EE301 Lab7

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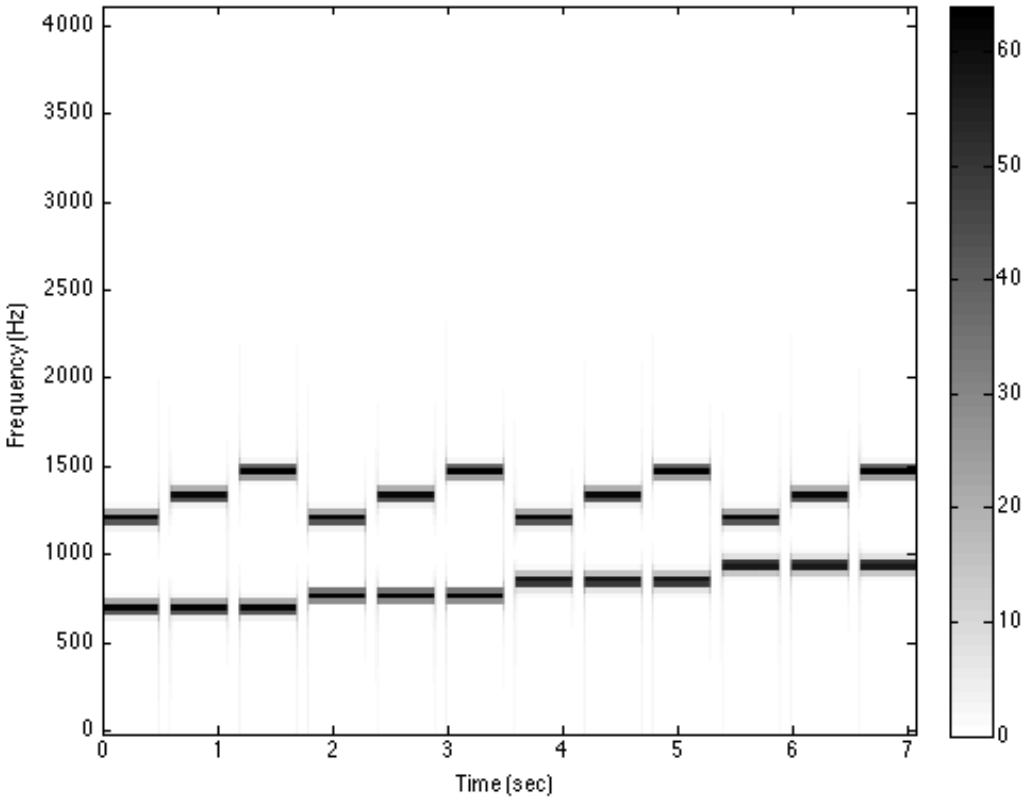
```
clc;
clear all;
close all;

%Q1
signal = dtmf_dial([1 2 3 4 5 6 7 8 9 10 11 12],1);

%Q2
%Part A) A vector was used instead of a command
M = 50;
fs = 8192;
k=0:M;

h697 = sin(2*pi*697.*k/fs); %first impulse response filter
h770 = sin(2*pi*770.*k/fs);
h852 = sin(2*pi*852.*k/fs);
h941 = sin(2*pi*941.*k/fs);
h1209 = sin(2*pi*1209.*k/fs);
h1336 = sin(2*pi*1336.*k/fs);
h1477 = sin(2*pi*1477.*k/fs);

figure
stem(h697); title('impulse response of 697'); xlabel('Frequency'); ylabel('H697');

figure
stem(h770); title('impulse response of 770'); xlabel('Frequency'); ylabel('H770');

figure
stem(h852); title('impulse response of 852'); xlabel('Frequency'); ylabel('H852');

figure
stem(h941); title('impulse response of 941'); xlabel('Frequency'); ylabel('H941');

figure
stem(h1209); title('impulse response of 1209'); xlabel('Frequency'); ylabel('H1209');

figure
stem(h1336); title('impulse response of 1336'); xlabel('Frequency'); ylabel('H1336');

figure
stem(h1477); title('impulse response of 1477'); xlabel('Frequency'); ylabel('H1477');
%
% [H697,w] = freqz(h697,M);
% figure
% plot(w/2/pi*fs,abs(H697));
```

