Stochastic Signals and Systems

Exercises

1 Task 3.1

Given is the following signal

$$x(t) = \sin(2\pi f t)$$

where, frequency f is 1 Hz.

Find the Auto-Correlation Function of the signal $x(t)$ using both Rectangular Window and Hamming Window.

2 Task 3.2

Given is the following random process with random noise added to it

$$x(\zeta, t) = \sin(2\pi f t) + \alpha \cdot \eta(\zeta, t)$$

where, frequency f is 1 Hz, α is 0.05 and $\eta(\zeta, t)$ is random noise.

Find the Auto-Correlation Function of the random process $x(\zeta, t)$ using both Rectangular Window and Hamming Window. Also, find the Probability Density Function of the random noise.

3 Task 3.3

Given is the following random process with random noise added to it

$$x(\zeta, t) = \sin(2\pi f t) + \alpha \cdot \eta(\zeta, t)$$

where, frequency f is 1 Hz, α is 0.05 and $\eta(\zeta, t)$ is random noise.

This given random process $x(\zeta, t)$ is now sampled by the help of Dirac Pulses of frequency 10 Hz to obtain a new sampled random process $y(\zeta, t)$ as shown,

$$y(\zeta, kT) = \sum_{k=-\infty}^{+\infty} \delta(t - kT)x(\zeta, t)$$

Find the Auto-Correlation Function of this sampled random process $y(\zeta, t)$ using both Rectangular Window and Hamming Window.

4 Task 3.4

Given is the following random process with random noise added to it

$$x(\zeta, t) = sin(2\pi f_1 t) + sin(2\pi f_2 t) + sin(2\pi f_3 t) + \alpha \cdot \eta(\zeta, t)$$

where, frequencies f_1, f_2 and f_3 are 1 Hz, 2 Hz and 3Hz respectively, α is 0.05 and $\eta(\zeta, t)$ is random noise.

Find the Auto-Correlation Function of the random process using both Rectangular Window and Hamming Window.