5-min knowledge sharing/discussion

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Lab III
Hearing and Speech Perception

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Purpose of this lab...

1. Continue to learn MATLAB functionality for speech processing (adjust SNR level, spectrogram, etc.)
2. Learn to synthesis vowels with pure tones
3. Test loudness/equal loudness perception
4. Learn to test speech quality with PESQ index

Problem 1

Synthesize vowels using pure tones:

1. Sample the spectral envelopes of vowels /a/ /i/ /u/ in last lab.
2. Use pure-tones to synthesize vowels /a/ /i/ /u/ (with F0 150 Hz and 250 Hz for male and female voice, respectively).
3. Plot the waveforms/spectra/spectrograms of the 3 synthesized vowels.

spectrogram(x, window, noverlap, nfft or f, fs, freqloc)

4. Attach the wav files of synthesized vowels with lab report.

Problem 2

http://www.phys.unsw.edu.au/jw/hearing.html

1. Hearing test on-line: sensitivity, and equal loudness contour
2. Screen-copy the equal loudness contour you obtained.

Problem 3

1. Adjust signal-to-noise ratio (SNR)

$$SNR = 10\log_{10}\left(\frac{E_{signal}}{E_{noise}}\right)$$

   - *E*: energy, and SNR in dB scale

   - or in MATLAB:

```
>> SNR=20*log10(norm(sig)/norm(noise))
%% sig and noise must have the same length
```

2. For mhint_01_01.wav, generate noisy speech by white noise at 5 and 0 dB SNR. y = awgn(x, snr, signalpower)
3. Equalize the energy of noisy speech to that of clean speech.
4. Plot the waveforms and spectra of clean speech and noisy speech at 5 and 0 dB SNR. equalized
5. Call MATLAB command to show spectrograms of clean speech and noisy speech at 5 and 0 dB SNR.

Problem 4

Objective speech quality evaluation

1. Add white noise to a clean speech signal (mhint_01_01.wav) at -5, -3, -1, 1, 3, 5 dB SNR level.
2. Equalize the energy of noisy speech to that of clean speech.
3. Run PESQ code in MATLAB.
4. Plot the PESQ value as a function of SNR level.

```
scores = pesq(ref_wav, deg_wav)
```