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SHANNON SAMPLING AND INTERPOLATION THEORY

University of Washington

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Textbook

This course is an in-depth study of the analytic theory whereby analog signals can be reconstructed from their samples. Effects of data noise and other error sources on this restoration is considered. A number of important generalizations of the Shannon sampling theorem are discussed including those of Lagrange and Papoulis. Extensions to bandpass and multidi-dimensional signals are also studied. Interpolation is also considered in the case where signals are continuously sampled over a number of disjoint intervals.

Intended Audiences
Shannon sampling theory is an integral component in such disciplines as image and digital processing, communications, information theory, optics and holography.

Instructor
Dr. Robert J. Marks II, Professor, Electrical Engineering, University of Washington.

Course Contents
1. INTRODUCTION; 2. FUNDAMENTALS OF FOURIER ANALYSIS AND STOCHASTIC PROCESSES: Signal Classes; The Fourier Transform; Stochastic Processes; 3. THE CARDINAL SERIES: Interpretation; Proofs; Properties; Application to Spectra Containing Distributions; Application to Bandlimited Stochastic Processes; 4. GENERALIZATIONS OF THE SAMPLING THEOREM: Generalized Interpolation Functions; Papoulis' Generalization; Derivative Interpolation; Sampling Theory for Trigonometric Polynomials; Sampling Theory for Bandpass Functions; A Summary of Sampling Theorems for Directly Sampled Signals; Lagrangian Interpolation; Kramers Generalization; 5. SOURCES OF ERROR: Effects of Additive Data Noise; Jitter; Truncation Error; 6. THE SAMPLING THEOREM IN HIGHER DIMENSIONS: Fourier Analysis; The Multidimensional Sampling Theorem; Restoring Lost Samples; Periodic Sample Decimation and Restoration; Raster Sampling; 7. CONTINUOUS SAMPLING: Interpolation From Periodic Continuous Samples; Prolate Spheroidal Wave Functions; The Papoulis-Gerchberg Algorithm; Remarks.

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