Common problems in Project 1

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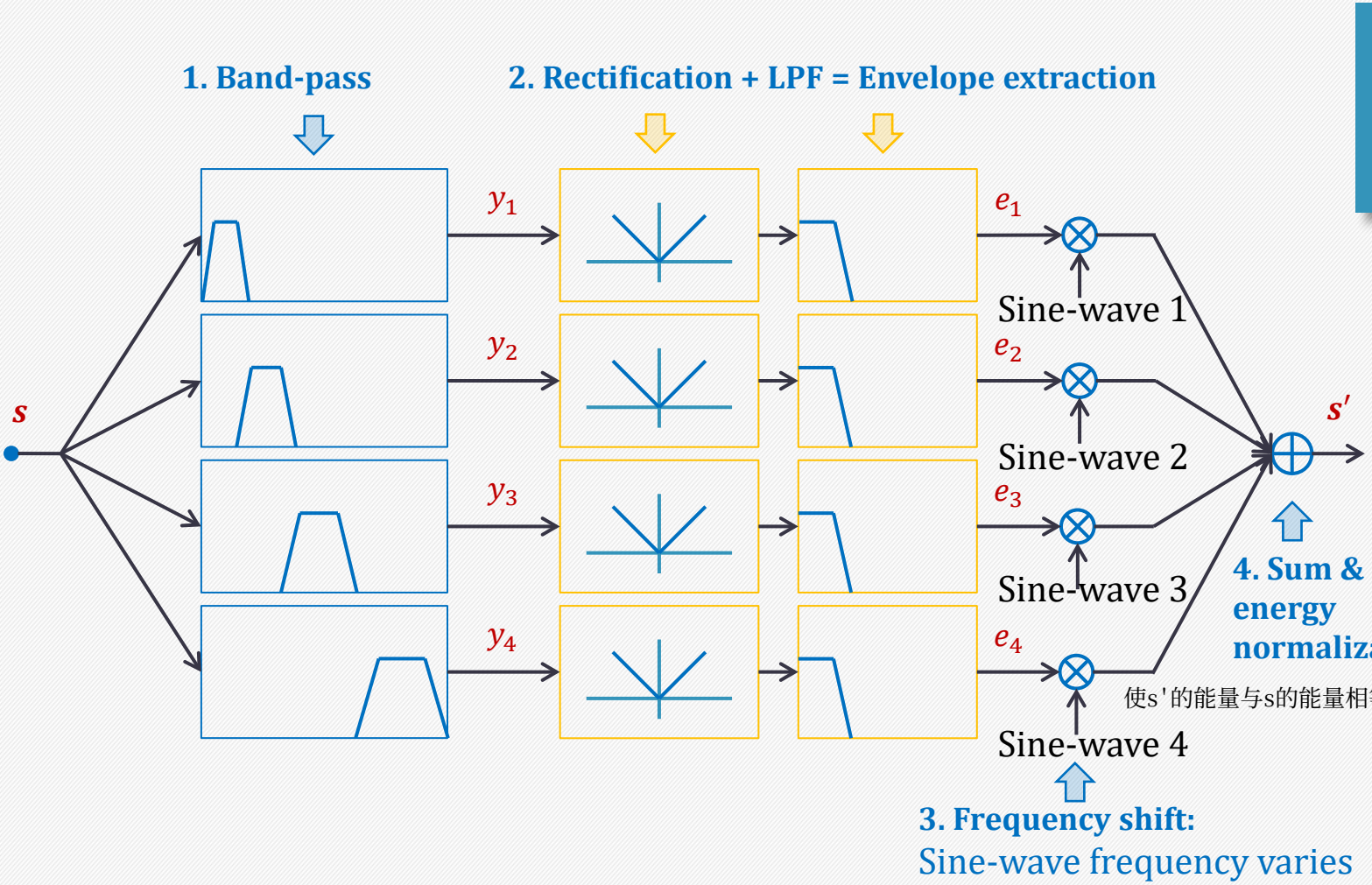
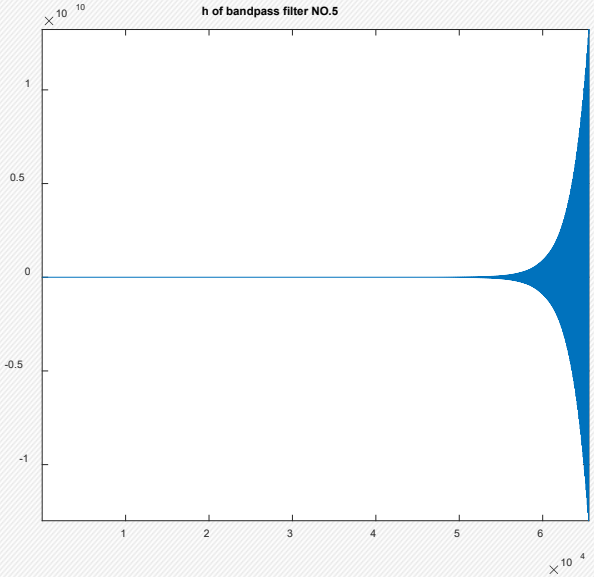

