B.M.S. COLLEGE OF ENGINEERING

(Autonomous College Affiliated to Visvesvaraya Technological University, Belgaum)

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REPORT

ON

"APPLICATION OF FILTERS ON A SOUND SAMPLE"

Submitted in partial fulfilment of the requirements for the partial completion of
DIGITAL SIGNAL PROCESSING
(16EC5DCDSP)

SUBMITTED BY:

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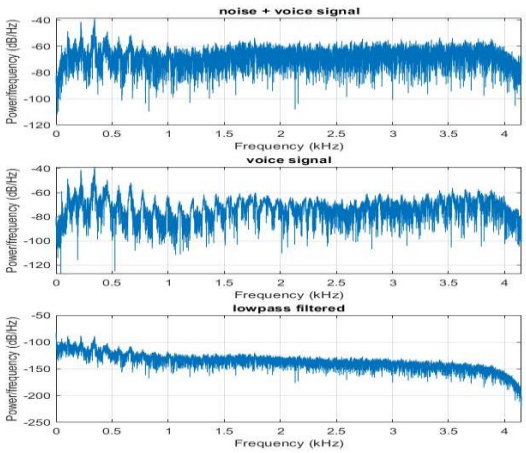
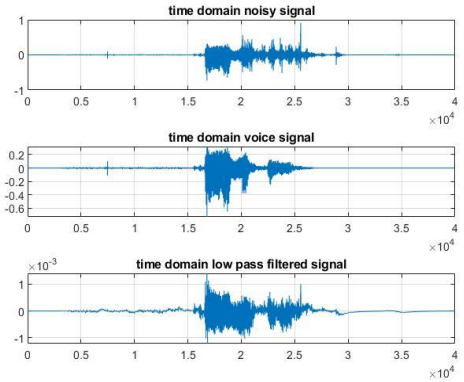
CODE TO RECORD AUDIO.

```
%get voice signal

recObj = audiorecorder;
disp('Start speaking.')
recordblocking(recObj, 5);
disp('End of Recording.');
play(recObj);

%get noise signal

recObj1 = audiorecorder;
disp('add noise.')
recordblocking(recObj1, 5);
disp('End of Recording.');
play(recObj1);

% combine both signals
y = getaudiodata(recObj);
filename = 'audiodsp.wav';
audiowrite(filename,y,8300);

[y,Fs] = audioread(filename);
[y1,Fs1] = audioread('noise.wav');


y2 = y + y1;

filename2 = ('voice_with_noice.wav');
audiowrite(filename2,y2,Fs1);
```

BUTTERWORTH LOW PASS FILTER

```
%read noise + voice signal
[noisy,Fs] = audioread('voice_with_noice.wav');
%read voice signal
[voice,Fs1] = audioread('audiodsp.wav');

figure(1)
%plot periodogram of noise + voice signal
subplot(3,1,1)
%plot periodogram of noise + voice signal
plot(psd(spectrum.periodogram,noisy,'Fs',Fs,'NFFT',length(noisy)));
title('noise + voice signal');grid on;

%plot periodogram of noise + voice signal
subplot(3,1,2)
plot(psd(spectrum.periodogram,voice,'Fs',Fs,'NFFT',length(voice)));
title('voice signal');grid on;

%design butterworth lowpass filter
 wp=tan((1/Fs)*pi*2);
 ws=tan((100/Fs)*pi*2);

subplot(3,1,3)
[N,Wn] = buttord(wp/pi, ws/pi,3,40);
[b,a] = butter(N,Wn);
filtered = filter(b,a,noisy);
plot(psd(spectrum.periodogram,filtered,'Fs',Fs1,'NFFT',length(filtered
)));
title('lowpass filtered');grid on;
audiowrite('low_pass_filtered.wav',filtered,Fs);

%time domain respresentation
figure(2)
subplot(3,1,1)
plot(noisy);
title('time domain noisy signal');grid on;
subplot(3,1,2)
plot(voice);
title('time domain voice signal');grid on;
subplot(3,1,3)
plot(filtered);
title('time domain low pass filtered signal');grid on;
```

