Birla Institute of Technology & Science, Pilani, Rajasthan
First Semester 2020-2021
<u>Lab-6: Randomness and Real time</u>

Course: EEE F311 Communication Systems
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Date: 22-09-2020

Objectives

In this task, the objective is to study random variables, process, noise, and real time generation of signals.

Task 1

Random variables are represented in terms of cumulative and probability distribution functions. Write down the pdf of Gaussian random variable $\sim N(0, 1)$, Rayleigh with parameter $\sigma^2 = 2$, exponential with parameter $\lambda = 3$, Uniform $\sim U(1, 4)$. Plot the pdf versus the running variable. Use the MATLAB function integral to verify each pdf. Using the integral function, find the mean and variance of each random variable. Using the integral function, find $P(X > 1)$ for Gaussian and Rayleigh distributions. Verify $P(X > 1)$ with the Q-function qfunc. Can we use Q-function for Rayleigh?

Task 2

Generation of random numbers is always confused with the pdf of a random variable. Never use directly the pdf to generate the random numbers, but, the generated random numbers must satisfy the pdf. Generate 10^6 random numbers for Gaussian, Rayleigh, exponential, and uniform random variables of the given specification of TASK1. Use hist to verify the generated numbers. Use xcorr to find the auto-correlation for the Gaussian random variable. Also find the PSD of the Gaussian random number $\sim N(0, 10)$.

Task 3

Information signals are generally random which can be observed over time. Information signals are not transmitted as a whole but in smaller parts or chunks. Transmission rate is usually measured how many waveform (i.e., symbols) in a unit time are transmitted over channel. Thus, we use the rate of transmission in symbols/sec. For example, an audio file of 3 minutes duration is not transmitted in a go but transmitted over a time such that each time a smaller part of signal (i.e., of a certain duration)

is transmitted. Transmission stops once whole information is transmitted. Time has come to visualize signals in real time.

1. Generate a message signal $m_1(t) = U \cos(2\pi \times 5 \times t)$ each of duration 1 second for a total duration of 30 seconds, where U is a uniform random variable which can take integer values from 1 to 5. Visualize the signal in real-time for the duration of 30 seconds. Also visualize the signal in frequency domain.

2. Generate a message signal $m_2(t) = \cos(2\pi \times U_2 \times 5 \times t) + n(t)$, where $n(t) \sim N(0,1)$ each of duration 1 second for a total duration of 30 seconds, where U_2 is a uniform random variable which can take integer values from 1 to 3. This creates a message signal with varying frequency.

Project Task

We have started individual tasks with a bigger picture: to design an end-to-end simulator for a digital communication system. In this task, we have generated noise. We will also generate real time visualization of signals.