Lecture 4 Demo: Visualization of Complex Exponential and Sinusoidal Signals

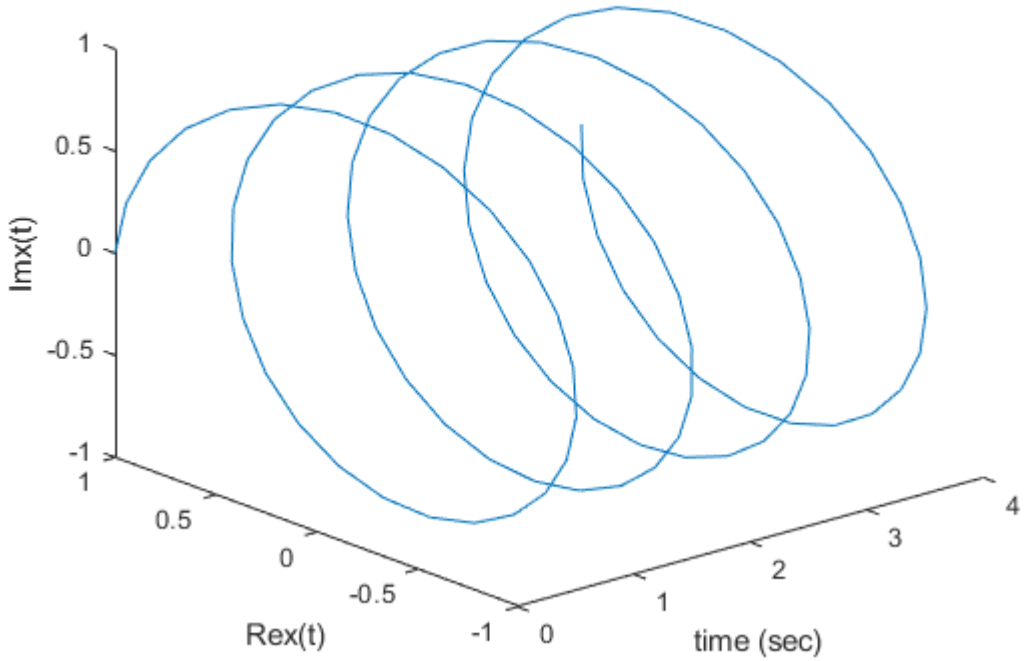
CT Periodic complex exponential signal

$$x(t) = e^{j2\pi t}$$

$$= cos(2\pi t) + j\sin(2\pi t), \quad 0 \le t \le 4$$

Use plot3 to make a 3-dimensional plot of the complex signal versus time. Rotate the plot to see the real and imaginary parts.

```
t=linspace(0,4,100);
re=cos(2*pi*t);
im=sin(2*pi*t);
plot3(t,re,im);
xlabel('time (sec)');
ylabel('Re{x(t)}');
zlabel('Im{x(t)}');
```



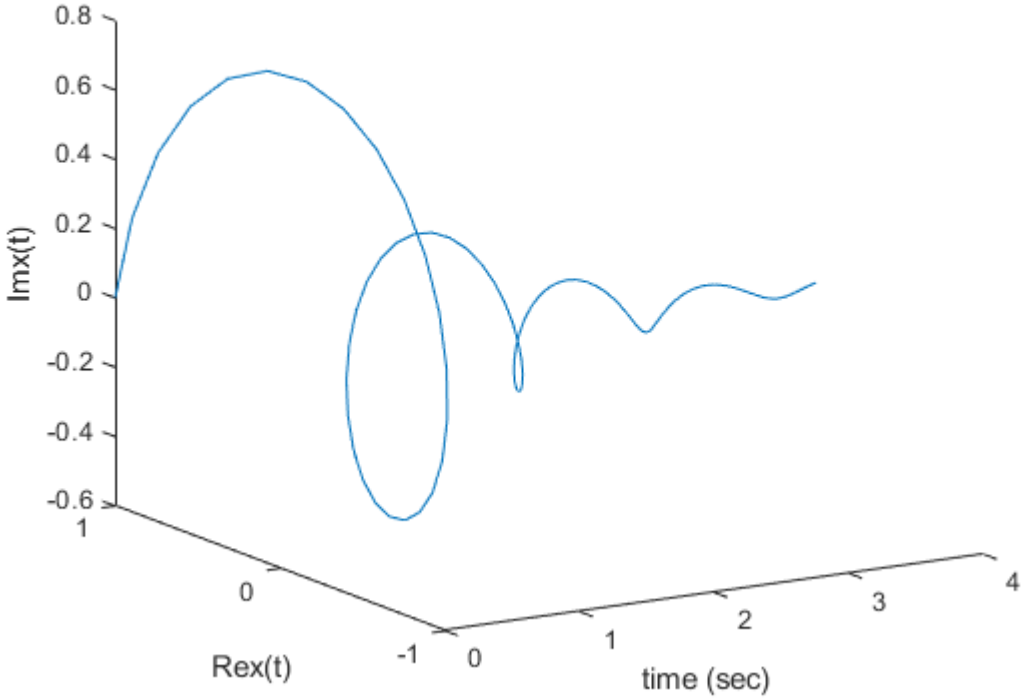
CT Decreasing general complex exponential signal

