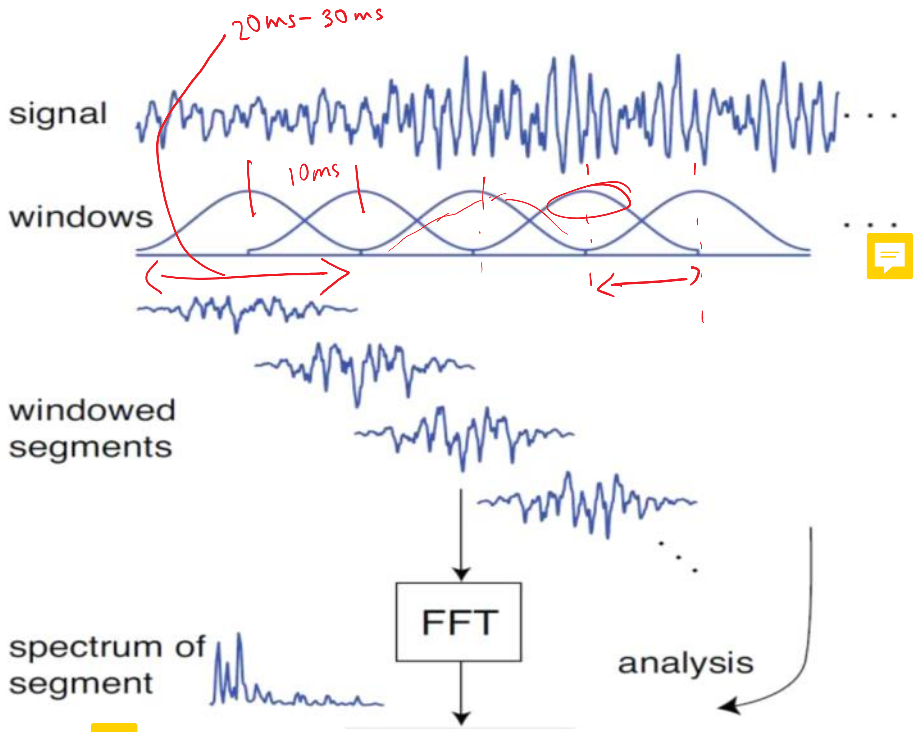
Spectrum analysis

15 August 2019 11:11 PM

Speech Analysis with Moving Window

short-term FT

STFT



Window Effects in Spectrum Analyses ....

Bb: p 45-49

Rectangular Window

Definition (M odd):

$$w_R(n) \triangleq \begin{cases} 1, & |n| \le \frac{M-1}{2} \\ 0, & \text{otherwise} \end{cases}$$

n

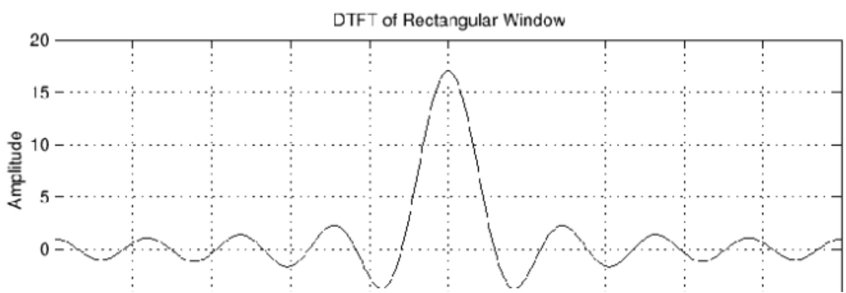
Transform:

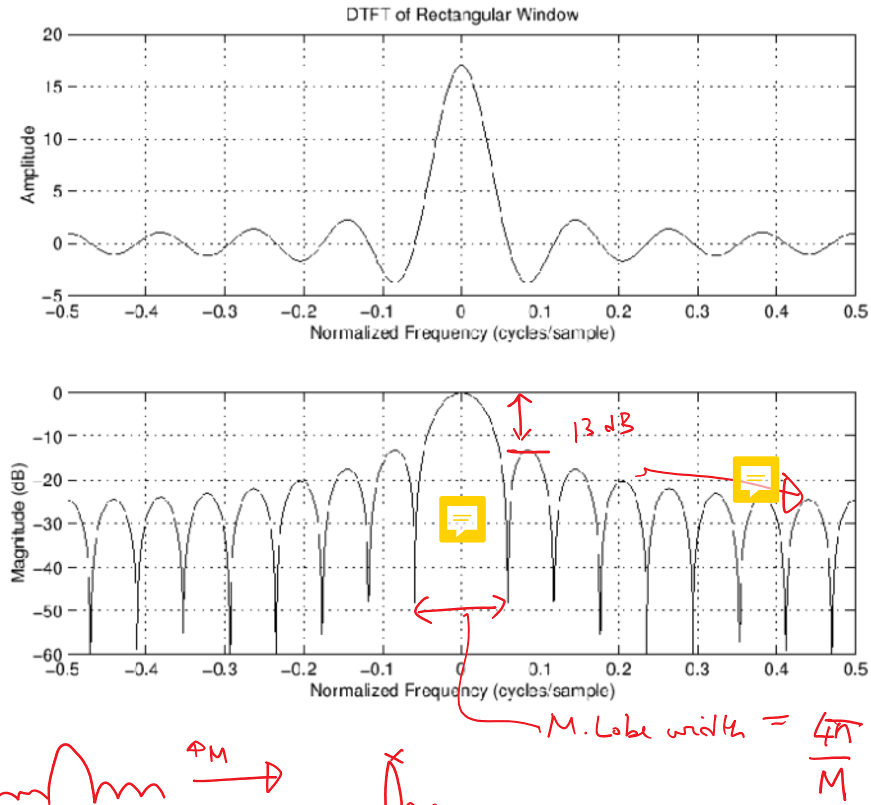
$$x[n] \longrightarrow \overset{w[n]}{\otimes} \longrightarrow y[n]$$

