UNIVERSITY OF MIAMI
DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

ENGINEERING ACOUSTICS

Homework No.6

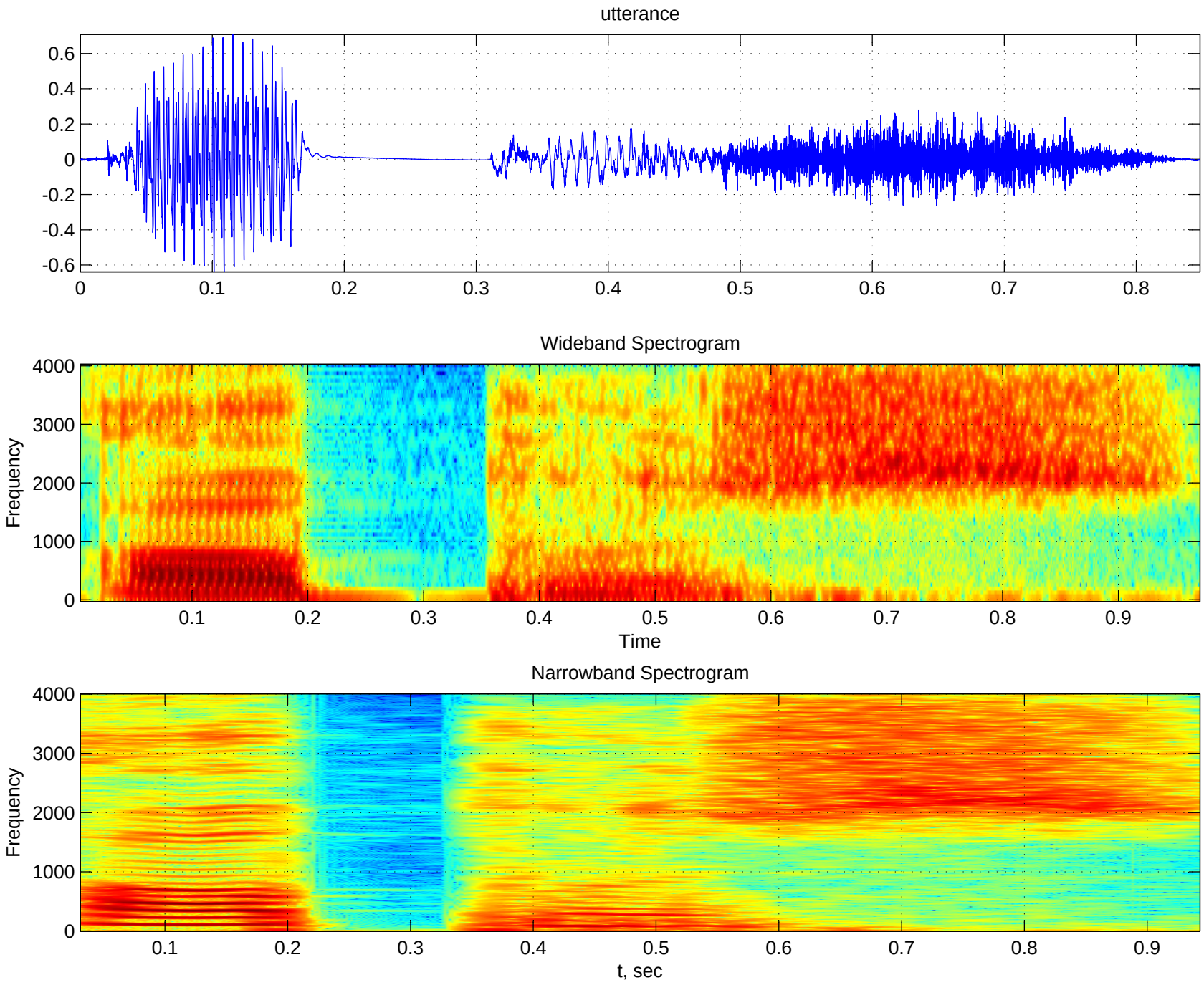
Submit solutions to the following exercises:

1. The attached plot contains the time waveform of a spoken word and its wideband and narrowband spectrograms.
   a. How many phonemes are in this word? Mark their beginning and ending times.
   b. Classify each phoneme according to the type of excitation that produces them (voiced, unvoiced, mixed or plosive).
   c. Carefully sketch the magnitude spectra (dB vs. linear frequency) that correspond to the sounds at times 0.1 s and 0.6 s, clearly indicating the envelope details (formant locations) and the spectral details (harmonic or noisy structure).
   d. Plot the pitch frequency against time.
   e. Is the speaker likely male or female and why?
   f. What do you think this word is?

2. An omnidirectional point source emits a sustained random noise whose bandwidth extends from 300 to 6000 Hz. Assume no reflections from the environment. A listening ear is located in the far field of that source and the entrance of the ear canal receives the emitted noise at SPL of 35 dB.
   a. Plot the power spectrum of the signal received at the tympanic membrane.
   b. Plot the power spectrum of the signal received at the oval window of the cochlea.
   c. Plot the basilar membrane displacement resulting from receiving the described sound.
3. An auditory stimulus consists of three sinusoids (i.e., pure tones), produced at sound pressures of $2x10^{-3}$ N/m^2, $2x10^{-2}$ N/m^2 and $3x10^{-3}$ N/m^2, and oscillating frequencies of 200 Hz, 250 Hz, and 500 Hz, respectively.
   a. Perform simultaneous masking analysis, plot the resulting masking threshold against frequency and determine if one, two or three of the tones will be audible, and which.
   b. Sketch the basilar membrane displacement resulting from receiving the described sound.
   c. The 250 Hz tone is replaced by narrowband noise of critical bandwidth (i.e., BW=100 Hz) and effective acoustic pressure at 10 mPa. Perform the masking analysis described in part (a) to determine which of the three stimuli will be audible.

d. With the stimulus as described in (c), determine the pre-masking and post-masking threshold if the stimulus is gated with a rectangular pulse of 1 sec duration.

Date due: 12/02/2009


utterance
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
Wideband Spectrogram
Frequency
4000
3000
2000
1000
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
Time
Narrowband Spectrogram
Frequency
4000
3000
2000
1000
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
t, sec