Digital Signal Processing SS 2019/20

Exercise Sheet 4

Due date: 31.5.2019, 10:00h
(time of the lecture)

Problem 1

Let

$$x[n] = \begin{cases} a^n & \text{for } n = 0, 2, 4, \ldots; \\ 0 & \text{otherwise,} \end{cases}$$

with $0 < a < 1$.

a) Compute $X(e^{j\omega})$, the Fourier-transform of $x[n]$.

b) Compute the magnitude and phase of $X(e^{j\omega})$ as funtions of ω and a.

c) Use MATLAB to plot magnitude and phase of $X(e^{j\omega})$ as functions of ω with $a = \frac{1}{2}$ for $-\pi \leq \omega \leq \pi$.

Hints:

(1) Do not give answers with complex numbers in denominators of fractions. Instead, multiply nominator and denominator by the complex conjugate of the denominator to get rid of imaginary parts in the denominator.

(2) To compute the phase one normally computes real and imaginary parts, then properly applies the arctan function. A quicker way here is to make use of $\sphericalangle \frac{1}{z} = -\sphericalangle z$ (for $z \neq 0$).

Aufgabe 2

Consider the ideal high pass filter with frequency response in $(-\pi, \pi]$ given by

$$H(e^{j\omega}) = \begin{cases} 0 & \text{if } -\frac{\pi}{4} \leq \omega \leq \frac{\pi}{4}; \\ 1 & \text{otherwise.} \end{cases}$$

a) Compute its impulse response $h[n]$ by using the inverse Fourier transformation.

b) Use MATLAB to plot the impulse response as a stem graph.