Applied Signal Processing and Computer Science
WS 11/12

Tutorial 3: Fourier-Series

1. Fourier-Series:

1.1. Prove the law of orthogonality of the Fourier Series basis functions $\Psi_n(t) = e^{j2\pi\frac{n}{T}t}$

1.2. Prove the validity of the Parseval's equation $\int\limits_{-T/2}^{T/2} |u(t)|^2 \, dt = T \sum\limits_{n=-\infty}^{\infty} |c_n|^2$ by using the law of orthogonality of the Fourier Series basis functions. (Hint: Make use of the definition of the Fourier Series)

1.3. Demonstrate the validity of the equation $c_n = \frac{1}{T} \int\limits_{-T/2}^{T/2} u(t) \, \Psi_n^*(t) dt$ for determining the Fourier Series coefficients.

1.4. Calculate the Fourier Series coefficients for the square pulse $rect(t/\Delta t)$ with $\Delta t < T$

1.5. The signal of a gedackt organ-pipe shall have the form of a square pulse $rect(t/T/2)$. Calculate the cosine and sine coefficients of this signal. Which harmonics (overtones) with which magnitudes are present besides the primary oscillation, if the primary oscillation has a frequency of 100Hz?