Experiment No.: 02

1 Aim

1. To compute and plot the exponential Fourier spectra for the periodic signal.
2. To illustrate the Gibb's phenomenon.

2 Software Used

1. MATLAB

3 Theory

For theory, we can refer the text books:

1. B. P. Lathi, Modern Digital and Analog Communication Systems, Third edition, Oxford (1998).
2. Alan V.Oppenheim and Alan S.Willsky, Signals and Systems, Second edition, Prentice hall (1997).

4 Procedure

Exercise 1 *The Fourier Series of a periodic signal $x(t)$ with period T_0 is given by*

$$x(t) = \sum_{k=-\infty}^{+\infty} a_k \, e^{j\,k\,\omega_0\,t}; \qquad \omega_0 = \frac{2\pi}{T} \tag{1}$$

where the Fourier Series coefficient a_k is calculated by

$$a_k = \frac{1}{T}\int_T x(t)\, e^{-j\,k\,\omega_0\,t} dt. \tag{2}$$

In order to compute the a_k discretely, we approximate the finite integral of equation (2) as

$$a_k = \frac{1}{N}\sum_{n=0}^{N-1} x(n\,T_s)\, e^{-j\,k\,\Omega_0\,n}; \qquad \Omega_0 = \omega_o\,T_s \tag{3}$$

where T_s denotes the sampling interval and $N = \frac{T}{T_s}$ is the number of samples in one period T. For this exercise we consider the period signal $x(t)$ with period $T = \pi$ defined as

$$x(t) = e^{-t/2}; \qquad 0 \leq t \leq \pi \tag{4}$$

For the numerical computation of a_k, we use $N = 256$. Compute the 10 coefficients of this period signal and plot the exponential Fourier spectra of this period signal.

Exercise 2 *Gibb's phenomenon: Let $x_M(t)$ be the approximation of the original periodic signal $x(t)$. It is defined as*

$$x_M(t) = \sum_{k=-M}^{M} a_k \, e^{j\,k\,\omega_0\,t}. \tag{5}$$

Plot $x_M(t)$ as a function of time for $M = 2, 9, 19$ and $, 100$.

5 Analysis of Results

Write Your own.

6 Conclusions

Write Your Own.

Precautions

Observation should be taken properly.