EEC-201 Final Project

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March 2021

1 Problem 1

Suppose $x(n)$ is the following discrete-time signal,

$$x(n) = 2\cos(0.2\pi n) + 3\cos(0.4\pi n) + 4\cos(0.6\pi n).$$

Suppose we generate the sequences $y(n)$ and $s(n)$ from $x(n)$ with the following system

$$x(n) \longrightarrow \boxed{H(z)} \longrightarrow \boxed{\downarrow 2} \longrightarrow \boxed{H(z)} \longrightarrow \boxed{\downarrow 2} \xrightarrow{s(n)} \boxed{\uparrow 4} \longrightarrow y(n)$$

where

$$H^f(\omega) = \begin{cases} 1, & |\omega| < \pi/2 \\ 0, & \pi/2 \leq |\omega| < \pi \end{cases}$$

Sketch $X^f(\omega)$, $H^f(\omega)$, $S^f(\omega)$ and $Y^f(\omega)$.

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%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%Problem 1
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%

%Parameters
wc = pi/2;
fs = 80;
sample_dur = 10;

%Generate "continuous" and "sampled" time stamps
tn = 0:1/fs:(sample_dur-(1/fs));
tnl = length(tn);

%Generate x[n]
xn = 2*cos(0.2*pi*tn)+3*cos(0.4*pi*tn)+4*cos(0.6*pi*tn);

%Generate s[n]
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[xn_filt1,d] = lowpass(xn,wc,fs,'ImpulseResponse','iir','Steepness'
    ,0.99);
[hlp,flp] = freqz (d ,1024 , tnl ) ;
xn_dwn1 = downsample(xn_filt1,2);
xn_filt2 = lowpass(xn_dwn1,wc,fs/2,'ImpulseResponse','iir','
    Steepness',0.99);
sn = downsample(xn_filt2,2);

%Generate y[n]
yn = upsample(sn,4);

figure('name','Problem 1')

%Plot x[n]
subplot(4,2,1);
plot(tn,xn)
title('x[n]')

subplot(4,2,2);
N = tnl;
xk = fft(xn,N);
fk = (0:fs/N:fs-(fs/N));
plot(fk,abs(xk))
title('X[k]')

%Plot h[n]
subplot(4,2,3);
stem(0:1:length(d.Coefficients)-1, d.Coefficients(1,:))
hold on;
stem(0:1:length(d.Coefficients)-1, d.Coefficients(2,:),'r')
legend('b[n]','a[n]')
title('h[n]')

subplot(4,2,4);
plot(flp,mag2db(abs(hlp)))
title('H[k]')

%Plot s[n]
subplot(4,2,5);
plot(tn(1:4:end),sn)
title('s[n]')

subplot(4,2,6);
N = tnl/4;
sk = fft(sn,N);
fk = (0:fs/N:fs-(fs/N));
plot(fk,abs(sk))
title('S[k]')

%Plot y[n]
subplot(4,2,7);
stem(tn,yn)
title('y[n]')

subplot(4,2,8);
N = tnl;
yk = fft(yn,N);
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fk = (0:fs/N:fs-(fs/N));
plot(fk,abs(yk))
title('Y[k]')
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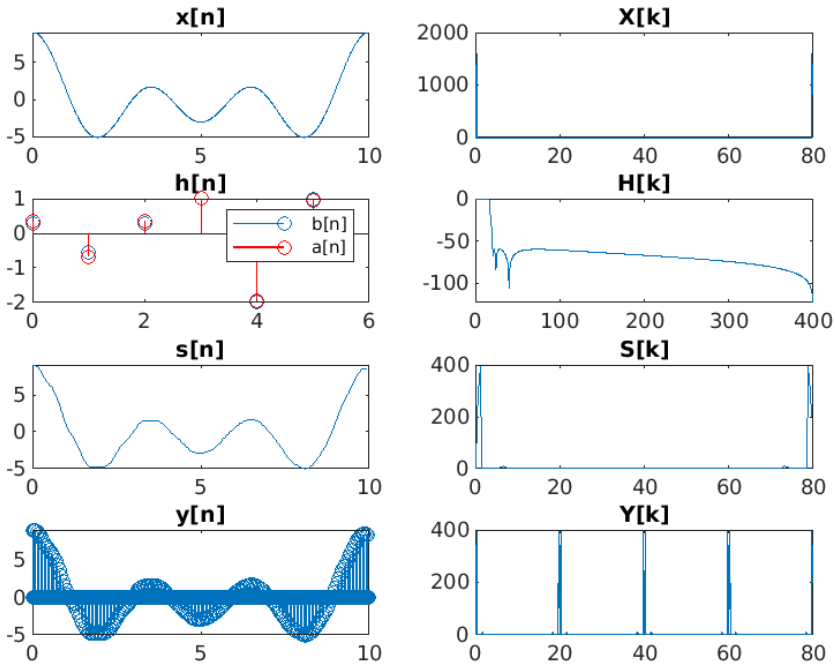

2 Problem 2