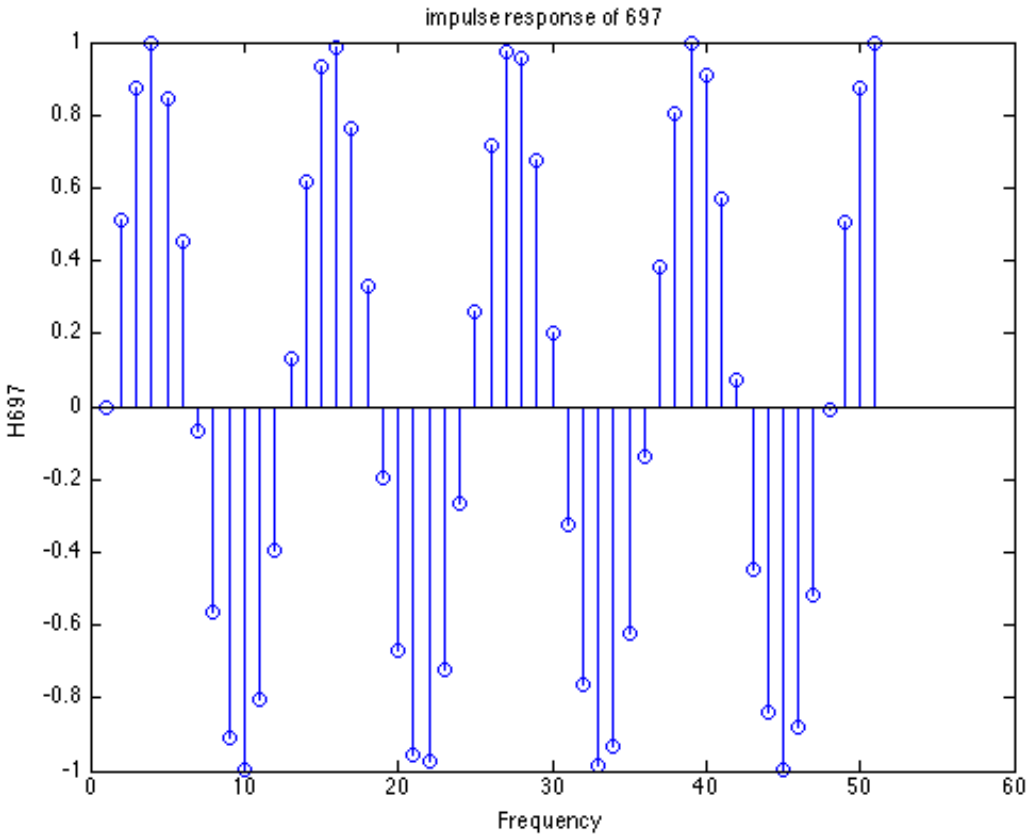
```
%c
for M=1:1000;
    gain = dtmf_filt_char(M,697,0);
    g1=sort(gain);
    g0(M)=g1(7)/g1(6);
end

M=1:1000;
figure;
plot(M,g0);

% As the value of M increases, the peaks increase.
% As a result, there are more delays.
% The resulting gain of the frequency is 107, 104, 98, 95, 66, 62, 59

%Q3
figure
numbers = dtmf_decode(signal)
soundsc(signal, fs);

%Q4
success_rate = dtmf_attack(0.9)
```