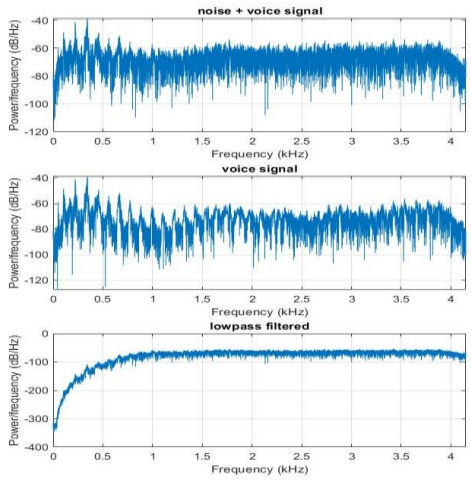


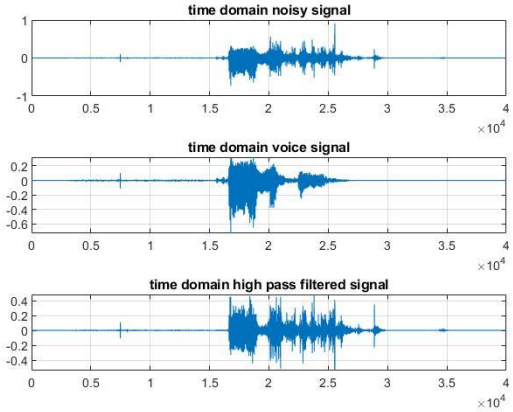


BUTTERWORTH HIGH PASS FILTER

```
%read noise + voice signal
[noisy,Fs] = audioread('voice_with_noice.wav');
%read voice signal
[voice,Fs1] = audioread('audiodsp.wav');

figure(1)
%plot periodogram of noise + voice signal
subplot(3,1,1)
%plot periodogram of noise + voice signal
plot(psd(spectrum.periodogram,noisy,'Fs',Fs,'NFFT',length(noisy)));
title('noise + voice signal');grid on;

%plot periodogram of noise + voice signal
subplot(3,1,2)
plot(psd(spectrum.periodogram,voice,'Fs',Fs,'NFFT',length(voice)));
title('voice signal');grid on;

%design butterworth highpass filter
 wp=tan((800/Fs)*pi*2);
 ws=tan((500/Fs)*pi*2);

subplot(3,1,3)
[N,Wn] = buttord(wp/pi, ws/pi,3,40);
[b,a] = butter(N,Wn,'high');
filtered = filter(b,a,noisy);
plot(psd(spectrum.periodogram,filtered,'Fs',Fs1,'NFFT',length(filtered
)));
title('lowpass filtered');grid on;
audiowrite('high_pass_filtered.wav',filtered,Fs);
```

```
figure(2)
subplot(3,1,1)
plot(noisy);
title('time domain noisy signal');grid on;
subplot(3,1,2)
plot(voice);
title('time domain voice signal');grid on;
subplot(3,1,3)
plot(filtered);
title('time domain high pass filtered signal');grid on;
```

