3 SSP 2012 / Assignment 3:

3.1 KlattGrid, the source

Create a KlattGrid according to the defaults. Use scripts to:

1. Create a source signal with pitch 100 Hz and voicing amplitude 90 dB. Draw the first 0.1 s of the flow signal and the first 0.1 s of the derivative in one picture.
2. Create a source signal with pitch 100 Hz and voicing amplitude 90 dB. Set flutter to the maximum value 1 and make the same picture as above but also draw the moments of glottal closures.
3. Try to reproduce the figure in the right display of figure 11.8 in the SSPBook. Hint: save your data in a TableOfReal and use Draw scatterplot....
4. Create a source signals with pitch 100 Hz and voicing amplitude 90 dB with different collision phases: increase the collision phase in steps of 0.02 starting from 0 to 0.1 and investigate how the spectrum changes.

3.2 KlattGrid, the filters

A digital resonator is given by the following equation

$$y_n = ax_n + by_{n-1} + cy_{n-2}, \tag{1}$$

where a, b and c are constants.

1. Filter a noise sound by a resonator filter with $a = 0.37625588017455336$, $b = 1.5928165461302572$ and $c = -0.9690724263048106$. Try to determine the resonance frequency and the bandwith from the spectrum.
2. Filter a noise sound by a resonator with $F = 900$ Hz and $B = 100$ Hz. Check frequency and bandwidth from the spectrum.
3. A frequency sweep is a signal for which frequency changes linear as a function of time. The formula for a sine to change from frequency f_1 at time t_1 to frequency f_2 at time f_2 is $s(t) = \sin(2\pi((f_1 - f_2)t^2/2 + (f_2t_1 - f_1t_2)t)/(t_1 - t_2))$. Make a sweep tone of 2 s duration that sweeps from 100 Hz to 10000 Hz.
4. Use the sweep to measure frequency and bandwidth of the filter of part 1.
5. Filter a noise by a cascade of two filters ($F_1 = 500, B_1 = 50$) and ($F_2 = 1500, B_2 = 50$). Draw the spectrum of the filtered sound.
6. The frequency response of the digital resonator in equation 1 for a formant with frequency F and bandwidth B is given by

$$|H(f)| = \frac{|a|}{\sqrt{2r^2\cos 4\pi fT - (4r\cos\theta + 4r^3\cos\theta)\cos 2\pi fT + r^4 + 4r^2\cos^2\theta + 1}}, \tag{2}$$

where $r = e^{-\pi BT}$ and $\theta = 2\pi FT$. The maximum amplitude of this filter, at frequency F_{max}, is given by $H(F_{max}) = \frac{|a|}{(1-r^2)\sin\theta}$.
Draw the filter response, i.e. $20\log(H(f))$ for two values of a :

(a) $H(0) = 1$

$H(F_{max}) = 1$
Use the Draw function... from the Picture window. Use $F = 500$, 1500 and 2500 Hz and all B's constant at 100 Hz.