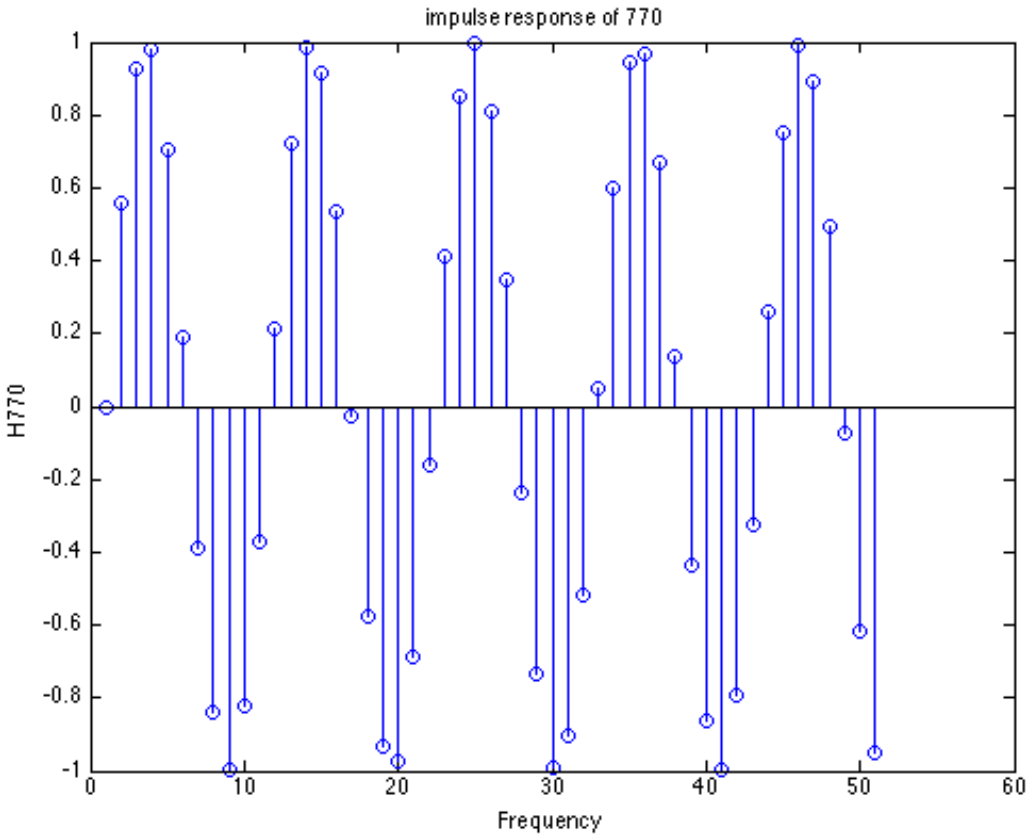
```
numbers =

     1
     3
     2
     3
     3
     4
     3
     5
     3
     5
     6
     3
     3
     7
     8
     3
     9
     3
    10
     9
    11
    15
    12

Noise Power: 0.9  Trial 1/10
   *** Decoder Error ***
     Original: 1   2   3   4   5   6   7   8   9  10  11  12
```

