Lab_10_HW

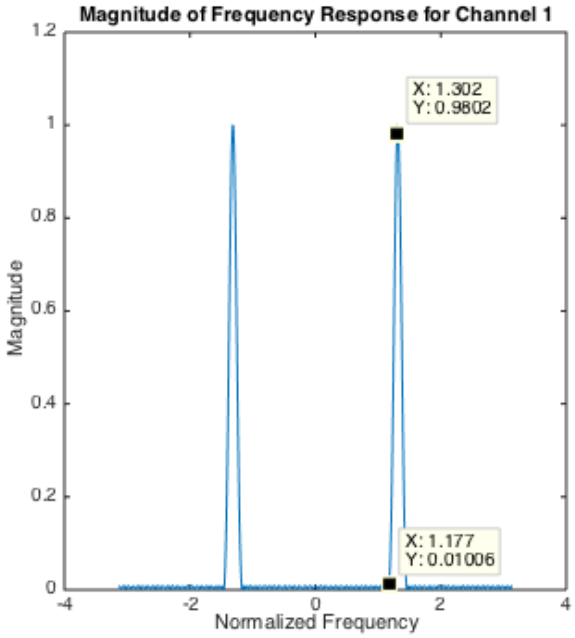
697 770 852 941 1209 1336 1477 1633 12 13 14 16 697 1 2 3 A 770 4 5 6 B 852 7 8 9 C 941 * 0 P D