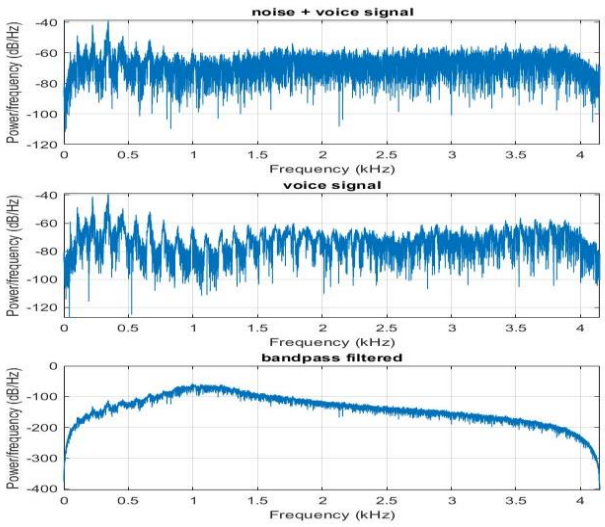


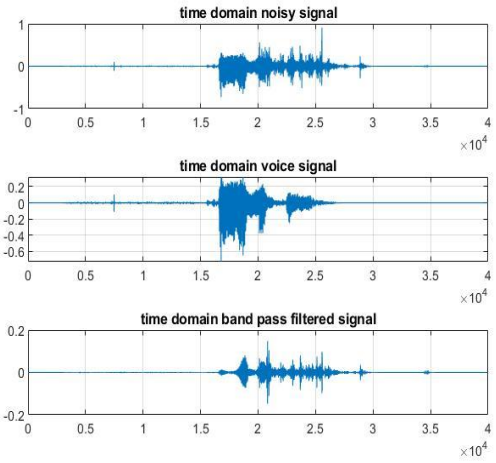


BUTTERWORTH BAND PASS FILTER

```
%read noise + voice signal
[noisy,Fs] = audioread('voice_with_noice.wav');
%read voice signal
[voice,Fs1] = audioread('audiodsp.wav');

figure(1)
%plot periodogram of noise + voice signal
subplot(3,1,1)
%plot periodogram of noise + voice signal
plot(psd(spectrum.periodogram,noisy,'Fs',Fs,'NFFT',length(noisy)));
title('noise + voice signal');grid on;

%plot periodogram of noise + voice signal
subplot(3,1,2)
plot(psd(spectrum.periodogram,voice,'Fs',Fs,'NFFT',length(voice)));
title('voice signal');grid on;
```

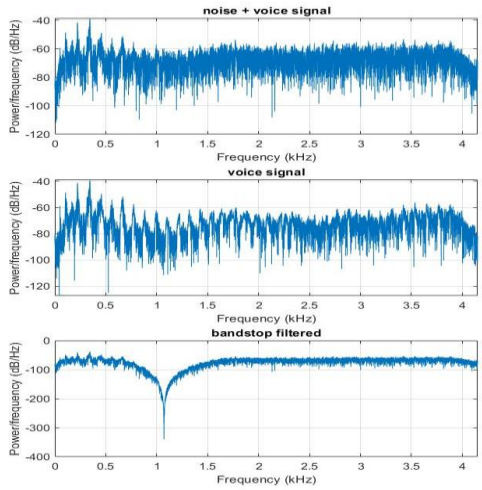
```
%design butterworth bandpass filter
 wp=[tan((800/Fs)*pi*2), tan((1000/Fs)*pi*2)];
 ws=[tan((600/Fs)*pi*2), tan((1200/Fs)*pi*2)];

subplot(3,1,3)
[N,Wn] = buttord(wp/pi, ws/pi,3,40);
[b,a] = butter(N,Wn);
filtered = filter(b,a,noisy);
plot(psd(spectrum.periodogram,filtered,'Fs',Fs1,'NFFT',length(filtered
)));
title('bandpass filtered');grid on;
audiowrite('butterband_pass_filtered.wav',filtered,Fs);

figure(2)
subplot(3,1,1)
plot(noisy);
title('time domain noisy signal');grid on;
subplot(3,1,2)
plot(voice);
title('time domain voice signal');grid on;
subplot(3,1,3)
plot(filtered);
title('time domain band pass filtered signal');grid on;
```

