Applied Computer Science and Signal Processing

Matlab Lab WS 11/12

1. *"Filtering a noisy function"*
   - Create the function $u_2(t) = \sin(2\pi f_1 t) + 0.3 * \sin(2\pi f_2 t)$ having a sampling rate of 10 kHz and signal duration of 0.1 seconds where $f_1 = 50Hz$ and $f_2 = 400Hz$.
   - Add random noise to the function by using the MATLAB command *randn* scaled by the factor 0.3.
   - Transform into frequency domain by means of a Fast Fourier Transform (use MATLAB command *fft* for transform, *fftshift* before displaying spectrum). Locate main frequency contributions in the spectrum and smooth the signal with an appropriate low pass filter to decrease the noise effect.
   - Plots to be prepared:
     - Filter in time and frequency domain (display absolute values by using MATLAB command *abs*)
     - Original, noisy and filtered function in time domain (use command *ifft* for inverse fourier transform)
     - Spectrum of original function, noisy function and filtered function (absolute values)

2. *"Sound file"*
   - Listen to the waveform audio file "Sample.wav" and import it into MATLAB by using command *wavread*.
   - Change into frequency domain and detect the primary frequency peak as well as secondary frequencies. Use the online link

     http://www.phy.mtu.edu/~suits/notefreqs.html

     for assigning notes to visible peaks in the signal spectrum.
   - Create an appropriate band pass filter for cutting of all secondary frequencies.
   - Tranform into time domain and save the result by using command *wavwrite*. Detect acoustic changes by listening to the resulting waveform audio file.
   - Plots to be prepared:
     - Filter in time and frequency domain (absolute values)
     - Original and filtered signal in time domain
     - Spectrum of original and filtered signal (display absolute values)

The properties of all itemized MATLAB commands can be checked up by entering *help "command"* in the MATLAB command window, e.g. *help fft.*

Further MATLAB commands for calculation:
- *fftshift*: sort elements after Fast Fourier Transform
- *ifftshift*: sort elements after Inverse Fast Fourier Transform
- *rectpuls*: tool to create rect pulse
- *length*: provides length of vector

Helpful MATLAB commands for plots:
- *title, xlabel, ylabel*: label current plot and axes

- *subplot*: for inserting several subplots into one plot
- *grid*: inserts grid into plot
- *xlim, ylim*: fix interval to be displayed along x-axis/y-axis