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a detailed study of least-squares filtering problems for such Gaussian Markov processes. The restriction to such processes enables the solution to be given in a recursive form, convenient for computations on "growing" data. Dyer gives rationalizations for the various equations that have been used to characterize aerodynamic noise. Jaynes discusses how the notion of entropy as uncertainty may be used to obtain prior distributions for the Bayesian solution of various decision problems. D. Slepian gives an outline—without any equations—of three basic communication problems that require the introduction of probabilistic notions—traffic problems, source characterization, noise theory. The volume is introduced by S. S. Shu who gives a brief history of probability in physics and engineering and discusses the papers that follow in the setting of his views on the future role of probability in engineering. In final summary, an entertaining and stimulating volume.

Noise and Fluctuations: An Introduction. By D. K. C. MacDonald. 118 pp. Wiley, New York, 1962. \$6.50. *Reviewed by R. Bruce Lindsay, Brown University.*

NOISE in acoustics is often defined as unwanted sound, but this is a far from satisfactory definition. Much more relevant is the viewpoint according to which noise is a random series of tones of a wide range of frequencies having no regular connection with each other. From this standpoint, there is a close analogy between acoustical noise and fluctuation phenomena like those encountered in Brownian motion and other instances of physical variables which are purely random functions of the time. It is on this analogy, indeed, that the use of the word "noise" in current physical literature is based. The book under review is a very attractive brief survey of fluctuation phenomena in general. As such, it will serve as an effective introduction to the more elaborate treatises on the subject which are now so numerous.

Professor MacDonald is a physicist and hence is not inclined to let mathematical rigor get in the way of physical understanding. The analysis he presents is quite within the grasp of the advanced undergraduate college physics major, and all steps are clearly explained. The physical tone of the book is set at the outset by the careful discussion the author gives of the Brownian motion, which is treated from several points of view in order to emphasize the various techniques available for treating random processes in general. This is followed by a more systematic study of the autocorrelation function and the Wiener-Khinchine theorem, which relates this function to the power spectrum of a random variable. Illustrations are presented from electrical fluctuations as well as traffic problems. Finally the Fokker-Planck equation is introduced and applied. The last quarter of the book is devoted to problems concerning noise in electric currents, mainly

in vacuum tubes. There is a useful series of mathematical appendices and a brief bibliography.

The author's bright and perspicuous style makes the book a pleasure to read. It is highly recommended.

Theory and Application of Liapunov's Direct Method. By Wolfgang Hahn. English ed. prepared by Siegfried H. Lehnigk. Transl. from German by Hans H. Hosenthien and Siegfried H. Lehnigk. 182 pp. Prentice-Hall, Englewood Cliffs, N. J., 1963. \$9.00.

Oscillations in Nonlinear Systems. By Jack K. Hale. 180 pp. McGraw-Hill, New York, 1963. \$9.00.

Nonlinear Problems. Rudolph E. Langer, ed. Symp. Proc. (Madison, Wisc., Apr.-May 1962). 321 pp. Univ. of Wisconsin Press, Madison, 1963. \$7.50. *Reviewed by Peter L. Balise, University of Washington.*

NONLINEAR analysis is characterized by its mathematical intractability, its pertinence to actual systems, and its appearance as the subject of many new books. Here are three different types of books on the subject.

The English translation of *Theory and Application of Liapunov's Direct Method* is most welcome, both because of the subject's importance and the presentation's excellence. Liapunov's work is the dominant basis for analysis of nonlinear control systems in Russia, and it is now receiving much attention here. Essentially, the method states that if a positive definite function V of the system-state variables can be found such that dV/dt is negative semidefinite, the system is stable; if dV/dt is negative definite, the system is asymptotically stable. The reasonableness of this is indicated by a particular V function, a system's energy, but usually a more complex function is required. Dr. Hahn gives many examples of the construction of suitable V functions, as well as a general introduction to the stability theorems. He also considers the converse problem of inferring the existence of a V function from knowledge of a system's stability. Other interesting topics are rate of decay (degree of stability), sensitivity to perturbations, and critical cases, where the equilibrium is stable but not exponentially stable. With the best bibliography on nonlinear analysis that this reviewer has seen, the volume is warmly recommended.

Indicating the subject's importance, *Oscillations in Nonlinear Systems* is the first volume in the publisher's new series, "Advanced Mathematics with Applications," whose consulting editors are LaSalle and Lefschetz, authors of apparently the first (1961) American monograph on Liapunov's method. Most appropriately, Dr. Hale introduces his book by explaining how the applicability of superposition is the basic characteristic of a linear system, so that knowledge of its behavior near the origin applies everywhere in the state space. This seems more desirable to merely stating the form of the linear differential equation. The rest of the introductory material is much more succinct, being a good summary for one who well understands matrix representation of system behavior. A large part of the work

Magnetohydrodynamic Shock Waves

by J. Edward Anderson, Minneapolis-Honeywell.

This monograph examines MHD shock-wave occurrence criteria in relation to plane shocks for which the collision frequency is large compared with cyclotron frequency. Steady-state shock relations are discussed in sufficient detail to provide a basis for analysis of existence and stability, and two novel features appear: first, a graphical representation of shock end states in three dimensions, and second, an exact solution for the shock adiabatic curve in a particularly convenient form. Analysis of the effect of small disturbances is based on the work of Russian authors, expanded to elucidate the conclusions reached. The concept of group velocity is discussed in detail. The existence and uniqueness properties of the shock layer are analyzed using a new set of equations that include the effects of current inertia and charge separation. Inclusion of current inertia so complicates the analysis that previous methods cannot produce general conclusions, but the author discovers more powerful topological arguments which do produce positive conclusions concerning existence and uniqueness. 1963 240 pages \$6.50

Waves in Anisotropic Plasmas

by W. P. Allis, S. J. Buchsbaum, and A. Bers.

A systematic treatment of plane waves in an unbounded plasma in a magnetic field, and of guided-wave propagation in plasmas and the associated conservation principles of energy and power flow. 1963 280 pp. \$7.50

Properties of the Thirty-Two Point Groups

by G. F. Koster, J. O. Dimmock, R. G. Wheeler, and H. Statz.

Computed character tables, basis functions, and coupling coefficients for irreducible representations of each of the 32 crystallographic point groups. 1963 160 pages \$5.00

Field-Coupled Surface Waves:

A Comparative Study of Surface-Coupled EHD and MHD Systems

by James R. Melcher, Notre Dame.

Describes the behavior of some simpler kinds of surface-coupled continuum-mechanical systems. 1963 224 pages \$5.00

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