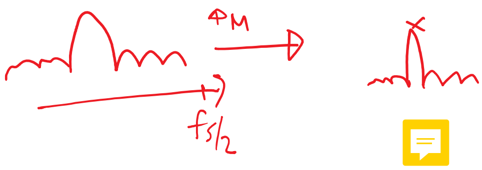
$$Y(e^{j\omega}) = X(e^{j\omega}) \circledast W(e^{j\omega})$$

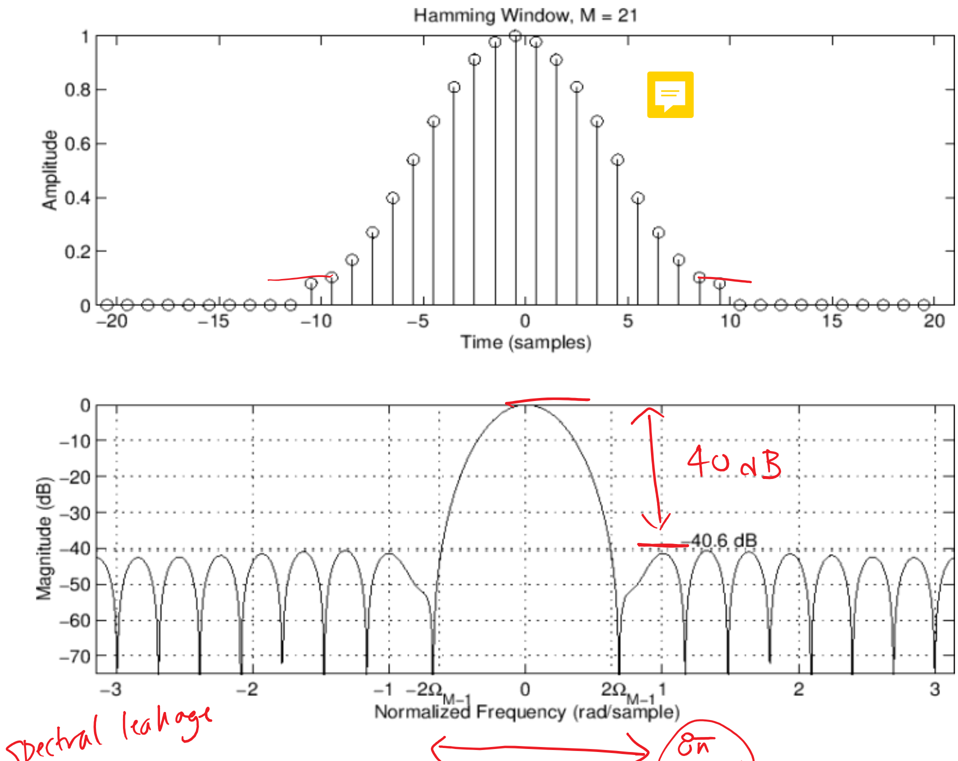
$$W_R(\omega) = M \cdot \text{asinc}_M(\omega) \triangleq \frac{\sin\left(M\frac{\omega}{2}\right)}{\sin\left(\frac{\omega}{2}\right)}$$

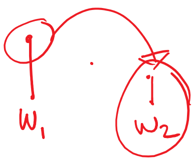
M = 17




DTFT of Rectangular Window
Amplitude
Normalized Frequency (cycles/sample)
Magnitude (dB)
Normalized Frequency (cycles/sample)
13 dB
M. Lobe width = $\frac{4\pi}{M}$


