Digital Signal Processing

WS 2017 Lab Sheet 2

Due date: 11.11.2017

Exercise 1: Signal and time transformation — 12 Points

Sketch an arbitrary time continuous signal $x(t)$ and the corresponding transformed signal $\tilde{x}(t)$. Make sure that by the choice of your signal $x(t)$ the transformation to the signal $\tilde{x}(t)$ gets obvious.

a. $\tilde{x}(t) = x(t-2)$

b. $\tilde{x}(t) = x(1-t)$

c. $\tilde{x}(t) = x(2t+2)$

d. $\tilde{x}(t) = x\left(\frac{t-T}{\tau}\right)$

Now repeat the same for the time discrete signals $x[n]$ and $\tilde{x}[n]$, where $u[n]$ is the step function and $\delta[n]$ is the impuls function.

a. $\tilde{x}[n] = (x[n] + x[2-n])\,u[1-n]$

b. $\tilde{x}[n] = x[n]\,(\delta[n+2] - \delta[n-1])$

Explain your results!

Exercise 2: Periodic signals — 4 Points

Which of the following signals is periodic? Give the reason and, if possible, determine its period.

a. $x[n] = e^{j2\pi n/5}$

b. $x[n] = \sin(\pi n/19)$

c. $x[n] = ne^{j\pi n}$

d. $x[n] = e^{jn}$

Exercise 3: Complex exponential functions 8 Points

- For $y[n] = Ae^z$, if possible, determine the frequency and the phase of the signal.(4)
- Use Matlab to plot the following exponential functions $y\,[n] = Ae^z u\,[n]$ for $n \in \mathbb{N}^{[-2;10]}$, where $u\,[n]$ is the step function and $z \in \mathbb{C}$. If possible, plot the envelope.(4)

a. $A = \frac{1}{2}\,;\; z = \frac{n}{2}$

b. $A = 2\,;\; z = \mathrm{j}n$

c. $A = 1\,;\; z = \mathrm{j}\frac{2\pi}{3}n$

d. $A = 1\,;\; z = -1 - \mathrm{j}\pi n$

Maximal score: 24 Points