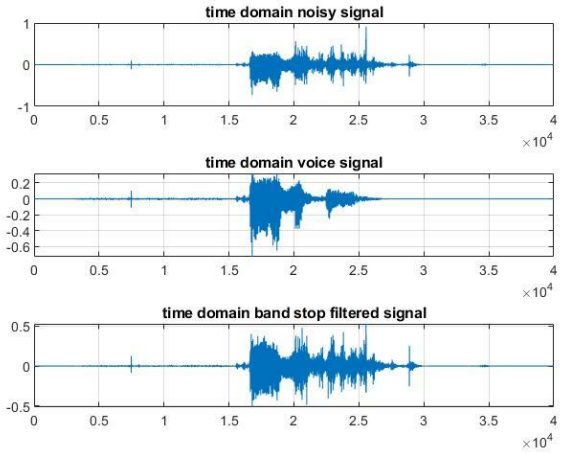




BUTTERWORTH BAND STOP FILTER

```
%read noise + voice signal
[noisy,Fs] = audioread('voice_with_noice.wav');
%read voice signal
[voice,Fs1] = audioread('audiodsp.wav');

figure(1)
%plot periodogram of noise + voice signal
subplot(3,1,1)
%plot periodogram of noise + voice signal
plot(psd(spectrum.periodogram,noisy,'Fs',Fs,'NFFT',length(noisy)));
title('noise + voice signal');grid on;

%plot periodogram of noise + voice signal
subplot(3,1,2)
plot(psd(spectrum.periodogram,voice,'Fs',Fs,'NFFT',length(voice)));
title('voice signal');grid on;

%design butterworth bandstop filter
 wp=[tan((600/Fs)*pi*2), tan((1200/Fs)*pi*2)];
 ws=[tan((800/Fs)*pi*2), tan((1000/Fs)*pi*2)];

subplot(3,1,3)
[N,Wn] = buttord(wp/pi, ws/pi,3,40);
[b,a] = butter(N,Wn,'stop');
filtered = filter(b,a,noisy);
plot(psd(spectrum.periodogram,filtered,'Fs',Fs1,'NFFT',length(filtered
)));
title('bandstop filtered');grid on;
audiowrite('butterband_stop_filtered.wav',filtered,Fs);

figure(2)
subplot(3,1,1)
plot(noisy);
title('time domain noisy signal');grid on;
subplot(3,1,2)
plot(voice);
title('time domain voice signal');grid on;
subplot(3,1,3)
plot(filtered);
title('time domain band stop filtered signal');grid on;
```

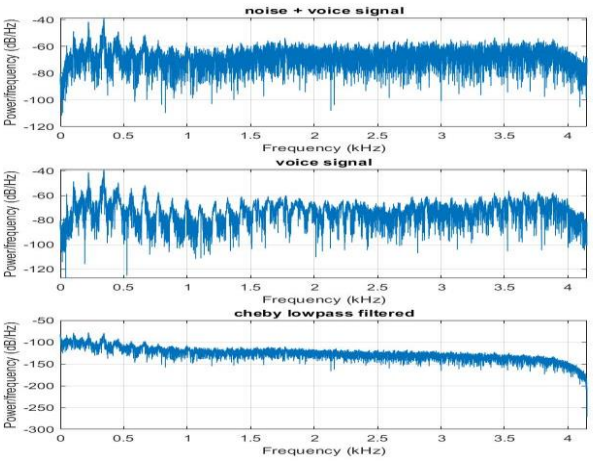


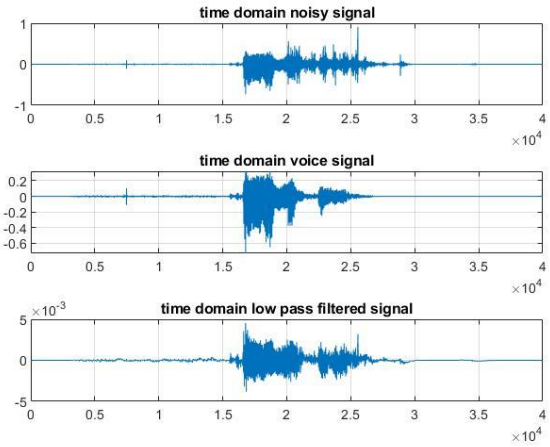


CHEBYSHEV LOW PASS FILTER

```
%read noise + voice signal
[noisy,Fs] = audioread('voice_with_noice.wav');
%read voice signal
[voice,Fs1] = audioread('audiodsp.wav');

figure(1)
%plot periodogram of noise + voice signal
subplot(3,1,1)
%plot periodogram of noise + voice signal
plot(psd(spectrum.periodogram,noisy,'Fs',Fs,'NFFT',length(noisy)));
title('noise + voice signal');grid on;

%plot periodogram of noise + voice signal
subplot(3,1,2)
plot(psd(spectrum.periodogram,voice,'Fs',Fs,'NFFT',length(voice)));
title('voice signal');grid on;

%design chebyshev lowpass filter
 wp=tan((1/Fs)*pi*2);
 ws=tan((1000/Fs)*pi*2);

subplot(3,1,3)
[N,Wn] = cheb1ord(wp/pi, ws/pi,0.4,20);
[b,a] = cheby1(N, 0.4, Wn);
filtered = filter(b,a,noisy);
plot(psd(spectrum.periodogram,filtered,'Fs',Fs1,'NFFT',length(filtered
)));
title('cheby lowpass filtered');grid on;
```

```
audiowrite('cheby_low_pass_filtered.wav',filtered,Fs);

figure(2)
subplot(3,1,1)
plot(noisy);
title('time domain noisy signal');grid on;
subplot(3,1,2)
plot(voice);
title('time domain voice signal');grid on;
subplot(3,1,3)
plot(filtered);
title('time domain low pass filtered signal');grid on;
```

