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Book Review

R. L. Stratonovich, *Topics in the Theory of Random Noise*, Vols. I and II, translated by R. A. Silverman, Gordon and Breach Science Publishers, Inc., New York, 1963.

This book, in two volumes, is mainly concerned with the application of the theory of random processes to the field of radio physics. Many new problems that have not been solved are discussed, and the method proposed to treat them is highly original.

The two volumes of this book each consists of two parts. Part 1 of Volume I, entitled "General Theory of Random Processes," is a review of the theory of random processes and forms a preliminary for later use. A concept of cumulant expansions in ordinary probability theory is introduced into the theory of stochastic processes in the first chapter and is used throughout the book. Chapter 4 is devoted to the theory of Markov processes. Emphasis is laid upon the method of the Fokker–Planck equation, and it is shown that rather wide classes of random processes may be treated by this method. In Chapter 6, the method to treat random point processes and the general theory of shot noise generated from those processes are discussed. This chapter also involves many new results on problems that have long been left unnoticed.

The title of Part 2 of Volume I is "Nonlinear Transformation of Signals and Noise." Chapter 8 is devoted to a review of the so-called moment method to obtain statistical properties of an output noise through a nonlinear zero-memory device. In Chapter 9, nonlinear transformation of random noise by a device with memory is discussed by taking an *RC* circuit with a diode as an example. It is shown that when a correlation time τ_{cor} of input noise is larger than the time constant *RC* of the circuit, the problem may be reduced to the zero-memory problem; and that in the opposite case, $\tau_{\text{cor}} < RC$, the method of the Fokker–Planck equation may be applicable.

Part 1 of Volume II is entitled "Peaks of Random Functions and the Effects of Noise on Relays." Noise is regarded mainly as a Markov process here.

Part 2 of Volume II is entitled "Nonlinear Self-Excited Oscillation in the Presence of Noise," and here the effects of noise disturbances on the stability of a self-sustained oscillator are discussed systematically for many sorts of noise disturbances.

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This book is a result of work developed in the USSR, for the most part in the past two decades.

In reading through this book, I was deeply impressed to see that so many problems in radio physics that have not been solved by Western scholars are treated systematically by using the Markov process method. This method would be applicable to stochastic problems in many other fields of science and technology. The contents of this book are given below to clarify its structure:

VOLUME I

Part 1. General Theory of Random Processes

1—Random Functions and their Statistical Characteristics. 2—Stationary Random Processes and Spectral Densities. 3—Gaussian and Non-Gaussian Random Processes. Quasi-Moment Functions. 4—Markov Processes and Related Processes. 5—Non-Stationary Random Processes. 6—Systems of Random Points and Related Random Functions. 7—Narrow-Band Random Processes.

Part 2. Nonlinear Transformations of Signals and Noise

8—Zero-Memory Nonlinear Transformations. 9—Nonlinear Transformations with Memory. Detections of Random Signals.

VOLUME II

Part 1. Peaks of Random Functions and the Effects of Noise on Relays

1—The Average Number of Peaks of a Random Function. 2—Duration of Peaks of Markov Processes. 3—Effect of Smoothly Varying Noise on Relays with High Operating Levels.

Part 2. Nonlinear Self-Excited Oscillations in the Presence of Noise

4—Basic Equations Describing the Operation of an Oscillator in the Presence of Noise. 5—Methods of Solving the Simplified Equations. 6—Effect of Internal Noise on an Oscillator. 7—Effect of Strong External Noise in an Oscillator. 8—Effect of Slowly Varying Noise. Frequency Instability. 9—Synchronization of an Oscillator in the Presence of Noise. 10—Parametric Oscillations.

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