EEE 554: Random Signal Theory

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- Prerequisites: (a) EEE 350 (Random Signal Analysis) or equivalent upper-division undergraduate course on basic concepts of axiomatic probability, random variables, expectations, moments and density functions; (b) thorough knowledge of calculus.


- Outline: The course is designed to study the theory of probability as it applies to various areas of electrical engineering, including detection, estimation, communications, and information theory. The study is mathematical in nature with many application examples to engineering problems. Probability theory formulates uncertain events or processes that do not only include tossing a coin or drawing a card at random. They also include processes such as additive noise (e.g., noisy signals received by radar sensors) or random jitters (e.g., steering wheel movements of a car’s power-steering system), and they are represented using statistical models with specific probability density functions and power spectral densities. If the output of a high-gain amplifier is connected to a loudspeaker, random noise (in the form of snaps and crackles) can be frequently heard. This random noise arises from the thermal motion of the conduction electrons passing through transistors. Although the value of this noise cannot be calculated at every time instant, the average power and frequency spectrum of the noise can be calculated and thus the quality of the amplifier can be determined. By studying statistical models for random signals and noise, electrical engineers can derive signal processing algorithms to recover information based on observations. For example, the location of a target can be estimated or the presence of an incoming missile can be detected using noisy radar observations. This course covers the following topics:
  - Review of probability theory: Axioms of probability, experiments, outcomes, events, conditional probability and independence.
  - Random variable (RV): Continuous and discrete distribution and density functions (normal, uniform, binomial), conditional distributions, functions of one RV, mean, variance, moments, characteristic functions.
  - Two RVs, sequence of RVs, joint distributions and density functions, marginal statistics, functions of two RVs, joint moments and characteristic functions, conditional distributions,
  - Stochastic processes: properties, white noise, Gaussian random processes, stationary processes, power spectrum, systems with stochastic inputs, Markov chains, applications.

- Grading: exam 1 (20%), exam 2 (25%), cumulative final exam (35%), assignments (15%), class participation (5%).