

ELEC-A5204 Homework 5

4.9.2019

Answer to all questions in given Matlab files and use Matlabs publish feature to generate a pdf file. Always return the published pdf AND Matlab files. When an exercise ask you to draw figures, return them always with suitable axis labels and titles.

1 Audio filtering

Listen the audio file 'Noisy_speech.wav' and import it to Matlab. Filter the unwanted noises from it so that speech can be heard clearly. Plot spectrograms (time on x-axis) from original and filtered signals. Also plot magnitude responses, phase responses, impulse responses and zero-pole plots from all filters you used.

Be careful not to filter out consonants characteristic "high frequency noise" so that all 's', 'k' and so on can be heard clearly.

2 Sample rate conversion

Write your own downBy2 and upBy2 function at the end of the script and learn how to use them.

- a) Read audio file 'Guitar.wav' to Matlab and confirm that its sampling frequency is 48000 Hz.
- b) Write a 'downsampling by 2' function without using Matlabs own downsampling functions. This is done by first filtering the signal with lowpass filter with cutoff frequency at $f_s/4$ and then taking every other sample.

Then downsample 'Guitar.wav' with it and plot it (samples in x axis) and listen it so that it looks/sound correct (should sound and look like original signal but has half to amount of samples). Sampling frequency should be now 24000 Hz. Plot the magnitude and phase response of the filter you use in the downsampling.

- c) Write a 'upsampling by 2' function without using Matlabs build in upsampling functions. This can be done by first adding 0 between every sample and then filtering the signal with a lowpass filter with cutoff frequency at $f_{s_new}/4$.

Then upsample the down sampled signal in part (a) with it and plot it (samples in x axis) and listen it so that it looks/sound correct (should sound and look like original signal). Sampling frequency should be at the end 48000 Hz. Plot the magnitude and phase response of the filter you use in the up sampling.