Course Outline

2102-502 Random Signals and Systems

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Objectives

- Can solve all of the exercises in the textbook
- Understand the physical meanings of all mathematical expressions
- Can apply the knowledge to solve problems in real applications

Course Contents (*Tue and Thu 08:30 –10:00, Room 1307 Bldg. 4*)

1. Preliminary Review Probability Trio, Axiom, Random Variables, cdf, pdf, Expected Value, Joint Distributions, Independence, Conditional Prob., Marginal Prob., Bivariate, Multivariate
2. Hilbert Space of 2nd Order RV's, Gram-Schmidt, Random Processes
3. 1-D and 2-D Gaussian, Basic Decorrelation (Change of RV's)
4. Multidimensional Gaussian, LDL^T Decorrelation
5. Conditional Density, Conditional Mean and Covariance
6. Optimal Bayesian MMSE Estimator vs Optimal Linear Estimator
7. Finite Random Sequences, UWGN, Ensemble Average vs Time Average
8. SuccessiveViwpoint, Causal Linear System with UWGN Input
9. Simultaneous Viewpoint, Lower Triangular Matrix vs Causality

Mid-term Examination (*Fri 30 Jul 2010, 09:00 –12:00*)

10. Stationary Sequences vs Discrete-Time Linear Time-Invariant System
11. Auto and Cross-Covariance Functions vs Filter Impulse Response
12. Power Spectral Density vs Transfer Function, Causality (Bochner's)
13. Rational Spectral Densities Factorization vs Realizable Filters
14. Continuous-Time Stationary Gaussian, Strict & Wide Sense (2nd Order)
15. Rational Spectral Densities Factorization and Paley-Wiener Criterion
16. Min. Phase System, Ergodicity, Deterministic Signals, Matched Filter
17. Hilbert Space of 2nd Order RV's and Square Integrable Functions of Time
18. Eigenvalue Decomposition (Decorrelation), Kahunen-Loeve Expansion
19. Properties of K-L, Examples : Brownian Process and 1-D Discrete-Time
20. Fourier Series Expansion of Random Signals vs K-L Expansion
21. Discrete-Time Kalman Filtering Problem Formulation (State-Space)
22. MMSE Estimator and LDL^T Factorization $\rightarrow$ Update Formula, Innovation
23. State Equations $\rightarrow$ Propagate Formula, Kalman Filter Equations
24. Prediction & Estimation Error, Steady-State Kalman Filter
25. Kalman Filter Applications

Final Examination (*Tue 5 Oct 2010, 09:00 –12:00*)

Evaluations: Mid-term Examination (30%), Final Examination (70%)

Text Book: Richard E. Mortensen, " Random Signals and Systems", John Wiley & Sons (Chap. 1-6 , 8, 11)