$$x(t) = e^{(-1+j2\pi)t}$$

$$= e^{-t}\cos(2\pi t) + je^{-t}\sin(2\pi t),\ \ 0 \le t \le 4$$

Use plot3 to make a 3-dimensional plot of the complex signal versus time. Rotate the plot to see the real and imaginary parts.

```
t=linspace(0,4,100);
re=exp(-t).*cos(2*pi*t);
im=exp(-t).*sin(2*pi*t);
plot3(t,re,im);
xlabel('time (sec)');
ylabel('Re{x(t)}');
zlabel('Im{x(t)}');
```



CT Increasing general complex exponential signal

$$x(t) = e^{(1+j2\pi)t}$$

$$= e^{t}\cos(2\pi t) + je^{t}\sin(2\pi t),\ \ 0 \le t \le 4$$

Use plot3 to make a 3-dimensional plot of the complex signal versus time. Rotate the plot to see the real and imaginary parts.

```
t=linspace(0,4,100);
re=exp(t).*cos(2*pi*t);
im=exp(t).*sin(2*pi*t);
plot3(t,re,im);
xlabel('time (sec)');
ylabel('Re{x(t)}');
zlabel('Im{x(t)}');
```

DT and CT sinusoidal signals

$$x[n] = \sin(2\pi n/8), \quad 0 \le n \le 64$$

$$x(t) = \sin(2\pi t/8), \quad 0 \le t \le 64$$

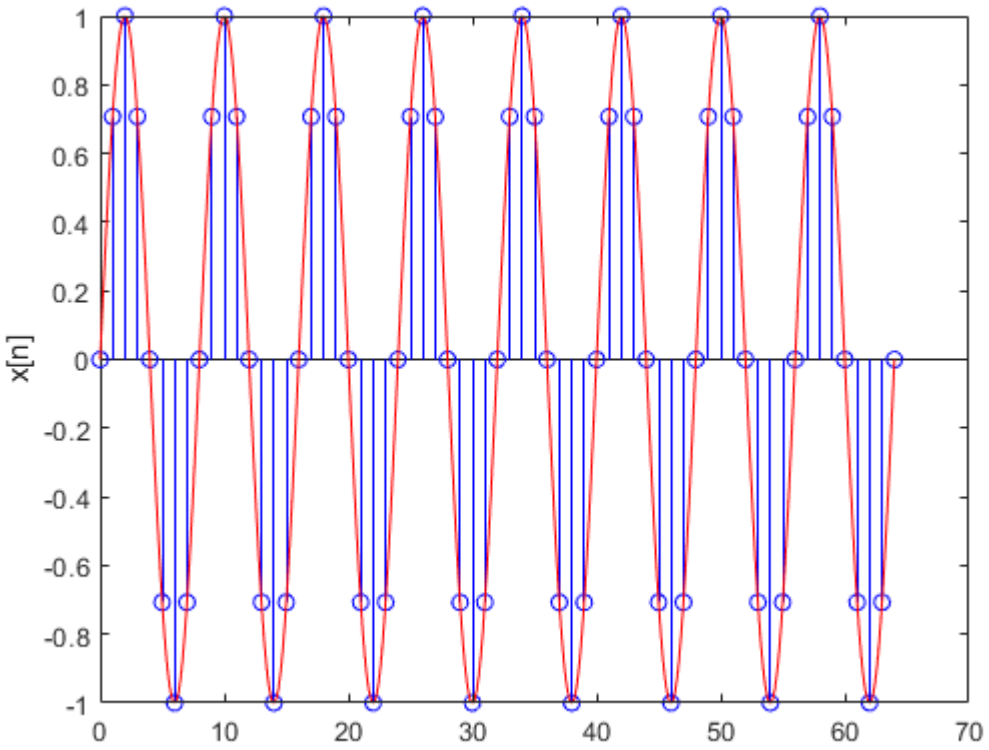
Use stem and plot to create a plot showing this pair of DT and CT sinusoids.

