Strict submission deadline: 17 June 2024 at 10:00 am.
Submit a PDF or Word document for calculations and plots. Submit Matlab source code for Matlab programs. Use the submit button.

Exercise #4

Task 4.1 Signal Analysis

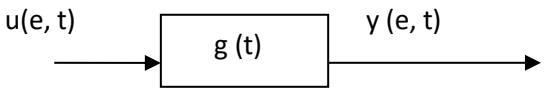
Analyze the sampled time signal given in the CSV file "testsignal". The only pre-knowledge is the sampling frequency which is 1 kHz. For reading the file, analyzing the data, and plotting the results use Matlab. Calculate and plot the PSD (Hint: use the Wiener-Khintchine theorem). Discuss your results.

Task 4.2 Digital Signal Synthesis

Write a Matlab program. Synthesize the digital signal analyzed in task 4.1 based on the determined PSD using a sampling frequency of 2 kHz. The timeframe of the synthesized signal and the original signal should have the same length. Plot the first 100 sampling points of the signal. Plot the ACF of the signal from -0,01s to +0.01s.

Task 4.3 Power spectral density and transfer function

A Gaussian noise signal u(e, t) is input to a linear system described by its impulse response g(t).



Some power spectral densities are given:

$$S_{uy} = \frac{S_1}{(1 - j\omega b)(1 + j\omega T_1)} \qquad S_{yy} = \frac{S_1}{1 + \omega^2 T_1^2}$$

a) Determine the transfer function G(jω) of the linear system.
b) Is the system described by G(jω) a causal system? Explain your statement.
c) Calculate the autocorrelation function $s_{uu}(\tau)$ of the input signal u(e, t).