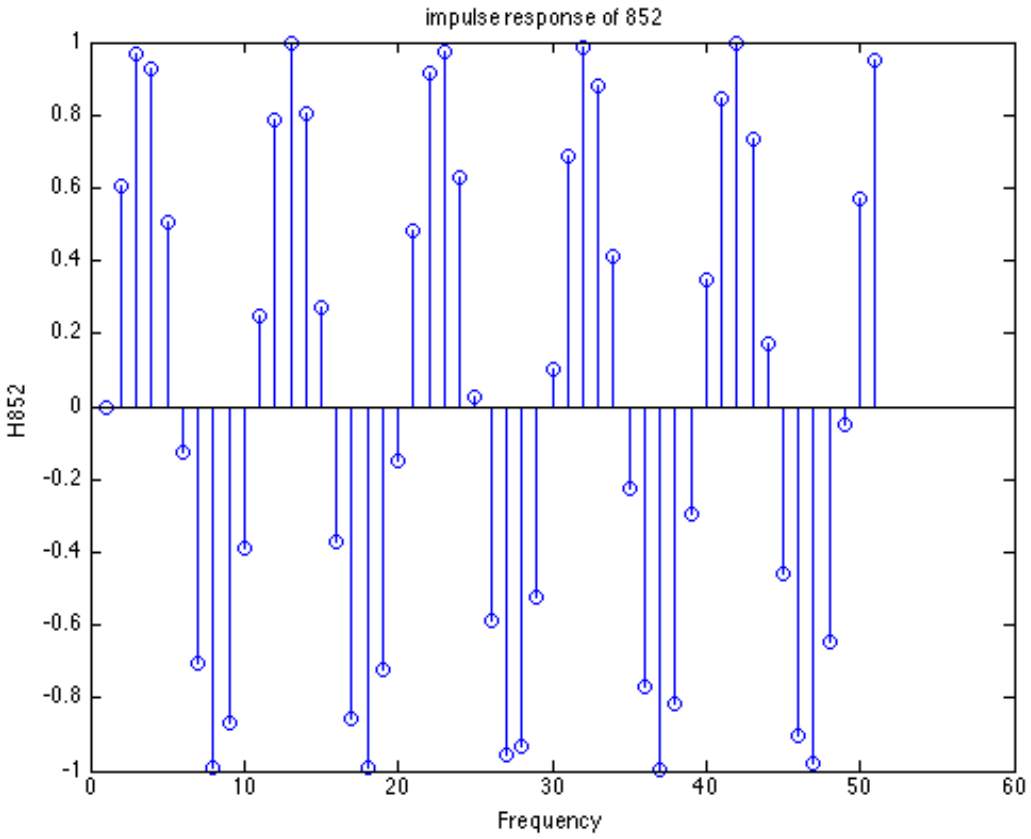
```
     Decoded : 1   4  12   4   3  11   2   3   4  10   3   4   9   5   9   4   7   9  12   3
 5   3   5   4   1   7   9   5   6   5   8   9   3  12   5   3   7   9   7   3   4  12   9  10
   8  11   3   5   9   1   4   5  11   4  10   4   3   4   3   5  11   4  12
Noise Power: 0.9  Trial 2/10
   *** Decoder Error ***
     Original: 1   2   3   4   5   6   7   8   9  10  11  12
     Decoded : 1   4   8  10   7   3   2   1   4   3  10  11   6   5   3   4   5   3   7   3
 8   5   3   1   4   9   5   6   3   4   3   4   7   9   4   5   4  11   8   7   4   5   9   3
   4   3   5   3  10   4   9   2   5   3  11   2   8   9  12   6   4  12
Noise Power: 0.9  Trial 3/10
   *** Decoder Error ***
     Original: 1   2   3   4   5   6   7   8   9  10  11  12
     Decoded : 1   2   9   6  12   4   8   3   2   4   3   5   3  10   9  15   9   5   4   8
 5  12   7   4   5   3   4  12  11   3   6   7  15   6   2  15   9   2   7   4   3  12  10  12
   2   8  12   9   7   5   6  12   9   5   3   4   5  10  12   5   3   9   3   5  11   3   4
 9   5  12
Noise Power: 0.9  Trial 4/10
   *** Decoder Error ***
     Original: 1   2   3   4   5   6   7   8   9  10  11  12
     Decoded : 1   4   5   8   4   2   4  12  10   3   4   3   5   3   5   8   3   4   9   5
 8   5   2  12   5   3  11   2   4   6   3   7   9  12   3   7   3  11   5   9   6   5   8   7
   1   4   6   9   4  12   9   4  15   7  10   5   9   7   8   5  11  12   1  10   4   3  12
 9  12
Noise Power: 0.9  Trial 5/10
   *** Decoder Error ***
     Original: 1   2   3   4   5   6   7   8   9  10  11  12
     Decoded : 1   3   4   9   5   3   2   6   3   5   8   9   3   1   7   9   8   9   4   5
 3   7   9   3   4   5   3   6   3   6   9   6   4   9   7   1   7   3  11  12   4   5   8   9
   3   7  10  11   9   5   1   3   5   4   1  10   3  11   5  12   5  11  15   3   9   4  12
Noise Power: 0.9  Trial 6/10
   *** Decoder Error ***
     Original: 1   2   3   4   5   6   7   8   9  10  11  12
     Decoded : 1   2   3   5   3   5   2   5  11   4   5   3   1   6   8   3   4   3   4   3
 5   3   5   2   5   6  12  11   4   6  10   6   2   5   7   9   5   3   4   8   5   8   4   5
   4   7   4   9   5   7  10   3   5  11   5   3   7   4   3  12
Noise Power: 0.9  Trial 7/10
   *** Decoder Error ***
     Original: 1   2   3   4   5   6   7   8   9  10  11  12
     Decoded : 1   4   5   3   5   3   2   3   2   4   3   4   6   3   8  11   5   3   4   9
 4   5   4   5   6   5   3   2   3   4   6   1   4   5   4   5   7   6   5   8   4   3   8   9
   4   5   3   9   3   2   5   3   5  10   4   1   6   8  11   8   3   5   9   1   9  12
Noise Power: 0.9  Trial 8/10
   *** Decoder Error ***
     Original: 1   2   3   4   5   6   7   8   9  10  11  12
     Decoded : 1   3   4   2   3  12   2   8   4   3   9   5   3   5  11   9  15  11   7   4
 1   7   5   3   2   5  10  11   5   8   5   4   6   5   3   4   5   7  15   9   7   8   5   4
   8  15   3   5   9  11   3   4   5   9  10   9   7   3   5   9   5  11   2   5  11  10   4
12
Noise Power: 0.9  Trial 9/10
   *** Decoder Error ***
     Original: 1   2   3   4   5   6   7   8   9  10  11  12
     Decoded : 1   5   2   8   1   3   2   3  12   3   4   3   1   4   5   4   5   4   3   1
 5  11  12   8   5   4   9   8  11   6   5   4   6   4   3   4   5   3   7   5   3   1   4   5
```