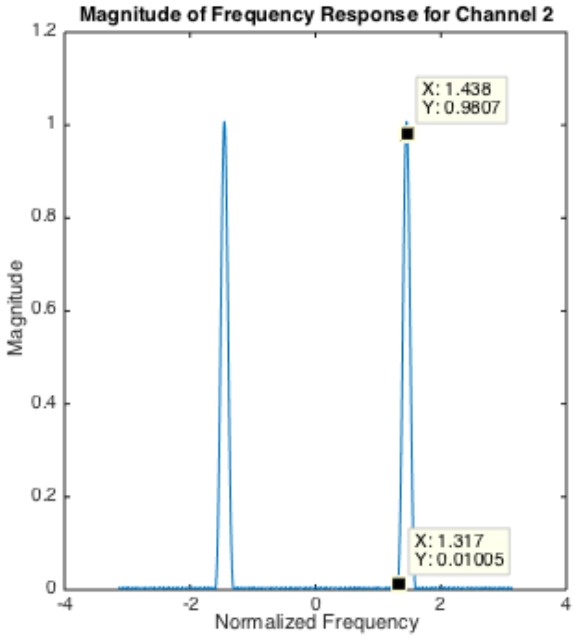
Contents

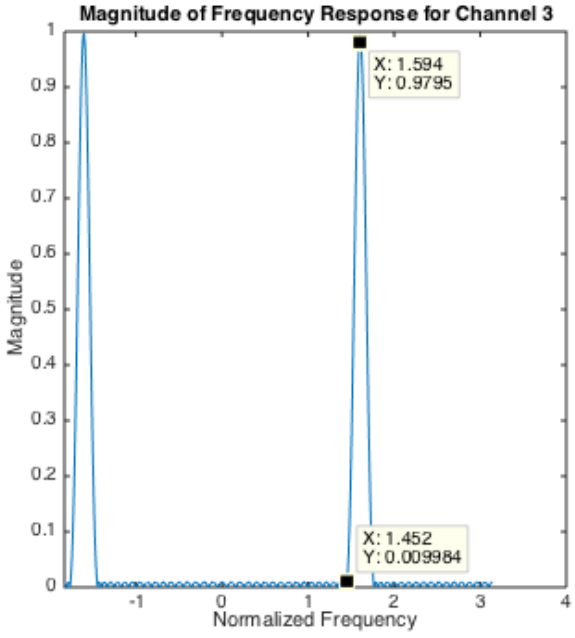
4.1 Design 8 Filters

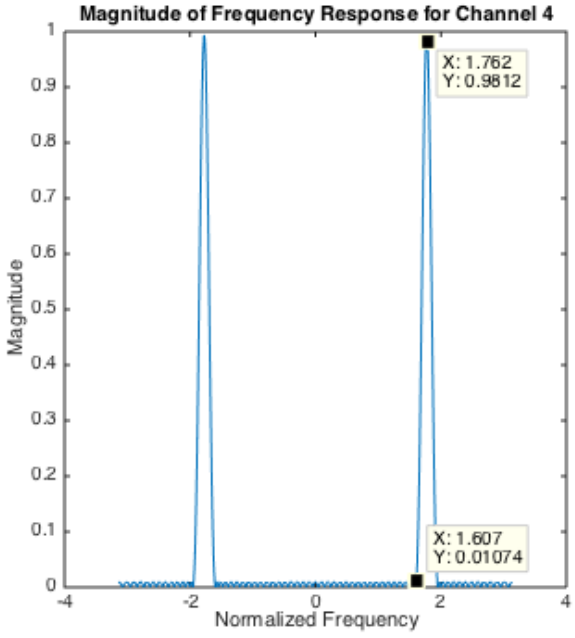
```
fc = [697, 770, 852, 941, 1209, 1336, 1477, 1633];
fpdelta = 6;
fpass = [fc - fpdelta;fc + fpdelta];
fs = 1/0.3e-3;
delp = .02;
dels = .01;
fsdelta = min([abs([diff(fc),1e100]);abs([1e100,diff(fc)])]);
fstop = [fc - fsdelta; fc + fsdelta];

wpass = (fpass*2*pi)/fs;
wstop = (fstop*2*pi)/fs;

% Correction for even and minimum order that fits specifications,
% determined graphically
correction = [-7,-1,-6,-6,-2,0,-3,6];
M = zeros(1,length(fc));
b = cell(1,length(fc));

for n = 1:length(fc)
    if(n ~= 8)
        [N, Fo, Ao, W] = firpmord([fstop(1,n), fpass(1,n), fpass(2,n), fstop(2,n)], [0, 1, 0], [dels, delp, d
els], fs);
    else
        [N, Fo, Ao, W] = firpmord([fstop(1,n), fpass(1,n)], [0, 1], [dels, delp], fs);
    end
    M(n) = N + correction(n);
    b{n} = firpm(M(n), Fo, Ao, W);

%     if (n == 5)
%         figure
%     end
%     if (n <= 4)
%         subplot(2,2,n);
%     else
%         subplot(2,2,n-4);
%     end
%     ww = -pi:1/10000:pi;
%     HH = freqz(b{n}, 1, ww);
%     plot(ww, abs(HH));
%     title(sprintf('Magnitude of Frequency Response for Channel %d', n));
%     xlabel('Normalized Frequency');
%     ylabel('Magnitude');
end

open MagnitudeResponse1.fig
open MagnitudeResponse2.fig
```

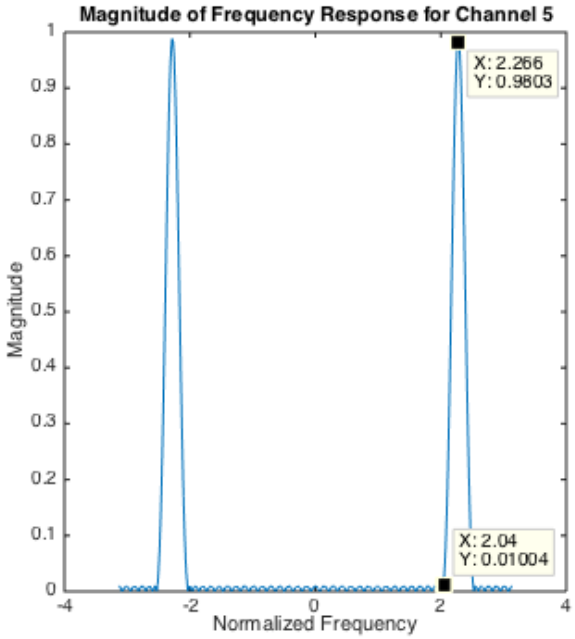
```
maxdelay = max(M)/2;
delay = maxdelay - M/2;
maxlength = 0;
for n = 1:length(fc)
    bf{n} = firfilt([zeros(1,delay(n)),1],b{n});
end
```

