TD 2

Exercises on: Random signal time-domain characteristics

2.1 Exercise 1

Given a process $X(t) = Ut, -\infty < t < \infty$, where U is a random variable uniformly distributed in the interval[0,1]. Find the mean, the auto-correlation, the auto-covariance and the variance of $X(t)$.

2.2 Exercise 2

Given a real stochastic process $X(t)$ with Mean $\mu_X(t)$, auto-covariance $C_X(t)$. We form the random process $Y(t) = X(t) + \phi(t)$, where $\phi(t)$ is a deterministic signal.

a) Find the mean of $Y(t)$.

b) Find the auto-covariance of $Y(t)$.

2.3 Exercise 3

Suppose random variables U, V, W are uncorrelated with zero mean and variance $\sigma^2 = 6$. Define processes $X(t) = Usint + Vcost, \quad Y(t) = Wsint + Vcost$. Find the cross-correlation and cross-covariance of $X(t)$ and $Y(t)$.

2.4 Exercise 4

The complex stochastic process $V(t)$ is composed of N complex signals,

$$V(t) = \sum_{n=1}^{N} A_n e^{j(\omega_0 t + \Phi_n)}$$

where:

- ω_0 is numeric constant.
- A_n is a random variable.
- Φ_n is a random variable uniformly distributed in the interval [0,2π].
- For $n = 1, 2, \cdots, N$, A_n are independent with Φ_n.

Find the auto-correlation of $V(t)$.