Digital Signal Processing
WS 2017 Lab Sheet
Due date: 13.01.2018

Exercise 1: Ambiguous sampling period   3 Points

The continuous signal $x_c(t) = \sin(20\pi t) + \cos(40\pi t)$ is sampled with a period T. We obtain the discrete signal $x_d[n] = \sin(0.2\pi n) + \cos(0.4\pi n)$.
Give all possible values for T.   (3)

Exercise 2: Spectrum of sampled signal   10 Points

   a. Determine the Fourier transform $X(\Omega)$ of a continuous aperiodic signal $x(t) = e^{-100|t|}$

$$X(\Omega) = \mathcal{F}\left\{e^{-100|t|}\right\} = \int_{-\infty}^{\infty} x(t)\, e^{-j\Omega t} dt$$

   and plot it with `Matlab`.   (4)

   b. This signal is sampled at a rate of $500\,\mathrm{Hz}$, which results in the discrete signal $x_d[n]$. Determine $X_d(e^{j\omega})$ and plot it into the same figure. Repeat the same with a sampling frequency of $1000\,\mathrm{Hz}$.   (6)

Exercise 3: Finite Dirac Comb   6 Points

   a. Compute the Fourier transform $X_c(j\Omega)$ of the finite dirac comb

$$x_c(t) = \sum_{k=-K}^{K} \delta(t - k)$$

   $K \in \mathbb{N}$.   (4)

   b. Plot (Matlab) the spectrum for $K = 1$ and $K = 10$.   (2)

Maximal score: **19 Points**