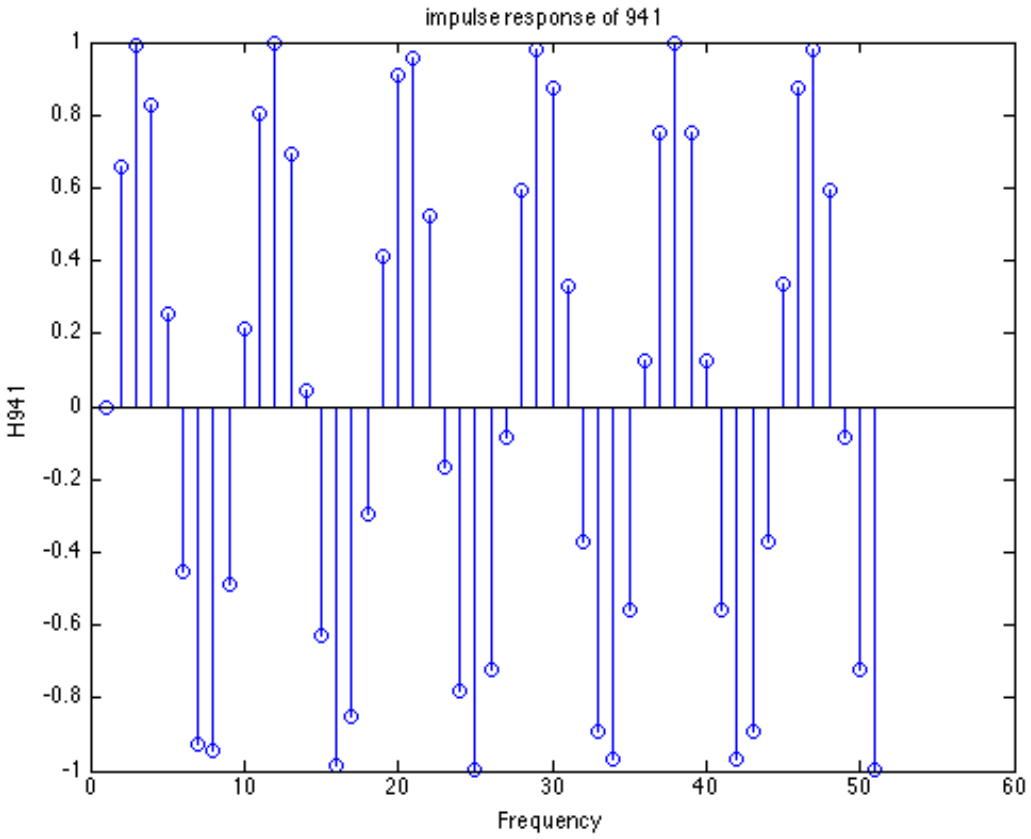
```
    8    4    3    5    9    6    2    4    6    4    3   10    5    3    8    5    4    5   11    3    9   11    5
12
Noise Power: 0.9  Trial 10/10
   *** Decoder Error ***
     Original: 1    2    3    4    5    6    7    8    9   10   11   12
     Decoded : 1    6   12   15    3    4    7    2   11    5    6    5    4    7    3    9    5    4    7    4
 1    3    5    9    5    3   15   12    5    8    5    6    5    8    9    7   10    4    9    4    3    8    9    5
  15    7    4    9    5    4   10    5   12   10    4    9    8   15    5   11   12    4    1    4    6   12

success_rate =

     0
```

