Temporal Characteristics of Random Processes

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Based on
Probability, Random Variables and Random Signal Principles,
P.Z. Peebles,Jr. and B. Shi

Outline

First Order Distribution Function
N Gaussian random variables

Definition

For one particular time t_1, the distribution function associated with the random variable $X_1 = X(t_1)$

$$F_X(x_1; t_1) = P\{X(t_1) \le x_1\}$$

the density function

$$f_X(x_1; t_1) = dF_X(x_1; t_1)/dx_1$$

Second Order Distribution Function

N Gaussian random variables

Definition

For one particular time t_1, t_2, the distribution function associated with the random variables $X_1 = X(t_1)$ and $X_2 = X(t_2)$

$$F_X(x_1, x_2; t_1, t_2) = P\{X(t_1) \le x_1, X(t_2) \le x_2\}$$

the density function

$$f_X(x_1, x_2; t_1, t_2) = \partial^2 F_X(x_1, x_2; t_1, t_2) / \partial x_1 \partial x_2$$

N-th Order Distribution Function
N Gaussian random variables

Definition

For one particular time t_1, t_2, ... ,t_N, the distribution function associated with the random variables $X_1 = X(t_1)$, $X_2 = X(t_2)$, ..., $X_N = X(t_N)$

$$F_X(x_1, \ldots, x_N; t_1, \ldots, t_N) = P\{X(t_1) \le x_1, \ldots, X(t_N) \le x_N\}$$

the density function

$$f_X(x_1, \ldots, x_N; t_1, \ldots, t_N) = \partial^N F_X(x_1, \ldots, x_N; t_1, \ldots, t_N) / \partial x_1 \cdots \partial x_N$$