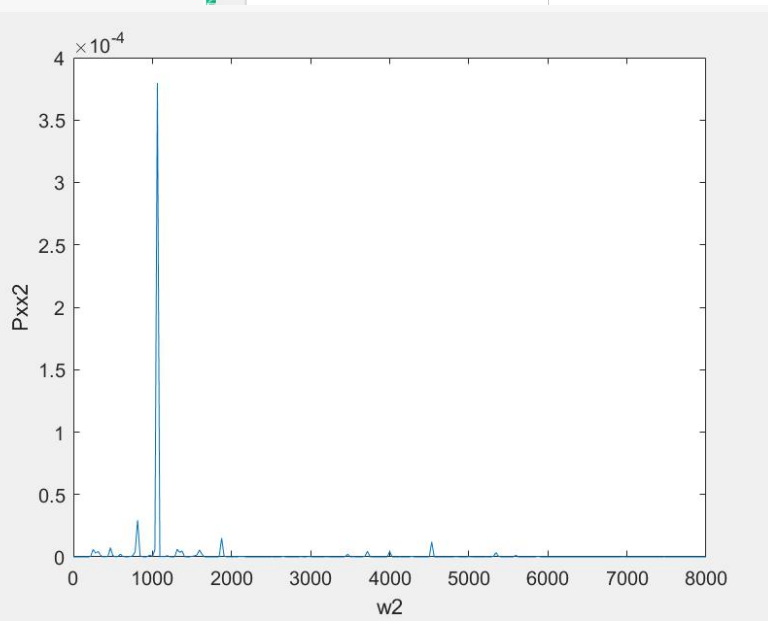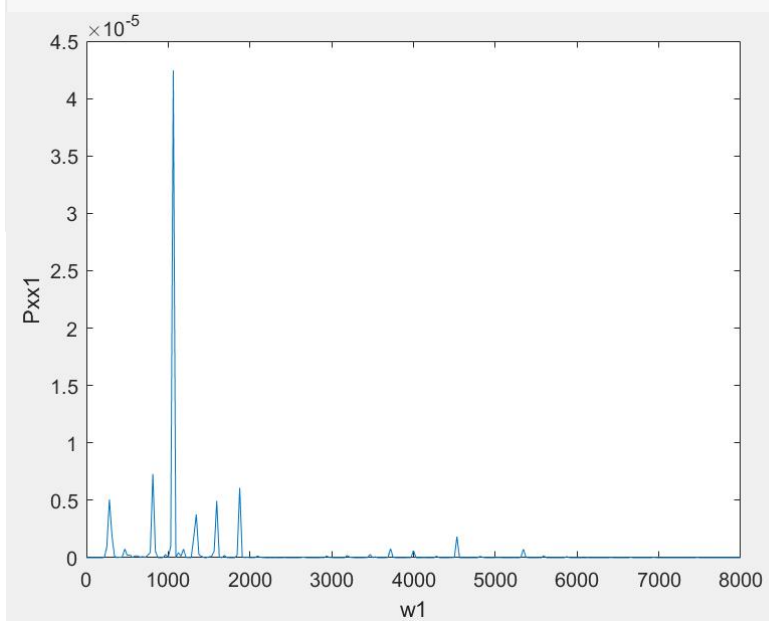# 信号作业（5）

12011918张宇潇
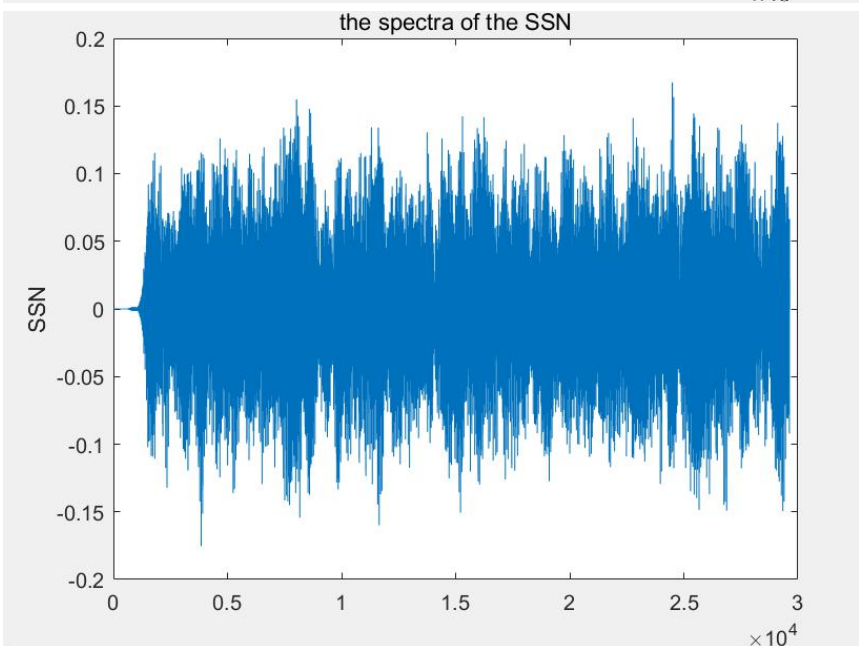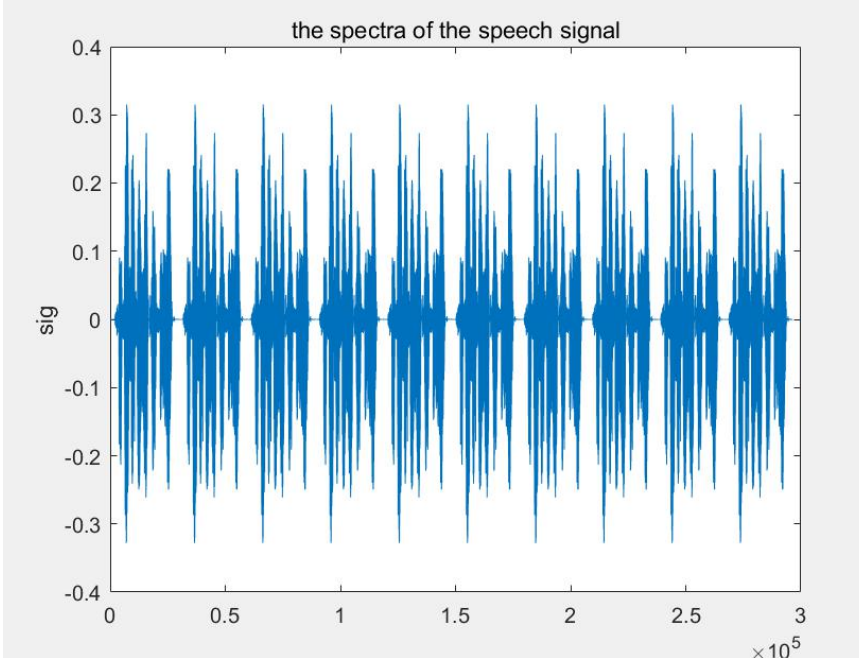
12011923张旭东

5.1

```matlab
[x0,fs]=audioread("C_01_02.wav");
sound(x0,fs);
x=x0';%转置的理由：x0 为列向量，如果不转置会导致 y 的占用内存 过大，运行不了，见附图
N=length(x);  noise=1-2*rand(1,N);
sig=repmat(x,1,10);
%sound(sig,fs);  [Pxx1,w1]=periodogram(sig,[],512,fs);
plot(w1,Pxx1);
figure;plot(sig);title('the spectra of the speech signal');
b=fir2(3000,w1/(fs/2),sqrt(Pxx1/max(Pxx1)));