Are they periodic? If so, what is the fundamental period of each of the signals?

$x[n]$ has fundamental period $N_0 = 8$

$x(t)$ has fundamental period $T_0 = 8$

```
n=0:64;
x=sin(2*pi*n/8);
stem(n,x,'b');
ylabel('x[n]')
hold on
%
t=0:0.1:64;
xt=sin(2*pi*t/8);
plot(t,xt,'r')
hold off
```



Another pair of DT and CT sinusoidal signals

$$y[n] = \sin(8\pi n/31), \ \ 0 \le n \le 64$$

$$y(t) = \sin(8\pi t/31), \ \ 0 \le t \le 64$$

Use stem and plot to create a plot showing this pair of DT and CT sinusoids.

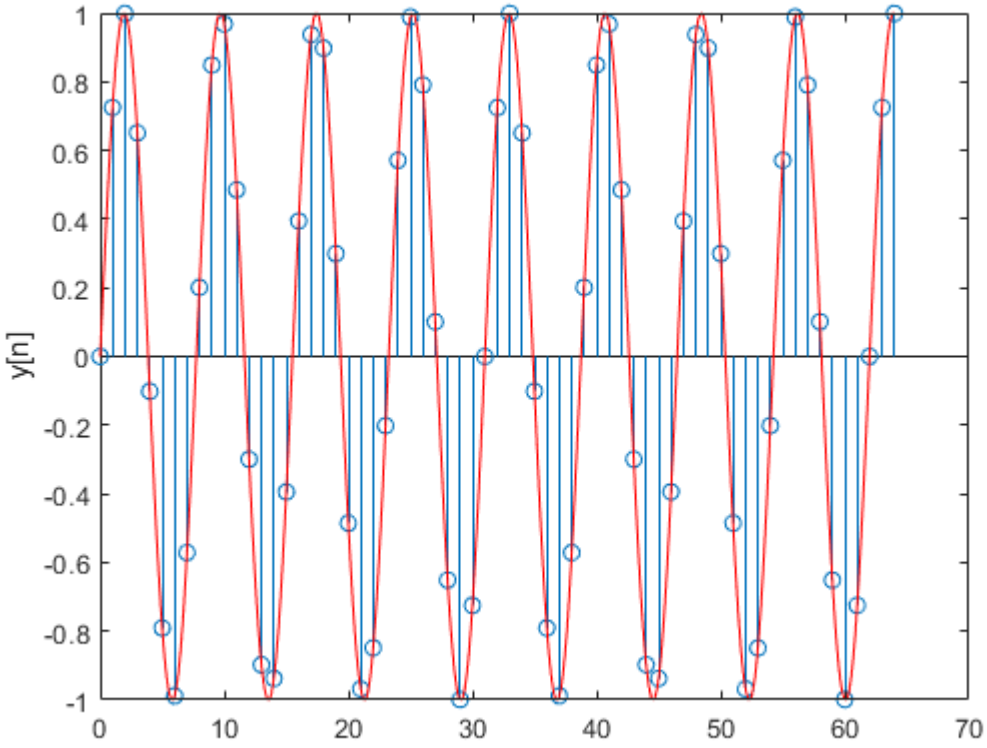
Are they periodic? If so, what is the fundamental period of each of the signals?

$x[n]$ has fundamental period $N_0 = 31$

$x(t)$ has fundamental period $T_0 = 31/4 = 7.75$

```
n=0:64;
y=sin(8*pi*n/31);
stem(n,y);
ylabel('y[n]')
hold on
%
t=0:0.1:64;
```

```
yt=sin(8*pi*t/31);
plot(t,yt,'r')
hold off
```



Yet another pair of DT and CT sinusoidal signals

$$z[n] = \sin(3n/4), \;\; 0 \le n \le 64$$

$$z(t) = \sin(3t/4), \;\; 0 \le t \le 64$$

Use stem and plot to create a plot showing this pair of DT and CT sinusoids.

Are they periodic? If so, what is the fundamental period of each of the signals?

$x[n]$ is aperiodic.

$x(t)$ has fundamental period $T_0 = 8\pi/3 \approx 8.3775$

```
n=0:64;
z=sin(3*n/4);
stem(n,z,'b');
ylabel('z[n]')
```

```
hold on
%
t=0:0.1:64;
zt=sin(3*t/4);
plot(t,zt,'r')
hold off
```