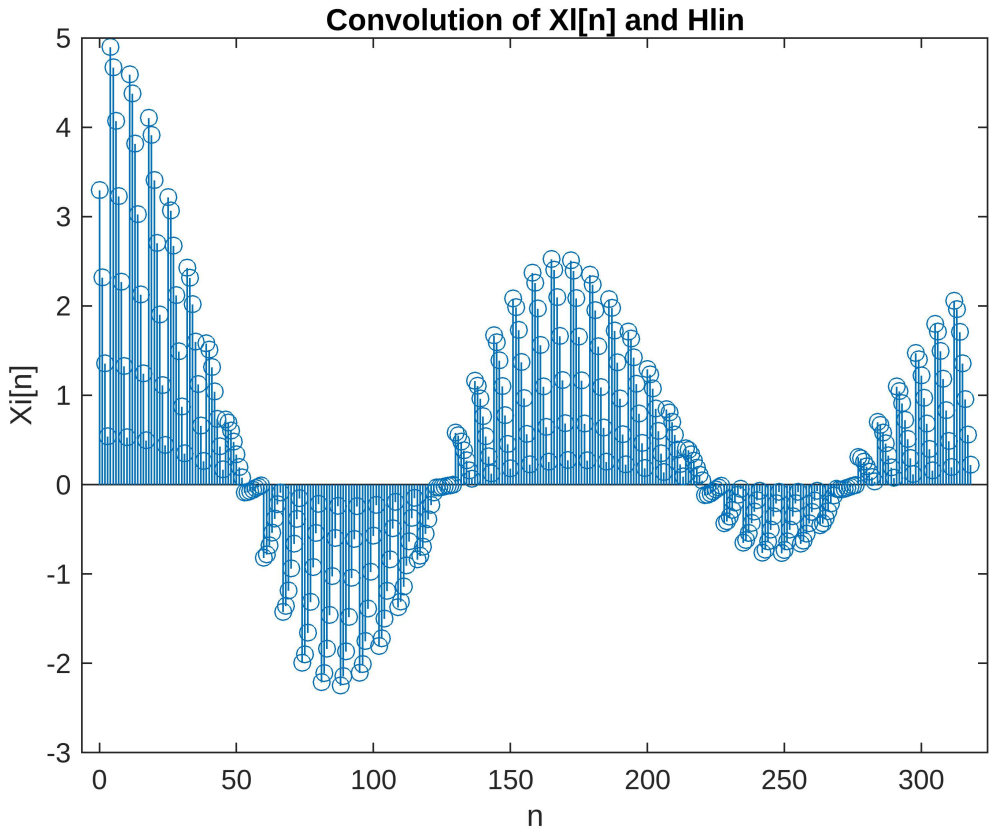




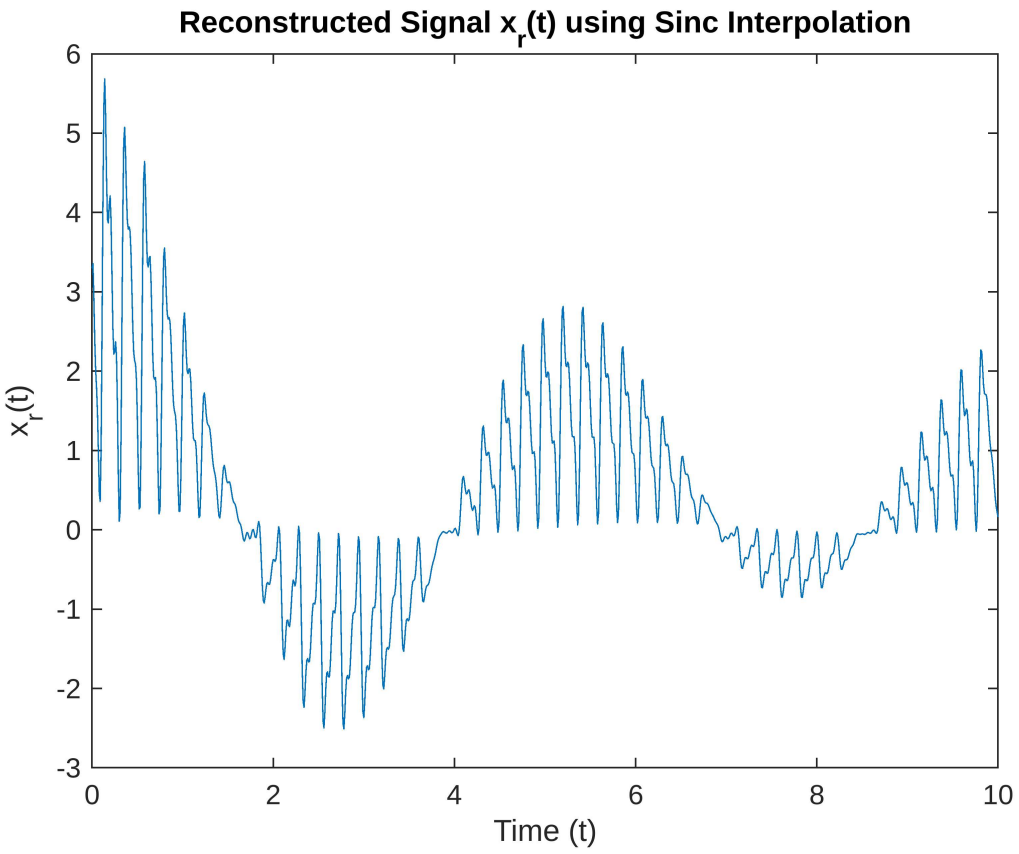
Question 8

```
a = -1/2;
h_n = zeros(1, length(n));

for k = 0:L
    h_n(k+1) = (a + 2) * abs(k / L)^3 - (a + 3) * abs(k / L)^2 + 1;
end

for k = (L+1):2*L
    h_n(k+1) = a * abs(k / L)^3 - 5 * abs(k / L)^2 + 8 * a * abs(k / L) - 4
* a;
end
n_h = 1:L;
h = h_n(n_h);

xi_n = conv(xl_n, h, 'same');
figure;
stem(n, xi_n);
xlabel("n");
ylabel("Xi[n]");
```