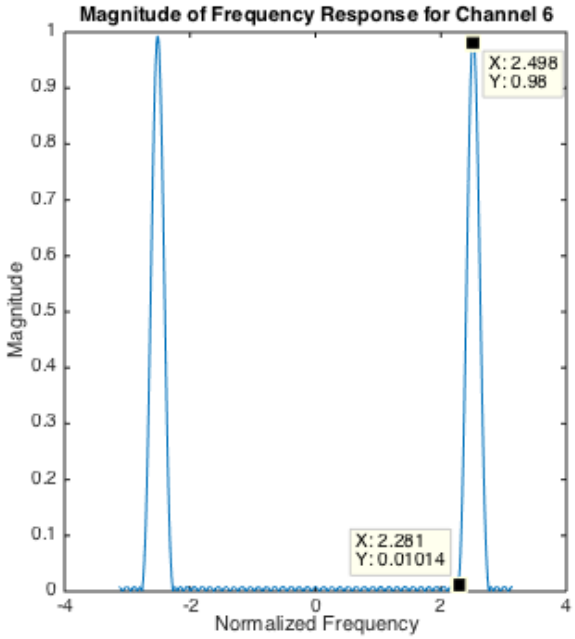


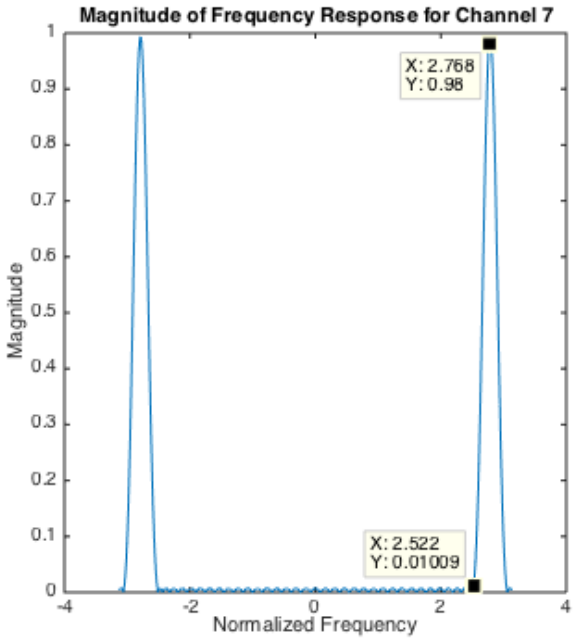


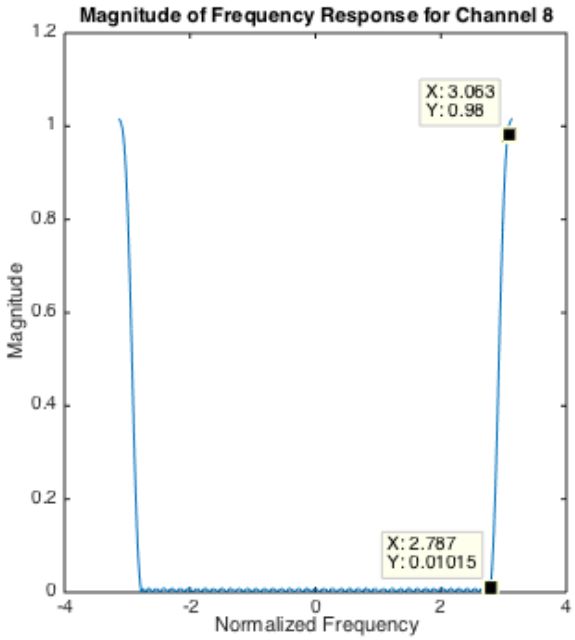










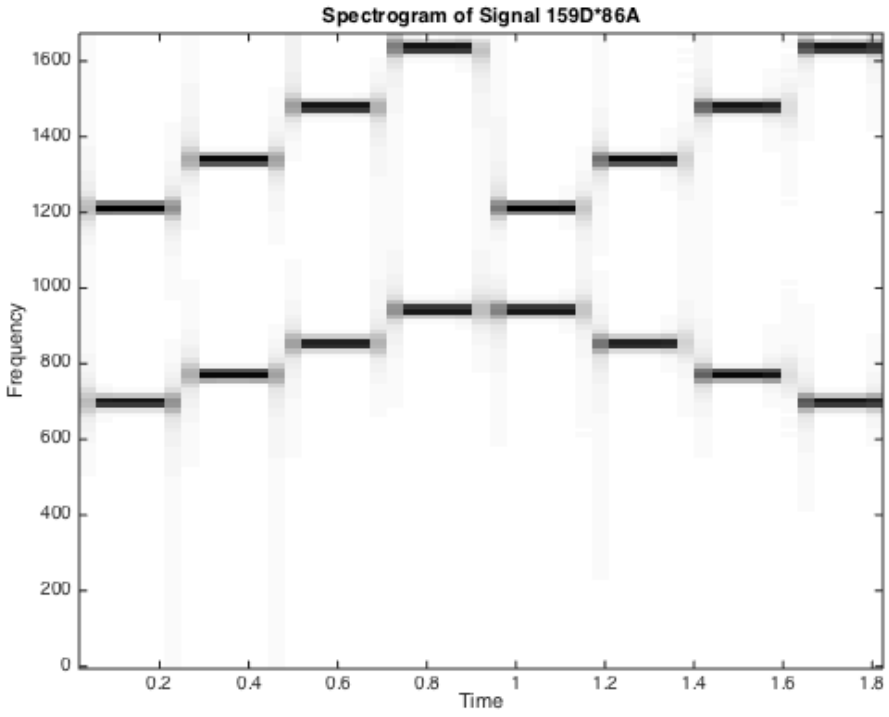


4.2a

xx = DTMFdial('159D*86A', fs);

