

Multirate Signal Processing

Seminar 2 12.05. & 19.05.2016

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Homework assignment

To be presented on: 26.05. or 02.06.

Improve the filters from Homework 1:

- a) Analyse (plot) the frequency responses of our short filters (low pass, high pass), as a comparison, to see how much improvement we can obtain (passband, stopband)
- b) Design new filters using the window method
- c) Further improve the filters by changing the window shape
- d) Conclude, if we still have perfect reconstruction

Homework assignment

How to design new filters

- the impulse response of an ideal low pass filter is known
- the impulse response of the ideal high pass can be determined by following: start with the ideal frequency domain formulation, take the inverse DTFT
- the goal is to obtain a causal finite impulse response filter from the ideal lowpass/highpass infinite impulse response
- start with the mean squared error approach: minimize the quadratic error (in time and frequency because of Parseval theorem) to the given ideal. Given is a length of the FIR filter of 10 taps.

Homework assignment

- chose the location of those 10 taps out of the ideal impulse response (sinc function or the shift of the sinc function), such that the error you make is minimum in the mean squared sense
- effectively this is a rectangular window of length 10 at the right place. Keep in mind that the sum of the squares of the coefficients which are outside the window represent the quadratic error!
- compute and plot the resulting frequency response of your new filters (low- and high-pass)

Homework assignment

Replacing the window type

To further improve the filters (improve the stopband attenuation), replace this rectangular window by another window type, like the sine window of the same length (10 taps). The sine window is simply the sine wave starting at 0 and ending at π (one half wave). Also plot the resulting frequency responses.