1. Band-pass
2. Rectification + LPF = Envelope extraction
s
y_1
y_2
y_3
y_4
e_1
e_2
e_3
e_4
Sine-wave 1
Sine-wave 2
Sine-wave 3
Sine-wave 4
s′
4. Sum & energy normalization
使s'的能量与s的能量相等（只需一行代码）
3. Frequency shift:
Sine-wave frequency varies

1. Unstable filter

- The bandwidths of the filters decrease with the increasing of N.
- A filter will be unstable when the band is too narrow. N过大会使滤波器不稳定

The impulse response of the 5th pass band filter when N = 200, and the filter order of is 4

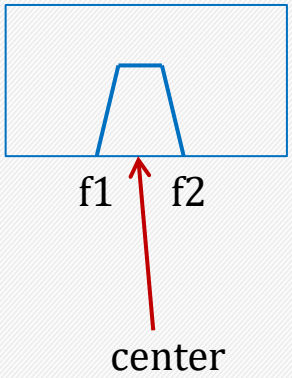


2. Sinusoidal signal generation

- Sinsig = sin(2*pi*f*t) → CT signal, (f – frequency in Hz)
- In Matlab, the Sinsig should be represented as a DT signal with the same sampling frequency as the original voice signal
- Sinsigdt = sin(2*pi*f*n*dT), dT is the sampling interval
  - dT=1/fs
  - n = 1:N

3. Center frequency of [f1,f2]

- (f2-f1)/2 ?
- (f2+f1)/2 ?

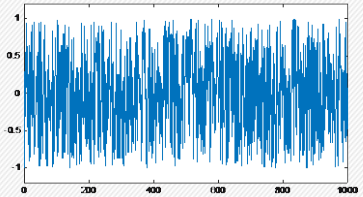


4. SSN, remember?

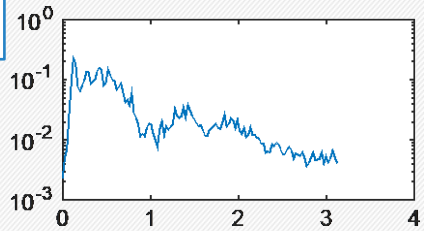
- Speech Shaped Noise, SSN
- As required in Project 1, the noise added to the original speech signal should be a SSN
  - White noise, the code 'noise = 1-2*rand(1,N)' generates
  - Feed this white noise into a specifically designed filter to generate SSN, as what we've done in Lab 5

5. SNR = -5dB

White noise → $H(j\omega)$ e.g. speech spectrum → Speech-shaped noise



PSD



1. Do you know the energy (or 2-norm) of the SSN obtained by filtering the white noise?
2. How do you know?
3. How much energy (or 2-norm) should the SSN has so that the SNR relative to the voice signal is -5dB?

