ECE 311 Lab 7

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Report Item 1

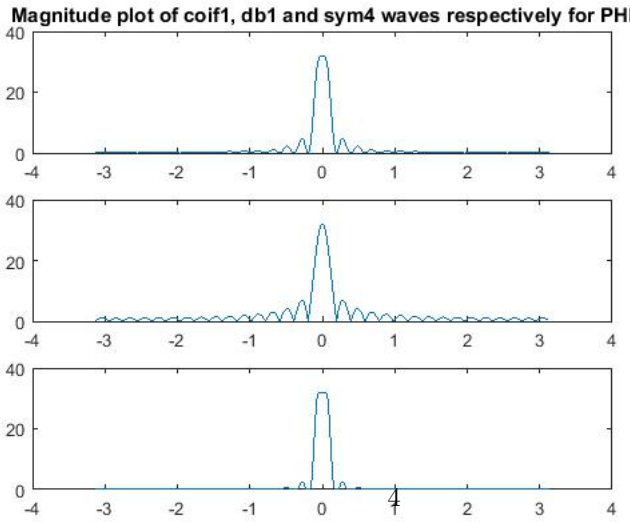
```
t = 0:.01:5.11;
st = t(t<.5);

PSI_1_0 = sin(2*pi*(st*2 + .5));
PSI_1_0 = PSI_1_0 * 2^(.5);
PSI_1_0(end:512) = 0;
figure;
subplot(411);
plot(t(1:500),PSI_1_0(1:500));
title('PSI_1_0')
xlabel('t(t<5)');
ylabel('PSI_1_0(t(t<5))');

PSI_0_1 = sin(2*pi*(st - 1 + .5));
PSI_0_1(end:512) = 0;
subplot(412);
plot(t(1:500),PSI_0_1(1:500));
title('PSI_0_1')
xlabel('t(t<5)');
ylabel('PSI_0_1(t(t<5))');

PSI_1_1 = sin(2*pi*(st*2 - 1 + .5));
PSI_1_1 = PSI_1_1 * 2^(.5);
PSI_1_1(end:512) = 0;
subplot(413);
plot(t(1:500),PSI_1_1(1:500));
title('PSI_1_1')
xlabel('t(t<5)');
ylabel('PSI_1_1(t(t<5))');

PSI_2_1 = sin(2*pi*(st*4 - 1 + .5));
PSI_2_1 = PSI_2_1 * 2^(1);
PSI_2_1(end:512) = 0;
subplot(414);
plot(t(1:500),PSI_2_1(1:500));
title('PSI_2_1')
xlabel('t(t<5)');
ylabel('PSI_2_1(t(t<5))');

w = fftshift((0:511)/512*2*pi);
w(1:512/2) = w(1:512/2) - 2*pi;

figure;
subplot(411);
plot(w,abs(fftshift(fft(PSI_1_0))));
title('PSI_1_0')
xlabel('w');
ylabel('abs(fft(PSI_1_0))');
subplot(412);
plot(w,abs(fftshift(fft(PSI_0_1))));
title('PSI_0_1')
xlabel('w');
ylabel('abs(fft(PSI_0_1))');
subplot(413);
plot(w,abs(fftshift(fft(PSI_1_1))));
title('PSI_1_1')
xlabel('w');
ylabel('abs(fft(PSI_1_1))');
subplot(414);
plot(w,abs(fftshift(fft(PSI_2_1))));
title('PSI_2_1')
xlabel('w');
ylabel('abs(fft(PSI_2_1))');

figure;
subplot(411);
plot(w,angle(fftshift(fft(PSI_1_0))));
title('PSI_1_0')
xlabel('w');
```

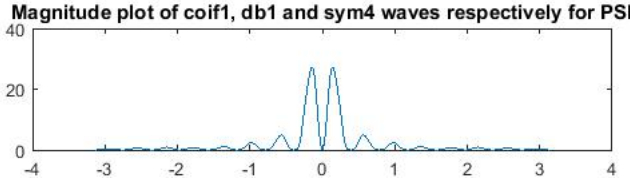
Report Item 2 The father wavelet is called a corking function because it fills up the holes of the lower frequency components that the mother wavelets do not detect. The wavelet coeffiecients are different than fourier coefficients because in wavelet analysis, a short modulated window is used to complete the spectral representation for that chunk. After that, the window is shifted along the signal. It is a time-frequency analysis instead a purely frequency analysis.