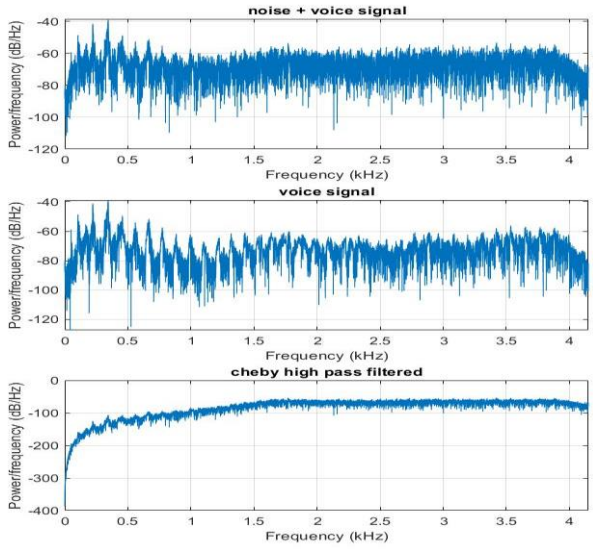


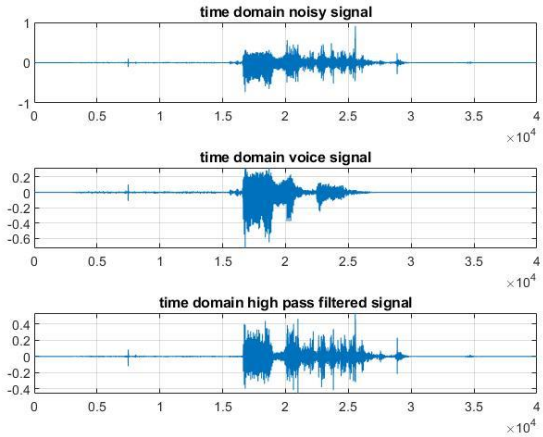


CHEBYSHEV HIGH PASS FILTER

```
%read noise + voice signal
[noisy,Fs] = audioread('voice_with_noice.wav');
%read voice signal
[voice,Fs1] = audioread('audiodsp.wav');

figure(1)
%plot periodogram of noise + voice signal
subplot(3,1,1)
%plot periodogram of noise + voice signal
plot(psd(spectrum.periodogram,noisy,'Fs',Fs,'NFFT',length(noisy)));
title('noise + voice signal');grid on;

%plot periodogram of noise + voice signal
subplot(3,1,2)
plot(psd(spectrum.periodogram,voice,'Fs',Fs,'NFFT',length(voice)));
title('voice signal');grid on;
```

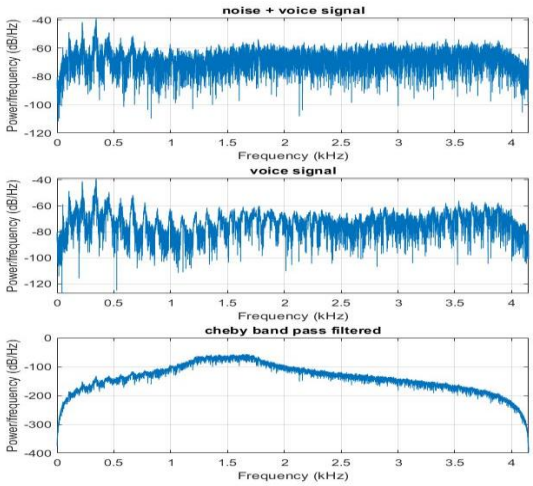
```
%design chebyshev high pass filter
 wp=tan((1200/Fs)*pi*2);
 ws=tan((500/Fs)*pi*2);

subplot(3,1,3)
[N,Wn] = cheb1ord(wp/pi, ws/pi,0.4,40);
[b,a] = cheby1(N, 0.4, Wn,'high');
filtered = filter(b,a,noisy);
plot(psd(spectrum.periodogram,filtered,'Fs',Fs1,'NFFT',length(filtered
)));
title('cheby high pass filtered');grid on;
audiowrite('cheby_high_pass_filtered.wav',filtered,Fs);

figure(2)
subplot(3,1,1)
plot(noisy);
title('time domain noisy signal');grid on;
subplot(3,1,2)
plot(voice);
title('time domain voice signal');grid on;
subplot(3,1,3)
plot(filtered);
title('time domain high pass filtered signal');grid on;
```