```
xx = DTMFdial('159D*86A', fs);
figure
plotspec(xx, fs);
title('Spectrogram of Signal 159D*86A');
```

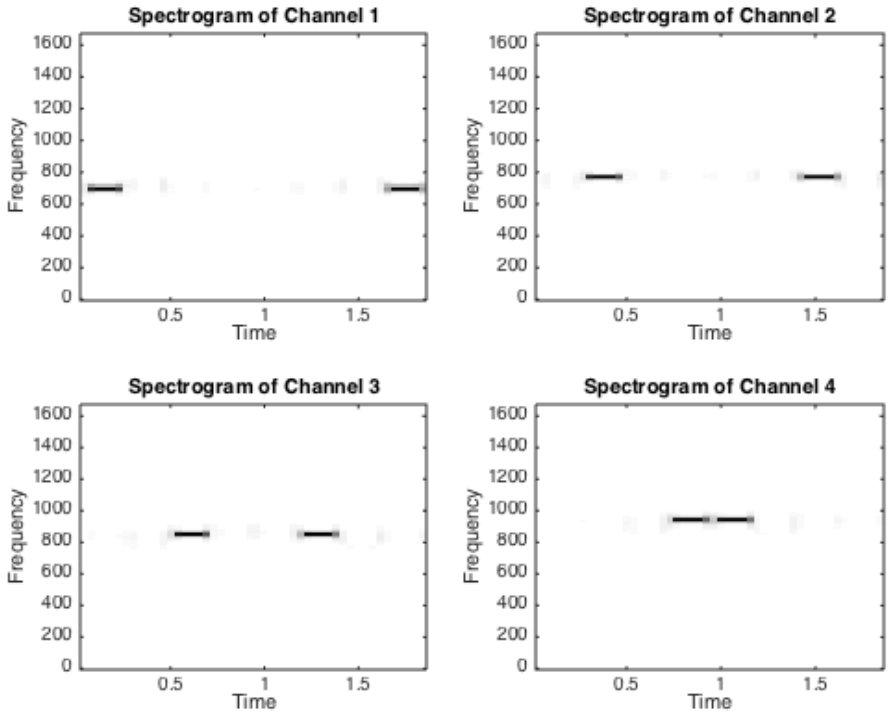
```
xlabel('Time');
ylabel('Frequency');
figure
```