5. SNR = -5dB (cont.)

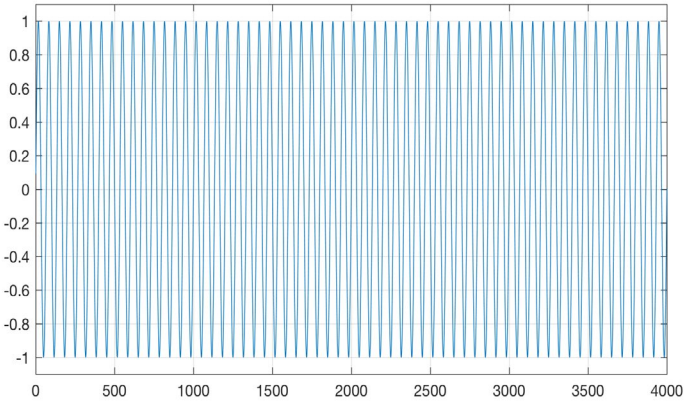
- normratio = 10^(-5/20); % 0.5623
- SSN = SSN*/norm(SSN)*norm(s) /normratio;

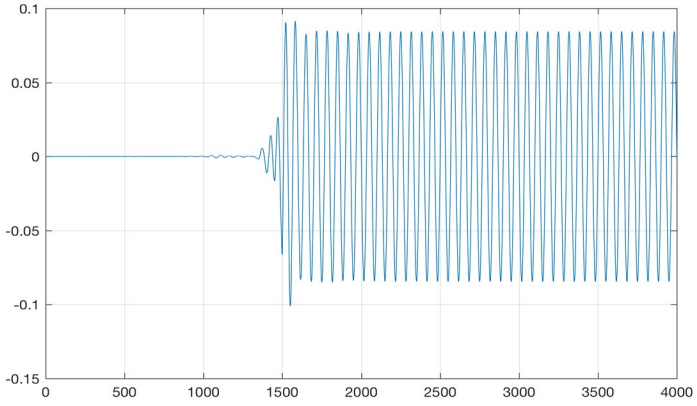
- SNR = 20*log10(norm(s)/norm(SSN))

```
>> SNR = 20*log10(norm(s)/norm(SSN))

SNR =

   -5.0000
```

6. Effect of filter length on filtered signal

- The length of the FIR filter used to generate SSN is 3001, that'll cause non-negligible delay of the filtered signal from the original signal.
  - sig1 = sin(2∗pi∗0.015∗(1:4000));
  - sig2 = filter(b,1,sig1);



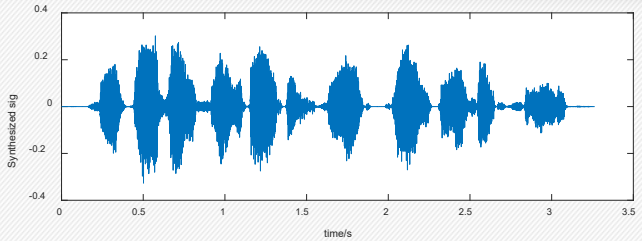


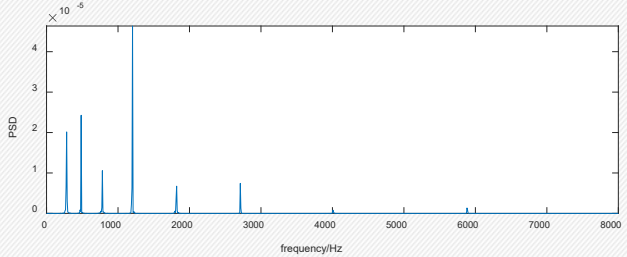
6. Effect of filter length on filtered signal (cont.)

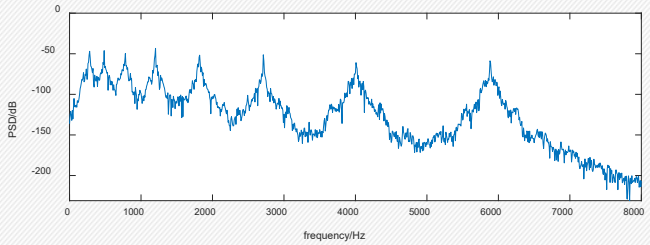
- Solution: Generate overlength SSN and Discard the beginning 1500 or more points

```
N = length(s);
noise=1-2*rand(1,length(b)+N);
SSN = filter(b,1,noise);
SSN = SSN((length(b)+1):end);
```

7. Spectrum display







plot(w, 10*log10(Pxx))

Or

semilogy(w, Pxx)