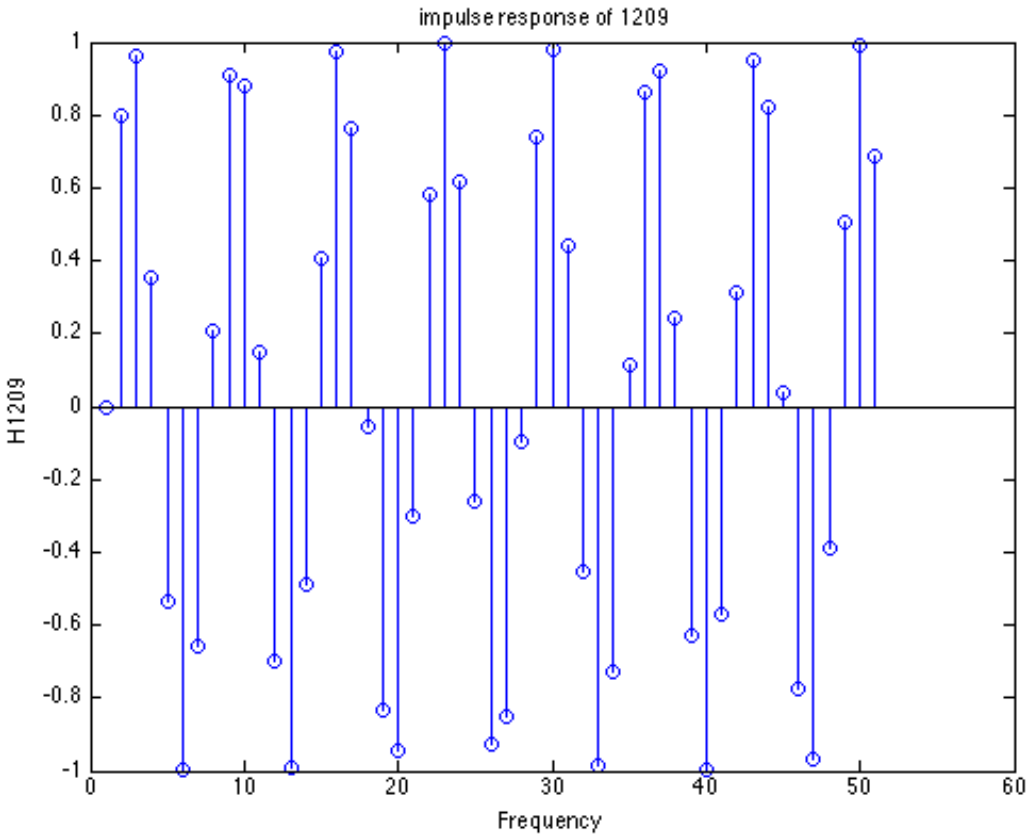


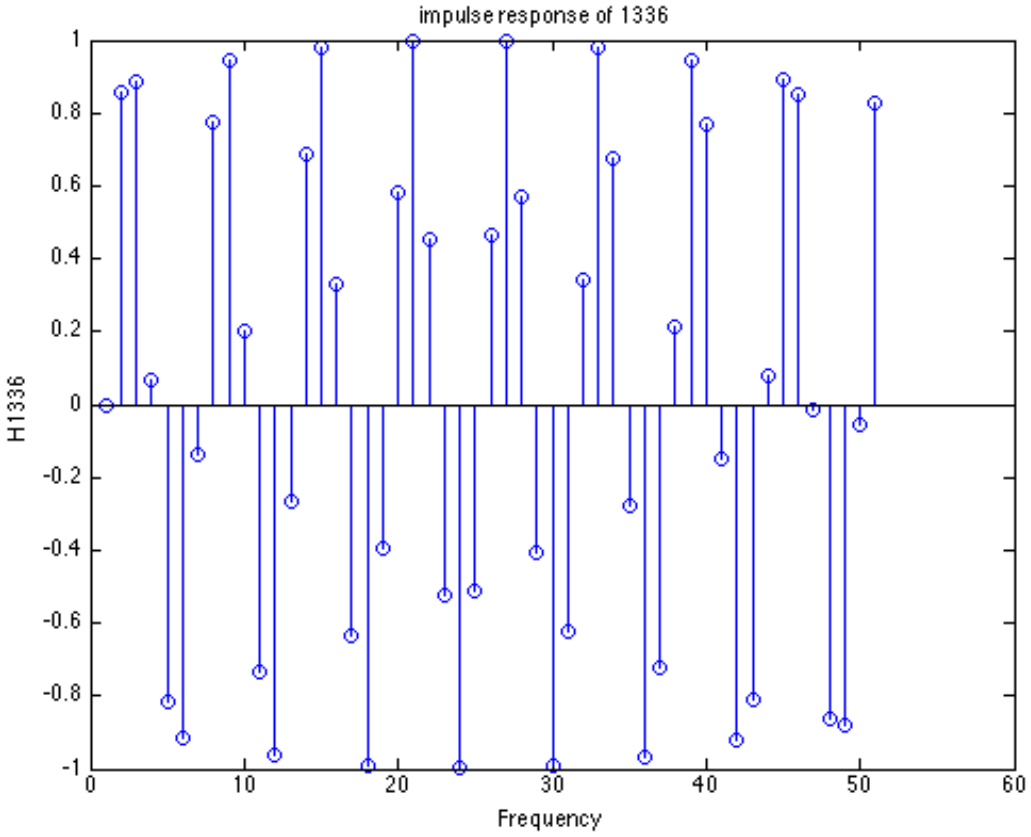

impulse response of 697
H697
Frequency
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
10
20
30
40
50
60

