

## Homework #2

- 목표 : LP model과 Cepstrum 기반으로 음성신호의 spectral envelope 구하기
- Input : male.raw
  - 8kHz sampling, 16-bit mono signed integer
  - 첫 320 sample 이용
  - 320-sample Hamming window 적용 :  $w(n) = 0.54 - 0.46 \cos\left(\frac{2\pi n}{319}\right)$
- LP : 10차 예측기
- Cepstrum : 15-point low-time liftering
- Output : input의 spectrum와 spectral envelop의 log-magnitude plot
  - 이 때, 두 plot의 gain이 서로 다르므로, gain을 맞추어 plot 해야 함

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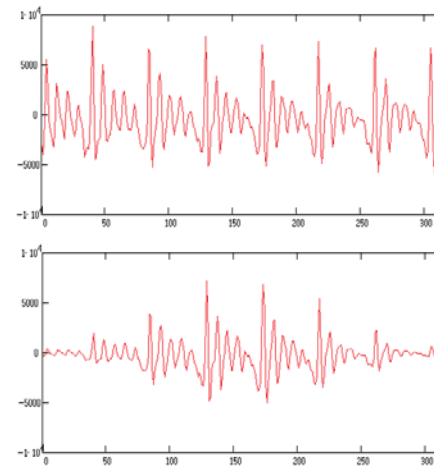
## Homework #2

- Due : 5월 24일(월) 23:59 (12주차)
- File name : AI\_Speech\_HW2\_이름\_학번.hwp, docx, pdf
- 제출 내용
  - C code
  - 두 방법으로 구한 spectral envelope plot
  - 다양한 실험 결과와 설명

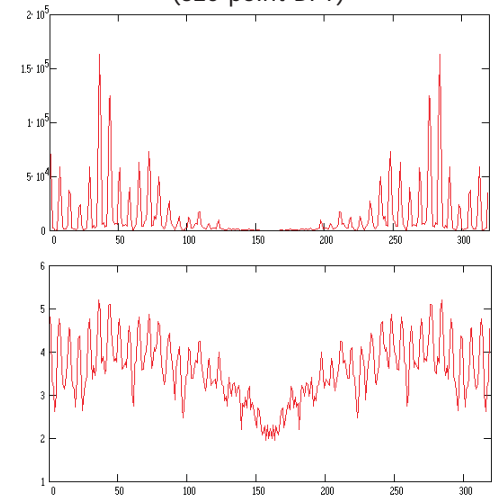
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## 진행 과정

Input and windowed input



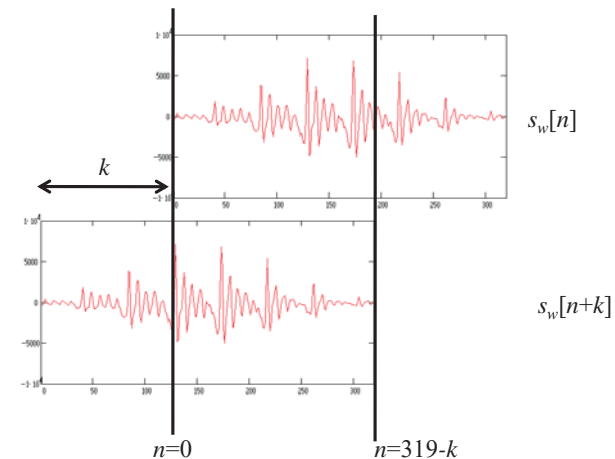
spectrum and log spectrum  
(320-point DFT)



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## Autocorrelation

$$R[k] = \sum_{n=0}^{319-k} s_w[n]s_w[n+k], \quad k = 0, 2, \dots, 10$$



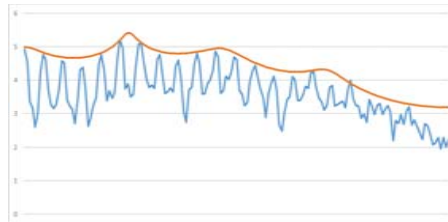
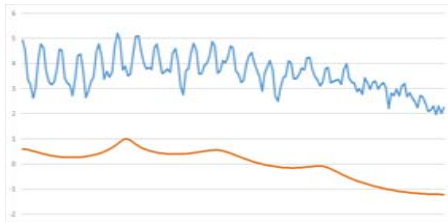
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## Spectral Envelope by LP Model

- Autocorrelation  $\rightarrow R[k]$ , 0~10
- Durbin algorithm  $\rightarrow a_i^{(10)}$
- $a(n)$  생성 : 1.0,  $-a_1, -a_2, \dots, -a_{10}, 0, 0, 0, \dots$
- 320-point DFT of  $a(n) \rightarrow H(k)$ , 0~160
- Log spectral envelope =  $\log (1/|H(k)|)$

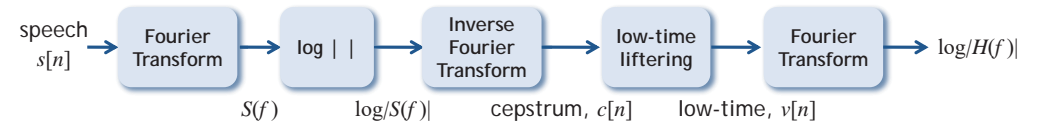
$$\frac{1}{A(z)} = \frac{1}{1 - \sum_{i=1}^{10} a_i z^{-i}}$$

Check-point  
 $R[1] = 4562xxxxx$   
 $a_1 = 1.766xxxx$



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## Spectral Envelope by Cepstrum

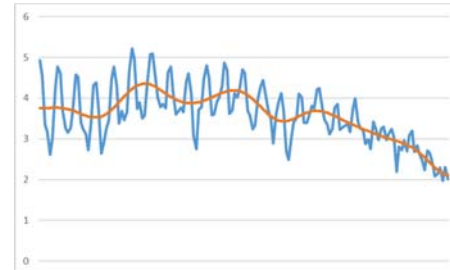


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## Spectral Envelope by Cepstrum

Cepstrum and liftered cepstrum

log spectral envelope



$k = 0 \sim 14$

$k = 306 \sim 319$

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