[h,wh]=freqz(b,1,128);
SSN=filter(b,1,noise);
figure;plot(SSN);title('the spectra of the SSN');
[Pxx2,w2]=periodogram(SSN,[],512,fs);
figure;plot(w2,Pxx2);
```
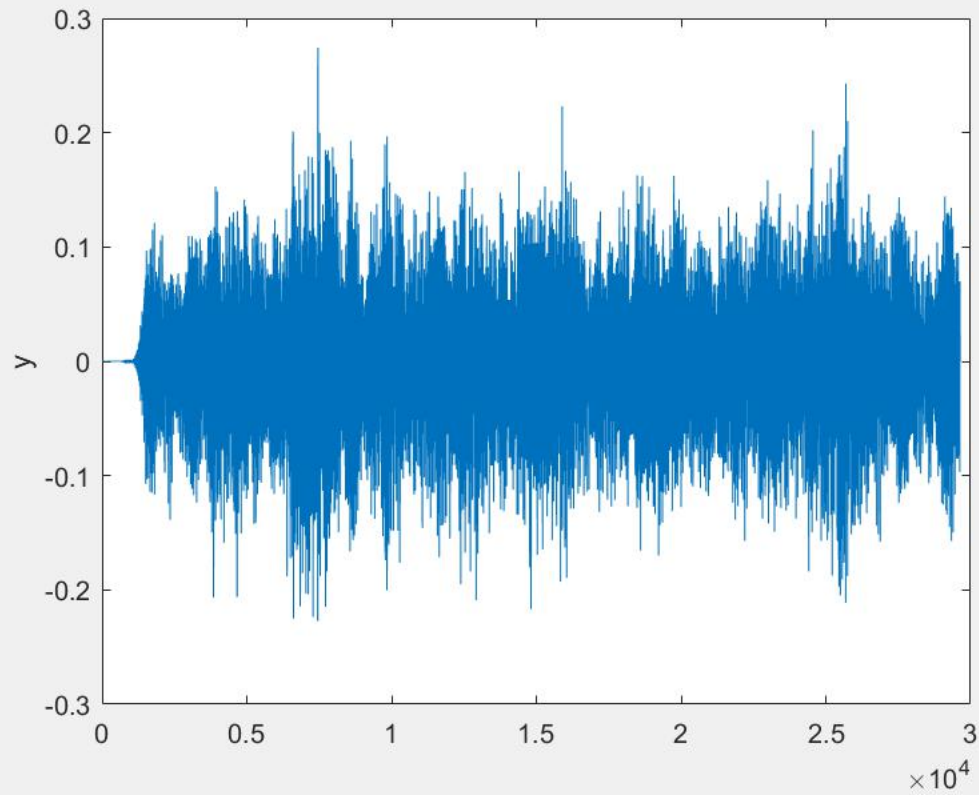

the spectra of the speech signal

the spectra of the SSN

5.2

```
SNR=20*log10(norm(x)/norm(SSN));
SSN=SSN*10^((5+SNR)/20);%SNR could be adjusted to -5dB by multiplying a certain coefficient.
y=x+SSN;
y=y/norm(y)*norm(x);
figure;plot(y);
sound(y,fs);
```

5.3(a)

```
y=abs(y);
[b1,a1]=butter(2,100/(fs/2));