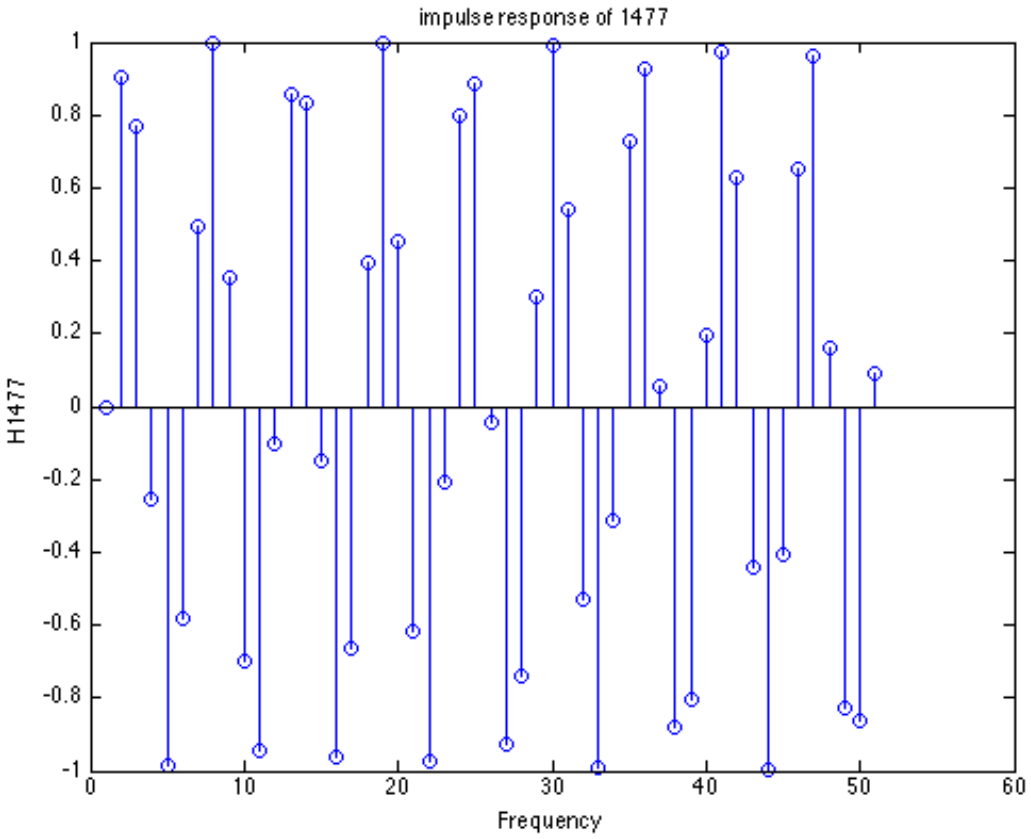

impulse response of 770
H770
Frequency
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
10
20
30
40
50
60