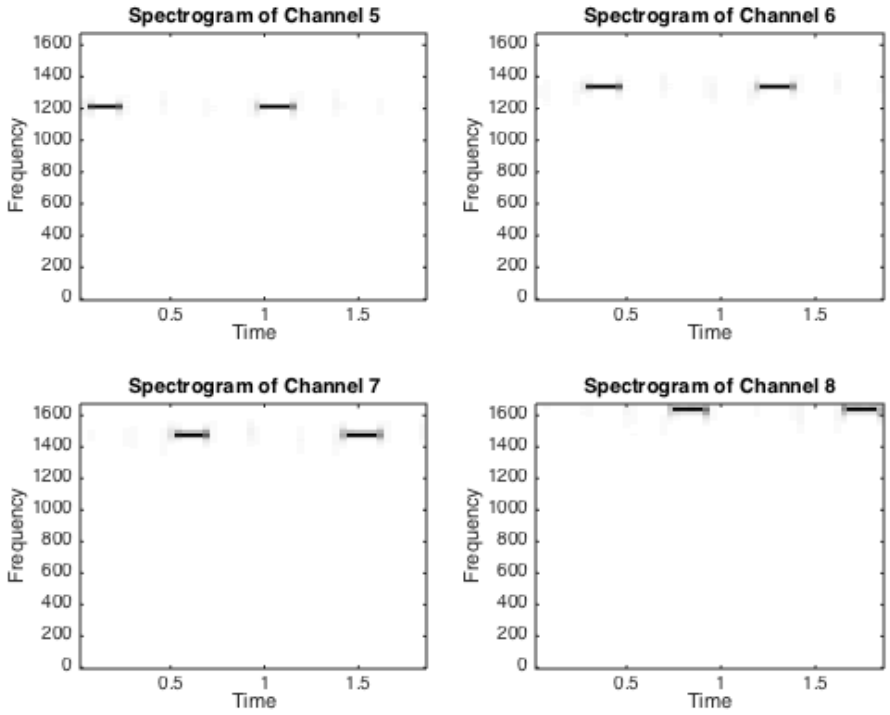


4.2a Filters

```
for n = 1:length(fc)
    yy = firfilt(xx,bf{n});
    if (length(yy) > maxlength)
```

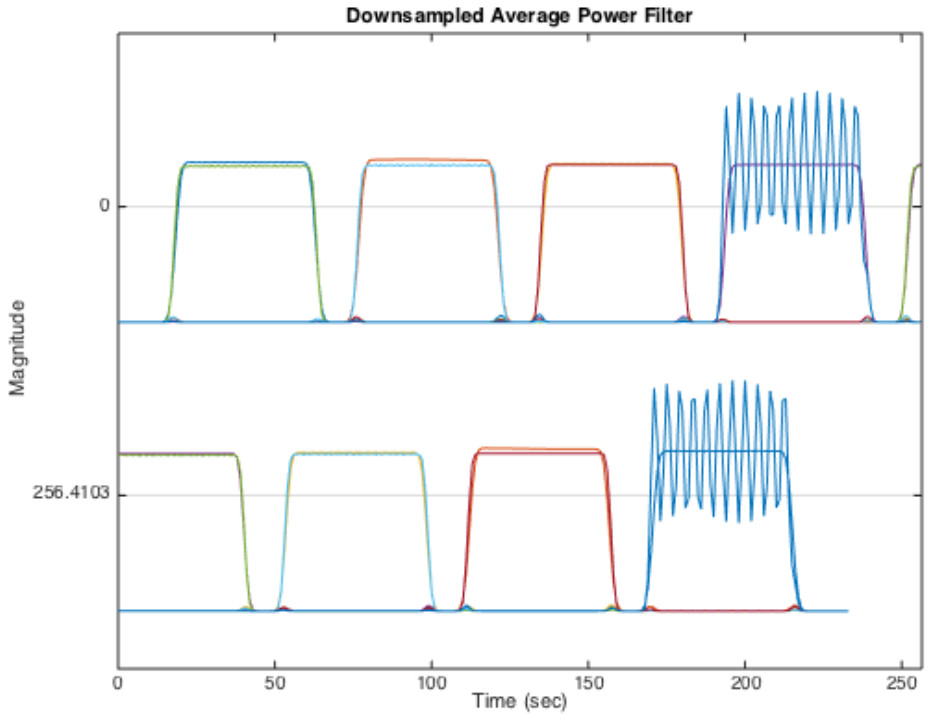
```
        maxlength = length(yy);
    end
    if (n == 5)
        figure
    end
    if (n <= 4)
        subplot(2,2,n);
    else
        subplot(2,2,n-4);
    end
    plotspec(yy, fs);
    title(sprintf('Spectrogram of Channel %d', n));
    xlabel('Time');
    ylabel('Frequency');
end
```





4.3b

```
Lp = round((48e-3*fs)/3);
R = round(Lp/4);
hh = hamming(Lp);
len = round((maxlength + length(hh) - 1)/R);
bfsq = cell(1,length(fc));
bfbl = cell(1,length(fc));
avgPower = zeros(len,8);
figure
for n = 1:length(fc)
   yy = firfilt(xx,bf{n});
   bfsq{n} = yy.^2;
   bfbl{n} = firfilt(hh, bfsq{n});
   pdown = bfbl{n}(1:R:end);
   avgPower(:,n) = [pdown, zeros(1,len-length(pdown))];
end

strips(avgPower,fs/R);
title('Downsampled Average Power Filter');
xlabel('Time (sec)');
ylabel('Magnitude');
```



4.3c

```
phoneNum = decodeDTMF(avgPower, fs, R);
fprintf('Decoded Phone Number is %s\n', phoneNum);
```

```
Decoded Phone Number is 159D*86A
```

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