E2 203 Wireless Communications (Jan.-Apr. 2024) Programming Assignment 2

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The goal of this exercise is to understand and implement the Jakes' fading simulator, which generates a trace of **time-varying** Rayleigh fading. You will implement the algorithm proposed in the following paper:

Y. R. Zheng and C. Xiao, "Simulation Models With Correct Statistical Properties for Rayleigh Fading Channels," IEEE Transactions on Wireless Communications, Vol. 51, No. 6, Jun. 2003, pp. 920–928.

What to do:
1) Please read the paper and also Chapter 2.4.3 of the text book.
2) Implement the simulation model proposed in Section III of the paper to generate the complex baseband time trace $X(t) = X_c(t) + jX_s(t)$ for a given speed.
3) Generate a sufficiently long time trace with a sufficient number of samples that are spaced T sec apart. (Understand what "sufficiently" means.) From the samples obtained from **one** trace, plot the following:
   - Probability density function (PDF) of $X_c(t)$, $|X(t)|$, and $|X(t)|^2$.
   - Cumulative distribution function (CDF) of $|X(t)|$ and $|X(t)|^2$.
   - Auto-correlation functions of $X_s(t)$ and $X(t)$.
   - Cross-correlation function of $X_c(t)$ and $X_s(t)$.
4) In each of the above plots, super-impose the results from analysis, which are also given in the paper.

Note:
- There is a typo in (14b) and (14c) in the paper. Please replace 2 with $\sqrt{2}$ in both the equations.
- Your code should be able to generate results for different T.
- When you generate PDFs, please use the following two methods:
  1) Using histograms
  2) Using `ksdensity`

  Why is there a difference between the accuracy of the two methods especially when there are fewer samples?