env1=filter(b1,a1,y);
[b2,a2]=butter(2,200/(fs/2));
env2=filter(b2,a2,y);
[b3,a3]=butter(2,300/(fs/2));
env3=filter(b3,a3,y);
```

```
figure;plot(env1,'r');hold on;
plot(env2,'k');hold on;
plot(env3,'b');legend('100Hz','200Hz','300Hz');
figure;plot(10000:12000,env1(10000:12000),'r');hold on;%全画太密，取部分分析
plot(10000:12000,env2(10000:12000),'k');hold on;
plot(10000:12000,env3(10000:12000),'b');legend('100Hz','200Hz','300Hz');
```

```
%the higher cutoff frequency is, the steeper and the denser the envelope is.
```

5.3(b)
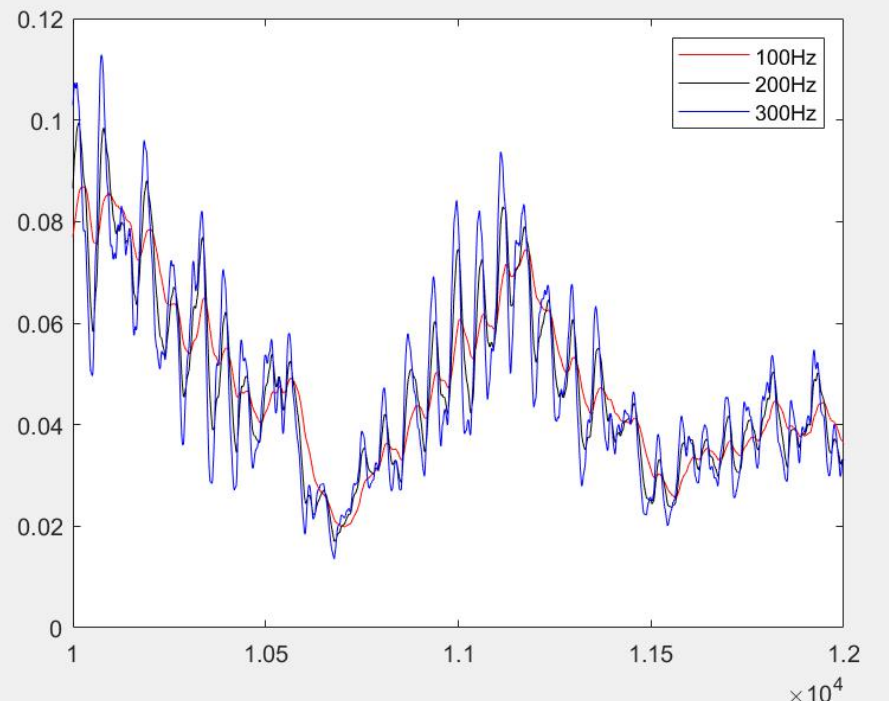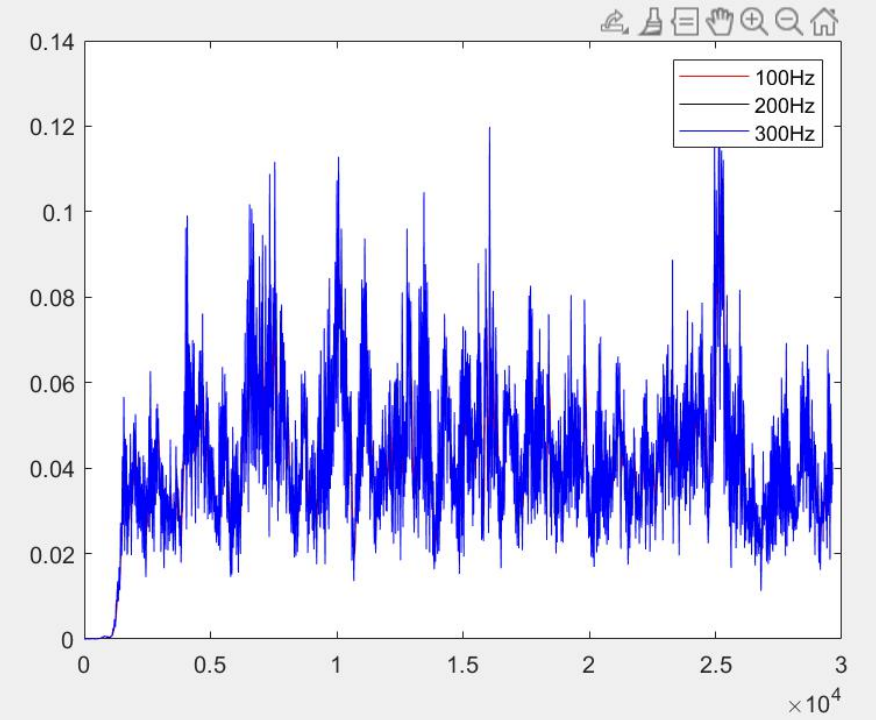
```matlab
[b4,a4]=butter(2,200/(fs/2));
env4=filter(b4,a4,y);
[b5,a5]=butter(6,200/(fs/2));
env5=filter(b5,a5,y);
figure;plot(env4,'r');hold on;
plot(env5,'k');
legend('2^(n*d)','6^(n*d)');
figure;plot(10000:12000,env4(10000:12000),'r');hold on;%全画太密，取部分分析
plot(10000:12000,env5(10000:12000),'k');
legend('2^(n*d)','6^(n*d)');
```

```matlab
%the higher the order of filter is,the flatter and looser the envelope is.