Report Item 3

```
[PHI1,PSI1,t1] = wavefun('coif1',5);
[PHI2,PSI2,t2] = wavefun('db1',5);
[PHI3,PSI3,t3] = wavefun('sym4',5);

w = fftshift((0:511)/512*2*pi);
w(1:512/2) = w(1:512/2) - 2*pi;

PH1w = fftshift(fft(PHI1,512));
PH2w = fftshift(fft(PHI2,512));
PH3w = fftshift(fft(PHI3,512));
PS1w = fftshift(fft(PSI1,512));
PS2w = fftshift(fft(PSI2,512));
PS3w = fftshift(fft(PSI3,512));

figure;
subplot(311);
plot(w,abs(PH1w));
title('Magnitude plot of coif1, db1 and sym4 waves respectively for PHI');

subplot(312);
plot(w,abs(PH2w));
subplot(313);
plot(w,abs(PH3w));


figure;

subplot(311);
plot(w,abs(PS1w));
title('Magnitude plot of coif1, db1 and sym4 waves respectively for PSI');
subplot(312);
plot(w,abs(PS2w));
subplot(313);
plot(w,abs(PS3w));
```

report2.m

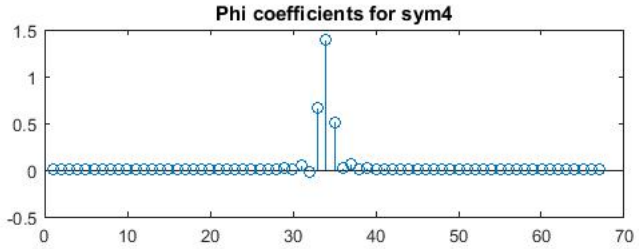


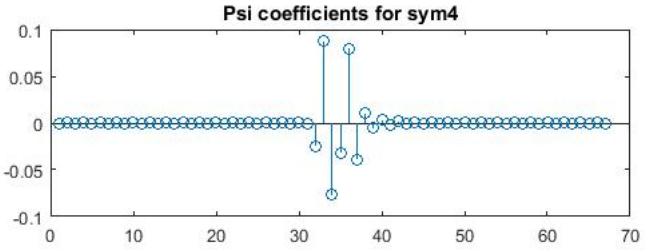


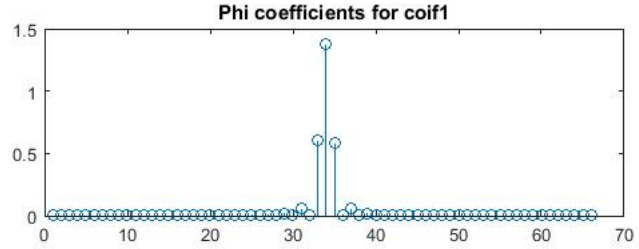
Report Item 4

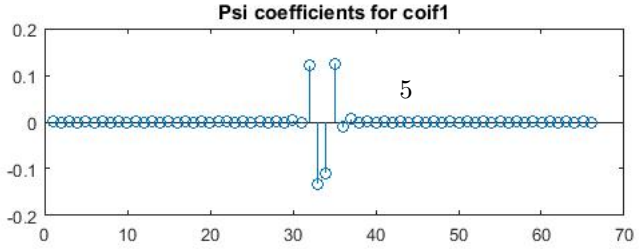
```
load signal.mat;
[A1,D1] = dwt(x,'sym4');
[A2,D2] = dwt(x,'coif1');

figure;
subplot(211);
stem(A1);
title('Phi coefficients for sym4');
subplot(212);
stem(D1);
title('Psi coefficients for sym4');

figure;
subplot(211);
stem(A2);
title('Phi coefficients for coif1');
subplot(212);
stem(D2);
title('Psi coefficients for coif1');
```

