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Winter Term 2018/2019

Foundations of Audio Signal Processing
Exercise sheet 5

To be uploaded in eCampus till: 23-11-2018 22:00 (strict deadline)

Exercise 5.1

[3 + 3 = 6 points]

Let $f, g : \mathbb{R} \to \mathbb{C}$ be functions defined by

$$f(t) := \begin{cases} t^{-1/2} & \text{if } t \in (0,1], \\ 0 & \text{otherwise} \end{cases}$$

and

$$g(t) := \begin{cases} t^{-1} & \text{if } t \in [1,+\infty), \\ 0 & \text{otherwise.} \end{cases}$$

Prove that:

(a) $f \in L^1(\mathbb{R}) \backslash L^2(\mathbb{R})$

(b) $g \in L^2(\mathbb{R}) \backslash L^1(\mathbb{R})$

Exercise 5.2

[3 + 3 + 3 = 9 points]

Classify the following DT signals by specifying all $p \in [1, \infty]$ with $x \in \ell^p(\mathbb{Z})$.

(a) $x(n) := e^n$.

(b) $x(n) := e^{2\pi i n}$.

(c) $x(n) := \dfrac{1}{\sqrt{n}}, \qquad n > 0$

Exercise 5.3

[4 + 2 = 6 points]

(a) Write a Matlab function which creates an animated plot of a discrete-time complex exponential function. The input parameters should include a frequency parameter ω, an amplitude parameter c, a time interval specified by start second and end second and a vector containing the number of sample values in the given interval. The animation should show the function for the different numbers of samples considered in the interval.

(b) Write a Matlab script which tests the function created in (a) with $\omega = 0.7$, and $c = 1$. The plot should show the interval from 0 to 5 seconds with sample points $p \in \{20, ..., 200\}$. For comparison there is an example on eCampus which shows how the result should look like.