↑M
fs/2


Hamming Window, M = 21
Amplitude
Time (samples)
Magnitude (dB)
Normalized Frequency (rad/sample)
−40.6 dB
40 dB
$-2\Omega_{M-1}$
$2\Omega_{M-1}$
$\frac{8\pi}{M}$
spectral leakage


w_1
w_2

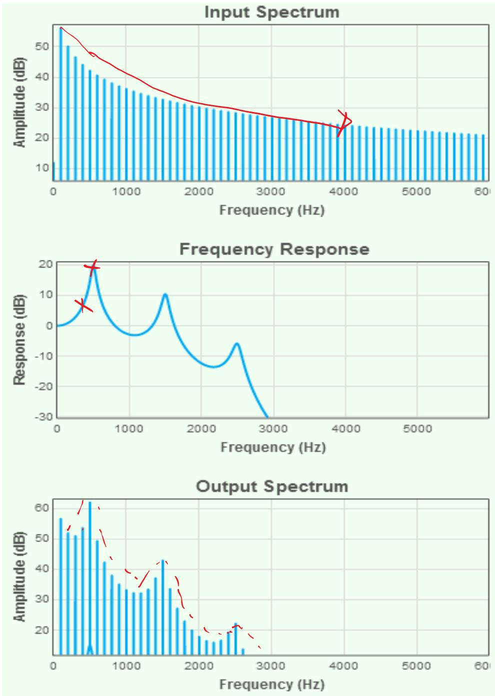
Specgrams

Sunday, August 11, 2013 9:08 AM

Source and tract parameters: influence on vowel spectrum

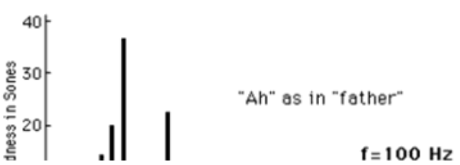
Excit^n

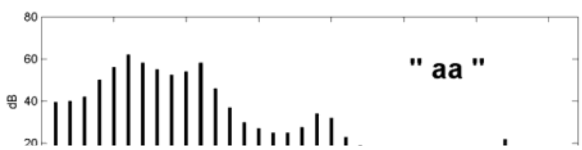
Excit^n → Filter → Speech

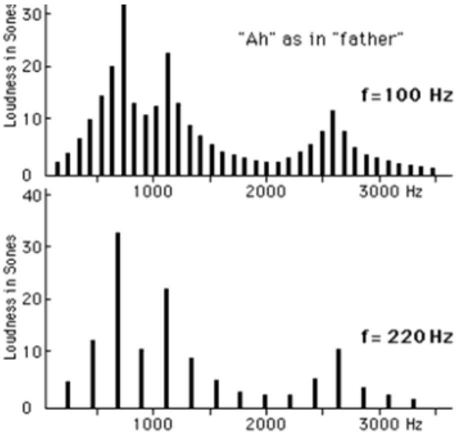


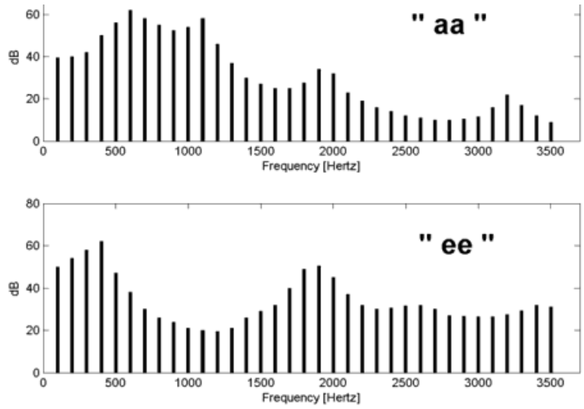
Different pitch, same formants

Different formants, same pitch









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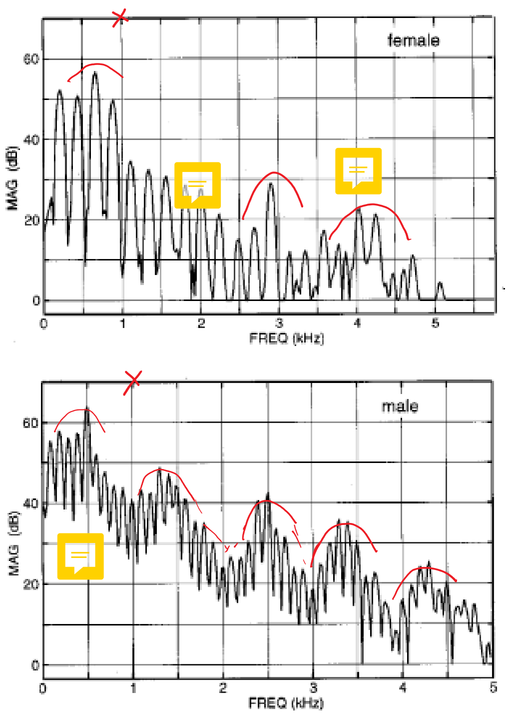
Computed Vowel Spectrum: ʌ ("gum")



To resolve harmonics, we need a narrow mainlobe.

F0 ~ 100 Hz

FIG. 8. Comparison of spectra of the vowel /ʌ/ for average female and male subjects. The female spectrum (upper plot) has greater spectral tilt, less well-defined formant peaks, a greater degree of noise at high frequencies, and a higher relative amplitude of the first harmonic, compared to the male speaker's vowel spectrum (lower plot).