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

1 The concepts of the random process

Random variables with time (1)

N Gaussian random variables

Definition

a function of both outcome s and time t
assign a time function to every outcome s

$$x(t,s)$$

the family of such time functions is called a random process

$$X(t,s)$$

the short-form notation $x(t)$ to present a specific waveform of a random process

$$X(t)$$

Random variables with time(2)

N Gaussian random variables

Definition

$X(t,s)$ represents a family or ensemble of time functions
$x(t,s)$a sample function, an ensemble member, a realization of the process
a random process $X(t,s)$ also represents a single time function whtn t is a variable and s is fixed at an outcome

Random variables with time

N Gaussian random variables

Definition

$$X_i = X(t_i, s) = X(t_i)$$

Classification of Random Processes

N Gaussian random variables

- a continuous alphabet continuous time random process
- a discrete alphabet continuous time random process
- a continuous alphabet discrete time random process
- a discrete alphabet discrete time random process

Deterministic and Non-deterministic Processes

N Gaussian random variables

a sample function
if future values of any sample function cannot be predicted exactly from observed past values, the process is called non-determinisitic
A process is deterministic if future values of any sample function can be predicted from past values

An alphabet

N Gaussian random variables

Definition

the alphabet of $X(t)$ is the set of its possible values
classify random processes according to
the values of t for which the process is defined
the alphabet of the random variable $X = X(t)$ at time t