WiSe0809. Hoole, Akustik für Fortgeschrittene

Measuring voice quality.

Aim: Get values for harmonics to noise (using Praat's command 'To Harmonicity'), and the difference in amplitude of the first two harmonics (H1 corresponds to F0), measured by hand in the spectrum.

Extracts from Praat's help for Harmonicity

> "A Harmonicity object represents the degree of acoustic periodicity, also called Harmonics-to-Noise Ratio (HNR). Harmonicity is expressed in dB: if 99% of the energy of the signal is in the periodic part, and 1% is noise, the HNR is 10*log10(99/1) = 20 dB. A HNR of 0 dB means that there is equal energy in the harmonics and in the noise.
> ..... a healthy speaker can produce a sustained [a] or [i] with a harmonicity of around 20 dB ... Hoarse speakers will have an [a] with a harmonicity much lower than 20 dB."

See *5.3 Spectral tilt* in Gordon and Ladefoged for background to measurements based on the relative amplitude of the lowest harmonics.

Load a sound e.g evi_a.wav and open it in an edit window.
Select a segment of about 0.2 seconds in a stable part of the vowel, and extract it to the object list with

```
Extract sound selection (time from 0).
```

Rename the sound to evi_a_x.

In the following script, set the variable mysound$ to evi_a_x and run the script.

```
mysound$="evi_a_x"
#dblow, dbhigh and freqhigh are variables for the Draw command
dblow=0
dbhigh=60
freqhigh=2000
Line width... 2
#For the Marks command (chose so grid lines are at e.g 10dB
intervals)
number_of_marks=7
#
select Sound 'mysound$'
#Resample so all sounds cover the same frequency range
Resample... 10000 50
#Remove any offset in the signal
Subtract mean
#Determine harmonics to noise ratio (Interactively, first
choose 'Periodicity')
To Harmonicity (cc)... 0.01 75 0.1 1
h2n=Get mean... 0 0
printline 'mysound$''tab$''h2n'
select Sound 'mysound$'_10000
#Change the colour so spectra of different voice qualities
#can be overlaid in the picture window
Red
To Spectrum... no
#The smoothing is just so the overlaid spectra are easier to
distinguish
#For a low male voice it may be better to reduce the bandwidth
setting
#from 20 to 10
Cepstral smoothing... 20
Rename... 'mysound$'_10000_smooth
Draw... 0 'freqhigh' 'dblow' 'dbhigh' yes
Marks left... 'number_of_marks' yes yes yes
#Open the spectrum in an edit window so the amplitude
#of the harmonics can be measured
Edit
```

Praat's note window should have printed the harmonics to noise ratio for this sound.
The spectrum should have been drawn in the picture window and opened in a new edit window. In the edit window measure H2-H1 by moving the cursor to the two peaks corresponding to the first two harmonics. It may be helpful to zoom in on the frequency axis. Also, it is advisable to have a rough idea what the pitch of the speaker's voice is in order to choose the right peaks.
Use Fig. 7 (p. 398) in the paper by Gordon & Ladefoged as a guide.
Make a note of the value for the first sound.
Before continuing, check in the picture window that the y-axis settings are appropriate (i.e the dB range). If not, erase the picture, change the dblow and dbhigh settings at the start of the script, and run the script once more.

Then load and extract the next sound (e.g the breathy version of the speaker), edit the first line of the script to make the name appropriate, change the colour for plotting the spectrum in the picture window, and run the script.
Measure and note H2-H1 for this sound, and then process the third sound of the speaker (e.g "gepresst").
When all three voice qualities have been processed for one speaker write the values of H2-H1 into the appropriate line in the info window (following the corresponding harmonics-to-noise value). Then save the contents of the info window to a text file

You can also save the overlaid spectra in the picture window to an eps file.
To get a clear picture it may be necessary to experiment some more with the dblow, dbhigh and freqhigh settings.
Before storing, use the Text top command in the picture window to note what colour corresponds to what sound.

Here are the results I got with Lia's sounds:

```
lia_normal_x   22.2 -10
lia_breathy_x  8.1 -17
lia_creaky_x   19.9 0
```

The results for H2-H1 (in the second column) come out as expected, i.e lowest for breathy, highest for creaky.
For harmonics to noise, breathy has the lowest value (again as expected), but the highest value is for normal, not for creaky. This is probably because the fundamental frequency can be very irregular for creaky, which will tend to lower the harmonics to noise value.

Additional Task
Concatenate the three extracted sounds to make one new sound.
Open it in an edit window.
Turn on the formant display, and make sure that the formant settings are appropriate.
Experiment with the dynamic range (and perhaps also window length) in the spectrogram settings so that the formants are easy to see in the sonagram.
Use the formant menu to extract the **bandwidth** of the first and second formants at a typical part of each of the three voice qualities.
Make a note of these values.
It is often the case that a creaky or pressed voice quality has more sharply defined formants (i.e lower bandwidth) than a breathy voice. This is probably because the longer glottal closure reduces losses to the subglottal region, and perhaps also because of overall more tension in the vocal tract.