Multirate Signal Processing

Seminar 3

To be presented:
even week – 11.06.20
odd week – 18.06.20

M.Sc. Oleg Golokolenko
(oleg.golokolenko@tu-ilmenau.de)
Kirchhoffbau, K3013

Homework assignment

Improve the filters from Homework 2 (everything else stays the same as in HW2):

a) **Design a new window** (using optimization) to achieve optimal attenuation and transition band (number of taps = 32)
   Hint: use 32 random coefficients as starting point of your optimization routine, define error function which has to be minimized.

b) Plot frequency and impuls responses of your window

c) Use ideal impulse response (sinc) for filter implementation

d) Using Modulation method with modulation function $N(n)=\cos\left(n\frac{\pi}{N}(k+0.5)\right)$ to implement LP, BP1, BP2, HP filters
   (The band pass filters should be such that all subbands have the same bandwidth)

e) Plot corresponding frequency and impuls responses VS previous filters to evaluate your improvement.

Homework assignment

- Listen to the downsampled subbands
- Listen to the reconstructed signal
- Plot frequency responses of the original and reconstructed signals to see the difference (alias components?)

Hints:

- Please refer to Lecture slides #6, page 17 “Conclusion”

Optimization Example

```
import numpy as np
import scipy.optimize as optimize

#Example for 2 unknowns, args: function-name, starting
point, method:

def functionexamp(x):
  #x: array with 2 variables

  y=np.sin(x[0])+np.cos(x[1])
  return y

xmin=optimize.minimize(functionexamp,[-1.0,-3.0],
method='CG')

#Alternative solution: sciopt.fminbound
print xmin
```