

EE 562a: Random Processes for Engineers Summer 2009

Lecture: Wednesday 6-9:10 p.m. in OHE 100B

Discussion: Friday 1-1:50 p.m. in OHE 136

Instructor: Christopher Wayne Walker, Ph.D.

Office: EEB 102

Office Hours: Wednesday 5-6 p.m.

Daytime phone: (213) 740-2221 – USC during office hours

or (310) 812-5176

email: cwwalker@cwwphd.com

Web page: <http://www.cwwphd.com> and/or DEN web site

Text: Required: Probability and Random Processes with Applications to Signal Processing, 3rd edition, Authors: John W. Woods and Henry Stark

Course Grading Policy:

Method	Date	Weight
Homework	As assigned in class	25%
Midterm	Wednesday, July 1, 6-8 p.m.	35%
Final	Wednesday, Aug. 5, 6-9:10 p.m.	40%

One 8 ½ x 11 sheet of notes (front and back) is allowed on the midterm. Two such sheets are allowed on the final. Calculators are allowed on all exams.

EE 562a Outline

Summer 2009

Inst: C.W. Walker

Section	Title
1.0	Introduction to Random Processes
2.0	Random Vectors
2.1	Definition of Correlation Matrices
2.2	Properties of Correlation Matrices
2.3	Linear Transformations of Random Vectors
3.0	Gaussian Random Vectors
3.1	Gaussian Random Variables
3.2	Gaussian Random Vectors
3.3	Characteristic Function of a Gaussian Random Vector
3.4	Density Function of a Gaussian Random Vector
4.0	Analysis of Correlation Matrices
4.1	Decomposition of a Correlation Matrix
4.2	The Spectral Decomposition of a Correlation Matrix
5.0	Spectral Shaping Problem
6.0	Causal Solution to Spectral Shaping
6.1	Direct Method for Causal Factorization
6.2	Row Operation Method for Causal Factorization
7.0	Spectral Whitening
8.0	Projections and Karhunen-Loeve Expansions
8.1	Projection of Random Vectors
8.2	Karhunen-Loeve Expansions
9.0	Random Sequences and Convergence Concepts
9.1	Random Sequences
9.2	Convergence Concepts
10.0	Hypothesis Testing and Detection Theory
10.1	Hypothesis Testing and the Neyman-Pearson Proposal
10.2	Detection Theory
10.2.1	Correlation Detection in White Noise
10.2.2	Correlation Detection in Colored Noise
10.2.3	Perfect Decisions
10.3	Some Practical Detection Schemes

Section	Title
11.0	Hilbert Spaces
11.1	Definitions and Properties
11.2	The Projection Theorem
11.3	Mean Square Convergence
12.0	Estimation Theory
12.1	Conditional Operations
12.2	Stein's Equation
12.3	Minimum Mean Square Error Estimation
12.4	Linear Minimum Mean Square Error Estimation
12.5	Affine Linear Minimum Mean Square Error Estimation
12.6	Gaussian Examples
12.7	Least Squares Estimation
12.8	Estimation of Parameters of PDF's
13.0	Random Processes
13.1	Introduction
13.2	The Second Moment Theory of Random Processes
13.3	Examples of Random Processes
13.4	Properties of Correlation Functions
14.0	Linear Time Invariant Systems
14.1	Definitions
14.2	Discrete Time Systems
14.2.1	Eigensequences
14.2.2	Fourier Analysis
15.0	Wide Sense Stationary Random Processes
15.1	Definitions
15.2	Power Spectral Density in Discrete Time Systems
16.0	Stochastic Inputs to Linear Shift Invariant Systems
16.1	General Systems
16.2	Wide Sense Stationarity in Linear Shift Invariant Systems
17.0	Spectral Concepts
17.1	Spectral Densities
17.2	Spectral Factorization
18.0	Wiener Filters
18.1	Discrete Case
18.2	Continuous Case
19.0	Wiener Processes

Section	Title
20.0	Mean Square Calculus
20.1	Mean Square Continuity
20.2	Mean Square Derivatives
20.3	Mean Square Integrals
21.0	Ergodicity
21.1	Ergodic in Mean
21.2	Ergodic in Correlation
21.3	Ergodic in Mean Square
21.4	Ergodic in Distribution
22.0	Karhunen-Loeve Expansion
23.0	Stochastic Differential Equations
24.0	LMMSE Estimation and Karhunen-Loeve Expansion
25.0	Bandpass Systems
25.1	Representations of Bandpass Systems
25.2	Representations of Linear Bandpass Systems
25.3	Response of a Bandpass System to a Bandpass Signal
25.4	Representation of Bandpass Stationary Stochastic Processes
25.4.1	Properties of the In-phase and Quadrature Components
25.4.2	Representation of White Noise
26.0	Miscellaneous Topics
26.1	The Poisson Process
26.2	Sampling Theorem for Bandlimited WSS Random Processes
26.3	Simulation of Random Events
26.3.1	Simulation of Discrete Random Variables
26.3.2	Simulation of Continuous Random Variables
26.3.3	Variance Reduction Techniques

The above outline is tentative and may change if circumstances warrant.