

Experiment 3

Autocorrelation and Energy Spectral Density of a deterministic Energy signal

Laboratory Tasks

To verify that Energy Spectral Density (ESD) of an energy signal is equal to the Fourier transform of the autocorrelation of the signal.

Description

In this lab, you will perform the following tasks:

1. Consider the following rectangular pulse in MATLAB

$$u[n] = [1,1,1,1,1] \text{ where } n = [-2, -1, 0, 1, 2]$$

Find its Discrete Time Fourier Transform (DTFT) by your own code

$$U(e^{-j\omega}) = \sum_{n=-2}^{n=2} u[n] e^{-j\omega n}$$

Also plot phase and amplitude of $U(e^{-j\omega})$ with respect to ω that goes from -2π to 2π .

Also find its ESD by

$$S_{uu}(e^{-j\omega}) = |U(e^{-j\omega})|^2$$

Hint: Remember $U(e^{-j\omega})$ is a continuous function of ω . Take 1000 values of ω and then use plot command of MATLAB so that the $U(e^{-j\omega})$ will appear as a continuous function of ω .

Warning: Do not use FFT command. Anyone found using it will have Negative -3 marks.

2. Find the autocorrelation R_{uu} of above $u[n]$ by using your own code. Find DTFT of R_{uu} and verify that it is equivalent to $S_{uu}(e^{-j\omega})$.

Laboratory Rubrics

Performance	Exceeds expectation (3)/(1)	Meets expectation (1.5)/(0.5)	Does not meet expectation (0)/(0)	Marks
				S1
K: Knowledge of required functions for code design. Marks: 1				
D: Design of Code Marks: 3				
S: Show proper results. Marks: 1				

Good ingenious programming or problem solving skills during lab work will be rewarded with additional bonus marks.