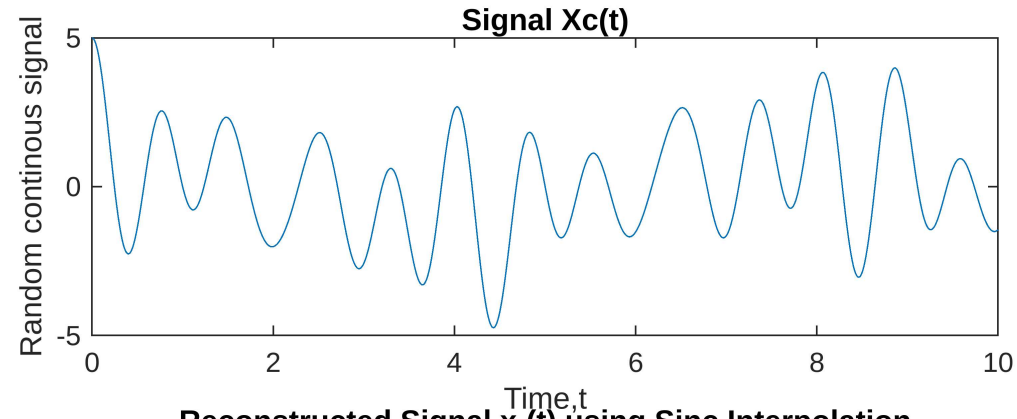
```
title("Convolution of Xl[n] and Hlin");
```

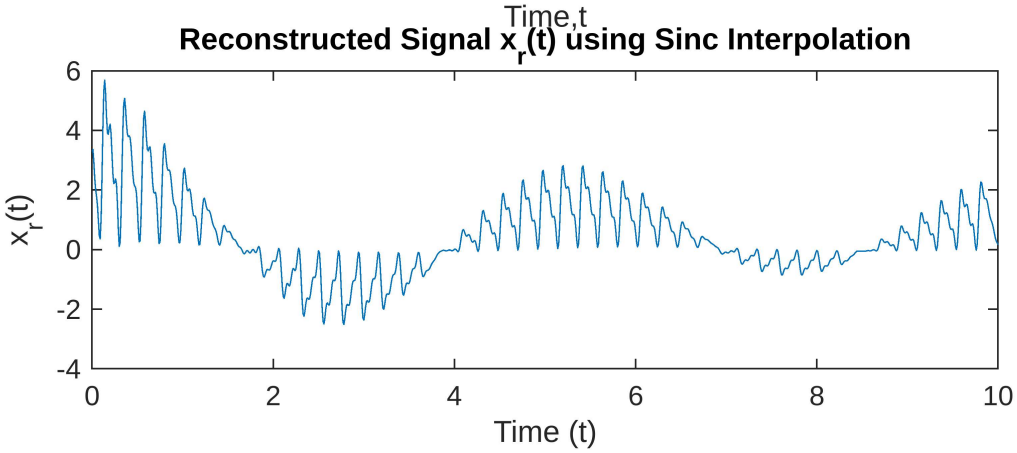



```
x_r = zeros(size(t));
for i = 0:length(xi_n)-1
    x_r = x_r + xi_n(i+1) * sinc((t - i * T) / T);
end
figure;
plot(t, x_r);
xlabel('Time (t)');
ylabel('x_r(t)');
title('Reconstructed Signal x_r(t) using Sinc Interpolation');
```




```
figure;
subplot(2,1,1);
plot(t,xc);
xlabel("Time,t");
ylabel("Random continous signal");
title("Signal Xc(t)");
subplot(2,1,2);
plot(t, x_r);
xlabel('Time (t)');
ylabel('x_r(t)');
title('Reconstructed Signal x_r(t) using Sinc Interpolation');
```


Signal Xc(t)
Random continous signal
5
0
-5
0
2
4
6
8
10
Time,t


Reconstructed Signal x_r(t) using Sinc Interpolation
x_r(t)
6
4
2
0
-2
-4
0
2
4
6
8
10
Time (t)