Signals & Systems

Laboratory no. 1 – Basics of Signal Analysis in the Time Domain

Exercise 1.

Execute the following m-files:

m-file no. 1

```
f1 = 1; % Frequencies of exemplary sinusoids
f2 = 4;
f3 = 6;

fs = 200; % Sampling frequency
t=0:(1/fs):1; % time vector

% Definition of exemplary sinusoids
x1 = sin(2*pi*f1*t);
x4 = -sin(2*pi*f2*t);
x6 = sin(2*pi*f3*t);
plot(t,x1,t,x4,t,x6)
```

m-file no. 2

```
fs = 5; % Sampling frequency
t=0:(1/fs):1; % time vector

% Definition of exemplary sinusoids
x1 = sin(2*pi*f1*t);
x4 = -sin(2*pi*f2*t);
x6 = sin(2*pi*f3*t);
plot(t,x1,t,x4,t,x6)
```

m-file no. 3

```
fs = 20; % Sampling frequency
t=0:(1/fs):10; % time vector

x = sin(2*pi*40*t);
plot(t,x)
```

Comment above examples. Briefly explain the mechanisms of ambiguity in the presented cases

Exercise 2.

Generate a few second signal composed of three sine waves of frequencies: 10, 80 and 120 Hz. Amplitude of the signals should be in the proportions 1:3:1 and the phase should be shifted by about 20^{o}. Pay special attention to the selection of the sampling frequency.

Exercise 3.

Design filters to filter out the consecutive components of the signal from the Ex 2. For each case filters should be prepared in both IIR and FIR versions.

Exercise 4.

Compare the parameters of the filters from the Ex. 3 comparing with each other IIR and FIR filters in low pass, high pass and band pass configurations respectively.

Exercise 5.

For one of the above configurations of the filter compare the results of filtration with use of the *filter* and *filtfilt* commends. Present the comparison in graphic form by imposing on each other:

- original unfiltered signal,
- signal filtered with *filter* command,
- signal filtered with *filtfilt* command.

Exercise 6.

On the generated test signal obtained in Ex. 2 impose a random noise of 10 % amplitude of the original signal. Filter new signals with use of the filters from Ex. 3. Comment on the results of the filtration.