report3.m





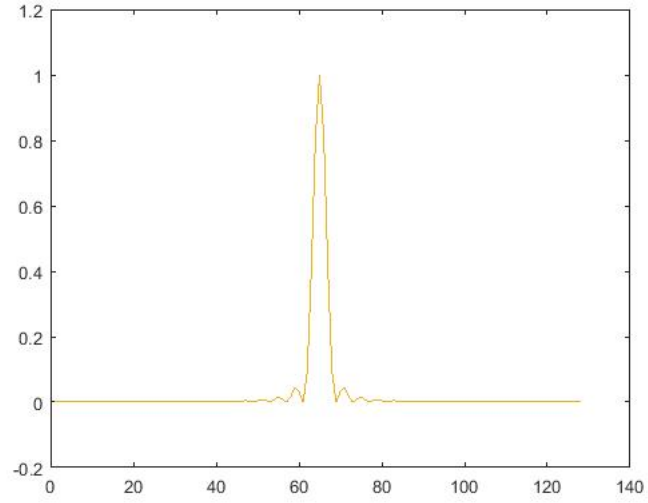


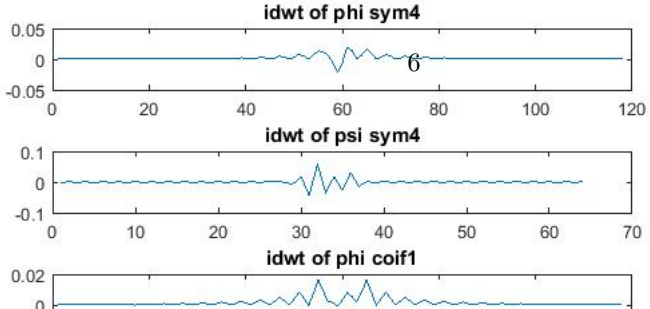


Report Item 5

```
load signal.mat;
[A1,D1] = dwt(x,'sym4');
[A2,D2] = dwt(x,'coif1');
xnew1 = idwt(A1,D1,'sym4');
xnew2 = idwt(A2,D2,'coif1');
figure;
plot(x);
hold on;
plot(xnew1);
plot(xnew2);
% plot shows same graph overlayed 3 times

x1 = idwt(A1(A1<mean(A1)),[],'sym4');
x2 = idwt([],D1(D1<mean(D1)),'sym4');
x3 = idwt(A2(A2<mean(A2)),[],'coif1');
x4 = idwt([],D2(D2<mean(D2)),'coif1');

figure
subplot(411);
plot(x1);
title('idwt of phi sym4');
subplot(412);
plot(x2);
title('idwt of psi sym4');
subplot(413);
plot(x3);
title('idwt of phi coif1');
subplot(414);
plot(x4);
title('idwt of psi coif1');
```

report4.m





Report Item 6

```
clc, clear all, close all

[xorig,fs] = audioread('original.wav');
[xnoise,fs] = audioread('noisy.wav');

wname = 'db1';


a1thresh = 0.016; % Must be positive.
d1thresh = 0.009; % Must be positive.
a2thresh = 0.016; % Must be positive.
d2thresh = 0.0; % Must be positive.
a3thresh = 0.02; % Must be positive.
d3thresh = 0.012; % Must be positive.
a4thresh = 0.0060; % Must be positive.
d4thresh = 0.012; % Must be positive.
a5thresh = 0.002; % Must be positive.
d5thresh = 0.016; % Must be positive.

% DWT
x = xnoise;
[a1,d1] = dwt(x,wname);
[a2,d2] = dwt(a1,wname);
[a3,d3] = dwt(a2,wname);
[a4,d4] = dwt(a3,wname);
[a5,d5] = dwt(a4,wname);

% Inverse DWT
a5_ = (abs(a5)>a5thresh).*a5;
d5_ = (abs(d5)>d5thresh).*d5;
a4t = idwt(a5_,d5_,wname);
a4_ = (abs(a4t)>a4thresh).*a4t;
d4_ = (abs(d4)>d4thresh).*d4;
a3t = idwt(a4_,d4_,wname);
a3_ = (abs(a3t)>a3thresh).*a3t;
d3_ = (abs(d3)>d3thresh).*d3;
a2t = idwt(a3_,d3_,wname);
a2_ = (abs(a2t)>a2thresh).*a2t;
d2_ = (abs(d2)>d2thresh).*d2;
a1t = idwt(a2_,d2_,wname);
a1_ = (abs(a1t)>a1thresh).*a1t;
d1_ = (abs(d1)>d1thresh).*d1;
x_ = idwt(a1_,d1_,wname);

% Output
figure;
subplot(221); stem(a5); title('a5','fontsize',14);
subplot(222); stem(d5); title('d5','fontsize',14);
subplot(223); stem(a5_); title('a5 filtered','fontsize',14);
subplot(224); stem(d5_); title('d5 filtered','fontsize',14);
figure;
subplot(221); stem(a4); title('a4','fontsize',14);
subplot(222); stem(d4); title('d4','fontsize',14);
subplot(223); stem(a4_); title('a4 filtered','fontsize',14);
subplot(224); stem(d4_); title('d4 filtered','fontsize',14);
figure;
subplot(221); stem(a3); title('a3','fontsize',14);
subplot(222); stem(d3); title('d3','fontsize',14);
subplot(223); stem(a3_); title('a3 filtered','fontsize',14);
subplot(224); stem(d3_); title('d3 filtered','fontsize',14);
figure;
subplot(221); stem(a2); title('a2','fontsize',14);
subplot(222); stem(d2); title('d2','fontsize',14);
subplot(223); stem(a2_); title('a2 filtered','fontsize',14);
subplot(224); stem(d2_); title('d2 filtered','fontsize',14);
figure;
subplot(221); stem(a1); title('a1','fontsize',14);
subplot(222); stem(d1); title('d1','fontsize',14);
subplot(223); stem(a1_); title('a1 filtered','fontsize',14);
```