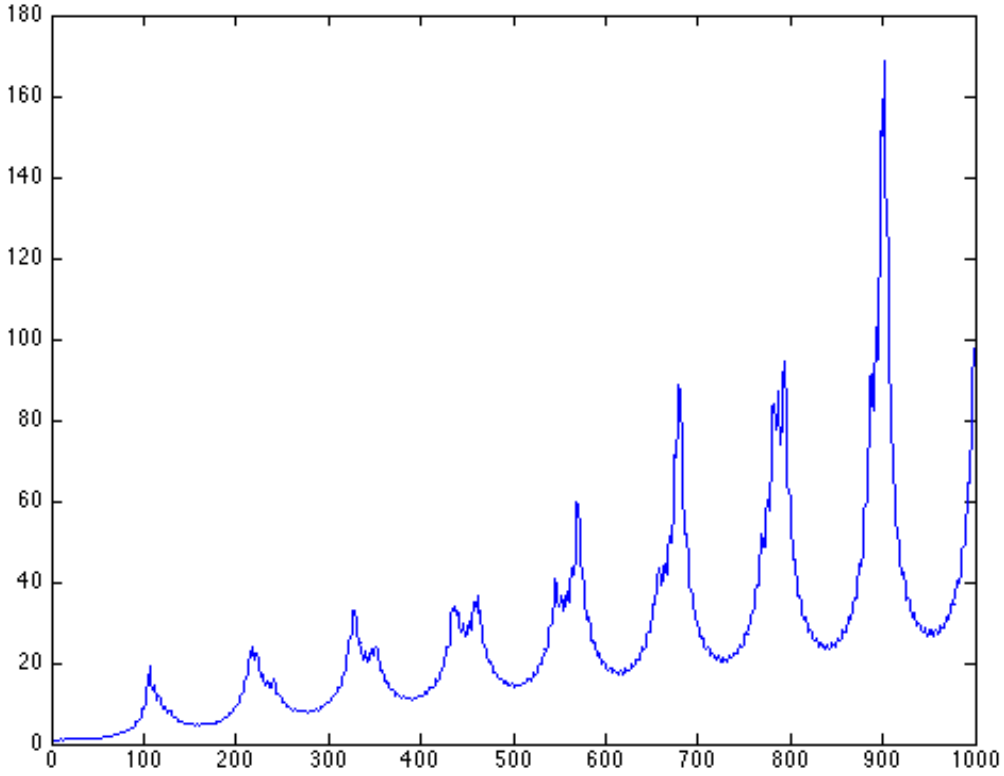

impulse response of 852
H852
Frequency
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
10
20
30
40
50
60

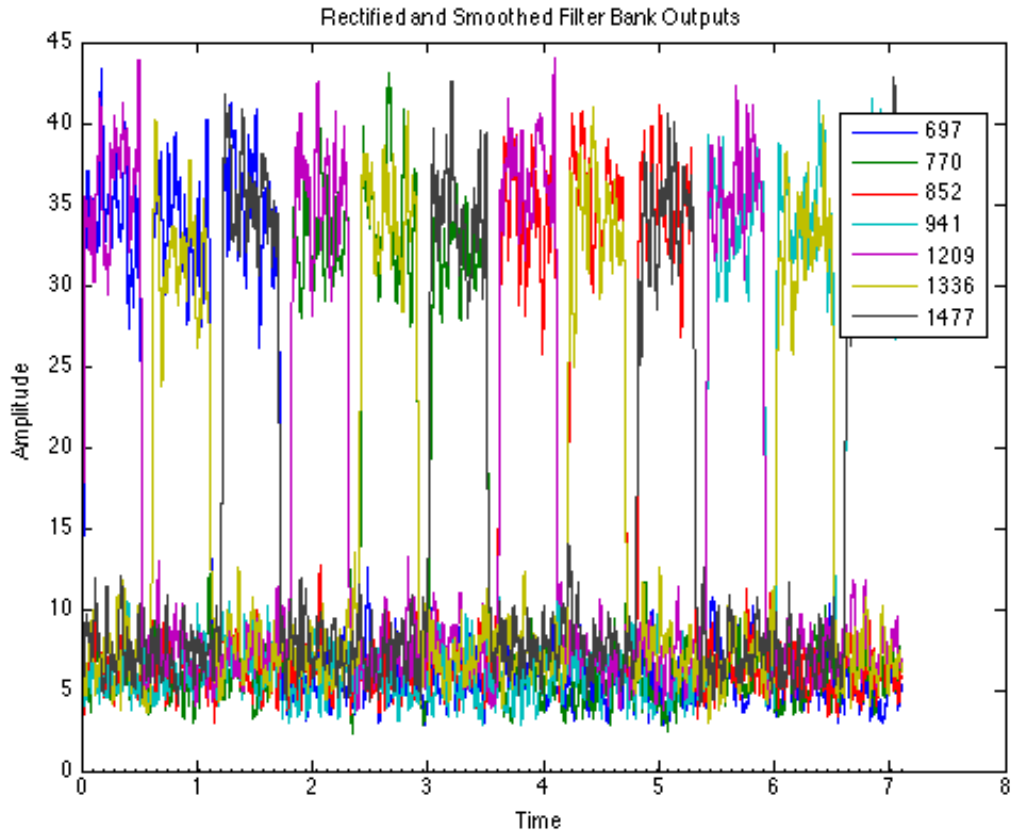

impulse response of 941
H941
Frequency
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
10
20
30
40
50
60


impulse response of 1209
H1209
Frequency
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
10
20
30
40
50
60


impulse response of 1336
H1336
Frequency
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
10
20
30
40
50
60


impulse response of 1477
H1477
Frequency
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
10
20
30
40
50
60


180
160
140
120
100
80
60
40
20
0
0
100
200
300
400
500
600
700
800
900
1000



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