```
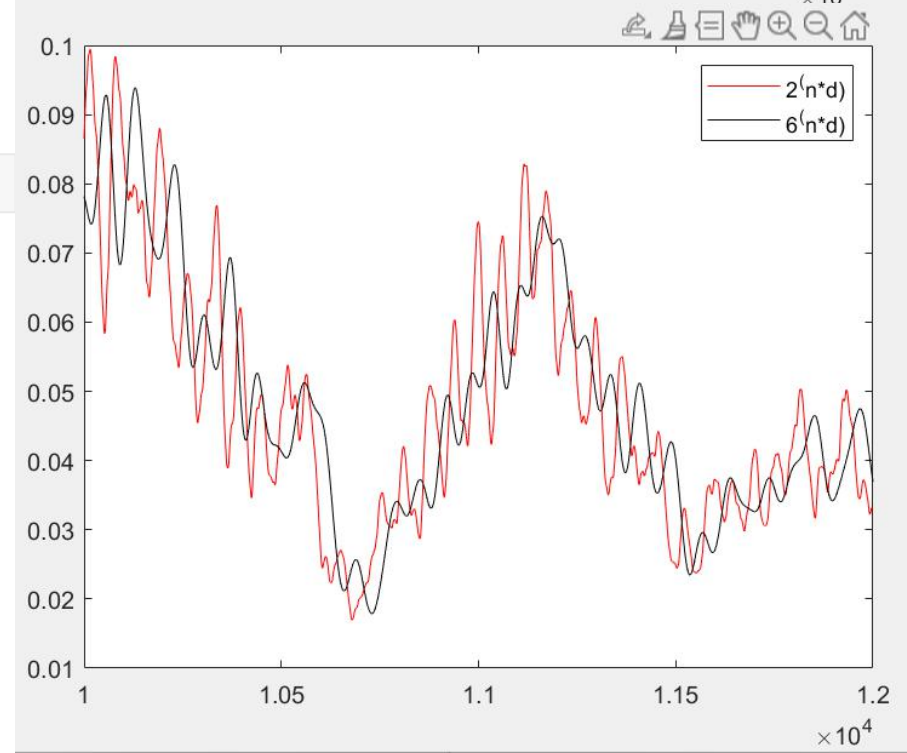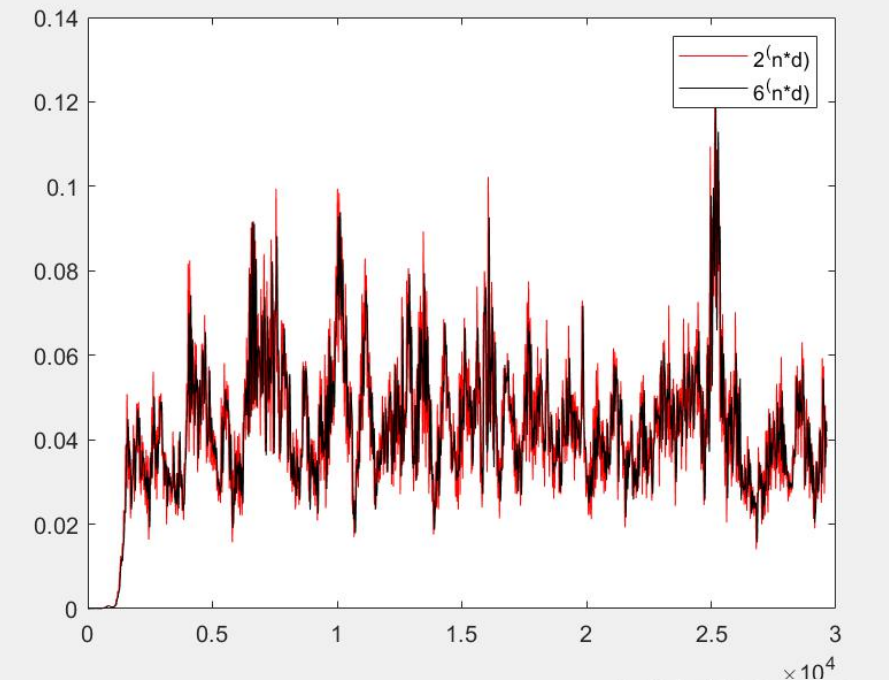
5.4

```matlab
[x0,fs]=audioread("C_01_02.wav");
sound(x0,fs);
x=x0';%转置的理由：x0 为列向量，如果不转置会导致 y 的占用内存过大，运行不了，见附图
N=length(x);
noise=1-2*rand(1,N);
sig=repmat(x,1,10);
%sound(sig,fs);
[Pxx1,w1]=periodogram(sig,[],512,fs);
plot(w1,Pxx1);
plot(sig);title('the spectra of the speech signal');
b=fir2(3000,w1/(fs/2),sqrt(Pxx1/max(Pxx1)));
[h,wh]=freqz(b,1,128);
SSN=filter(b,1,noise);
figure;plot(SSN);title('the spectra of the SSN');
[Pxx2,w2]=periodogram(SSN,[],512,fs);
figure;plot(w2,Pxx2);
SNR=20*log10(norm(x)/norm(SSN));
SSN=SSN*10^((5+SNR)/20);%SNR could be adjusted to -5dB by multiplying a certain coefficient.
y=x+SSN;
y=y/norm(y)*norm(x);
figure;plot(y);
sound(y,fs);
audiowrite("C 01 02+noise.wav",y,fs);%在 y被破坏前录制
```