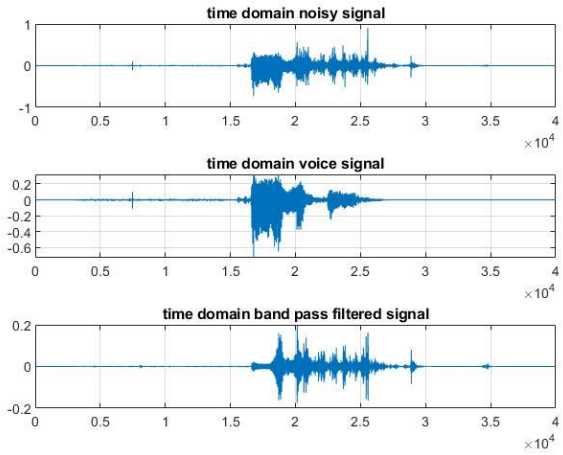




CHEBYSHEV BAND PASS FILTER

```
%read noise + voice signal
[noisy,Fs] = audioread('voice_with_noice.wav');
%read voice signal
[voice,Fs1] = audioread('audiodsp.wav');

figure(1)
%plot periodogram of noise + voice signal
subplot(3,1,1)
%plot periodogram of noise + voice signal
plot(psd(spectrum.periodogram,noisy,'Fs',Fs,'NFFT',length(noisy)));
title('noise + voice signal');grid on;

%plot periodogram of noise + voice signal
subplot(3,1,2)
plot(psd(spectrum.periodogram,voice,'Fs',Fs,'NFFT',length(voice)));
title('voice signal');grid on;

%design chebyshev band pass filter
 wp=[tan((1000/Fs)*pi*2),tan((1200/Fs)*pi*2)];
 ws=[tan((800/Fs)*pi*2),tan((1500/Fs)*pi*2)];

subplot(3,1,3)
[N,Wn] = cheb1ord(wp/pi, ws/pi,0.4,40);
[b,a] = cheby1(N, 0.4, Wn);
filtered = filter(b,a,noisy);
plot(psd(spectrum.periodogram,filtered,'Fs',Fs1,'NFFT',length(filtered
)));
title('cheby band pass filtered');grid on;
audiowrite('cheby_band_pass_filtered.wav',filtered,Fs);

figure(2)
subplot(3,1,1)
plot(noisy);
title('time domain noisy signal');grid on;
subplot(3,1,2)
plot(voice);
title('time domain voice signal');grid on;
subplot(3,1,3)
plot(filtered);
title('time domain band pass filtered signal');grid on;
```





CHEBYSHEV BAND STOP FILTER

```
%read noise + voice signal
[noisy,Fs] = audioread('voice_with_noice.wav');
%read voice signal
[voice,Fs1] = audioread('audiodsp.wav');

figure(1)
%plot periodogram of noise + voice signal
subplot(3,1,1)
%plot periodogram of noise + voice signal
plot(psd(spectrum.periodogram,noisy,'Fs',Fs,'NFFT',length(noisy)));
title('noise + voice signal');grid on;

%plot periodogram of noise + voice signal
subplot(3,1,2)
plot(psd(spectrum.periodogram,voice,'Fs',Fs,'NFFT',length(voice)));
title('voice signal');grid on;

%design chebyshev bandstop filter
 wp=[tan((800/Fs)*pi*2),tan((1500/Fs)*pi*2)];
 ws=[tan((1000/Fs)*pi*2),tan((1200/Fs)*pi*2)];

subplot(3,1,3)
[N,Wn] = cheb1ord(wp/pi, ws/pi,0.4,40);
[b,a] = cheby1(N, 0.4, Wn,'stop');
filtered = filter(b,a,noisy);
plot(psd(spectrum.periodogram,filtered,'Fs',Fs1,'NFFT',length(filtered
)));
title('cheby band stop filtered');grid on;
```

```
audiowrite('cheby_band_stop_filtered.wav',filtered,Fs);

figure(2)
subplot(3,1,1)
plot(noisy);
title('time domain noisy signal');grid on;
subplot(3,1,2)
plot(voice);
title('time domain voice signal');grid on;
subplot(3,1,3)
plot(filtered);
title('time domain band stop filtered signal');grid on;
```