Computer Simulation of Communication Systems—Homework 2

Due date: 3/9

1. Consider the signal

$$x(t)=\begin{cases}2\cdot\mathrm{sinc}(20t)\cdot\cos(2\pi\cdot 50t)+\mathrm{sinc}^2(20t)\cdot\cos(2\pi\cdot 130t), & 0\le t\le 10;\\ 0, & \text{otherwise}\end{cases}$$

   (a) Determine and plot the Hilbert transform of $x(t)$.

   (b) Determine and plot the envelop of $x(t)$.

   (c) Assume that the carrier frequency is $f_0=85\text{Hz}$. Determine the lowpass equivalent signal, and then plot the in-phase component and the quadrature component of $x(t)$.

2. Generate the following random variables and plot the histograms of the results by using command **histogram( )** or **hist( )**.

   (a) Uniform random variable. You may use the command **rand( )** in MATLAB.

   (b) Pareto distributed random variable. Notice that the cumulative density function of Pareto distribution is

$$F(x;x_m,\alpha)=\begin{cases}1-(x_m/x)^{\alpha}, & \text{if } x>x_m\\ 0, & \text{if } x\le x_m\end{cases}.$$

   Generate the Pareto distributed random variable by setting $x_m=2.5$ and $\alpha=1.25$.

   (c) Cauchy distributed random variable by setting $X=X_1/X_2$, where X_1 and X_2 are i.i.d. Gaussian distributed random variables with zero mean and unit variance. Please generate X_1 and X_2 by using the command **randn( )** in MATLAB.

   (d) Chi-square distributed random variable with degree $K=10$ by setting $Y=X_1^2+X_2^2+\cdots+X_K^2$, where X_k's are i.i.d. Gaussian distributed random variables with zero mean and unit variance.

Note: MATLAB source code should be included. Explain all your results.