Book Reviews

Kinetic Theory of Vehicular Traffic—I. Prigogine and R. Herman (New York: American Elsevier, 1971, 100 pp.). *Reviewed by R. S. Schechter, Department of Chemical Engineering, University of Texas, Austin, Tex. 78712.*

Traffic science is an infant field. Its birth has been greatly hastened by a sense of national urgency stemming from seemingly endless snarls of traffic which plague every urbanite. Now in its embryonic stage, traffic scientists have been searching for a viable theoretical framework to provide guidance in designing rational experiments. This monograph presents a stochastic model of traffic flow and develops some of its consequences. The central idea is that each individual driver possesses an intrinsic program which he would execute if he were alone on the road. In traffic the driver's desired "microgoals" are modified by the interaction with other drivers. The result of this interaction is predicted using a kinetic equation which is an expression of the desire of the driver and the interaction between other vehicles. To utilize this equation, the velocity distribution of traffic flowing at low concentrations is measured. This establishes the wishes of the individual drivers, and given this velocity distribution function, those at higher concentrations can be predicted.

The kinetic equation is developed in chapter 3, with chapters 1 and 2 providing essential background. Chapter 4 is by far the most impressive, interesting, and important chapter. Here ramifications of the kinetic equation are presented and a number of relevant conclusions discovered. For example, a maximum in the flux of traffic as the concentration of cars is increased is predicted, and the existence of a critical concentration at which the will of the individual driver no longer influences the velocity distribution is also found. Many other predictions are discussed.

The last two chapters treat stability and strategy and are more speculative, but provocative. Indeed this book which presents the first rational model of traffic theory is a must for traffic theorists. Moreover, it is recommended reading for social scientists. The authors have suggested a method of accounting for human behavior when the individuals are subjected to certain stresses. Thus the approach taken in this book may have much broader implications than those originally imagined by the authors.

State-Space and Multivariable Theory—H. H. Rosenbrock (London: Nelson, 1970, 257 pp.). *Reviewed by A. G. J. MacFarlane, Manchester Institute of Science and Technology, Manchester, Lancs., England.*

The earliest studies of the dynamic behavior of control systems used the standard theory of differential equations; these investigations could be classified as using single-input single-output time-response methods. In the 1930's these methods were superseded for engineering design purposes by the single-input single-output frequency-response methods developed from the classical work of Bode and Nyquist. During the 1950's and early 1960's the development of applied control theory continued with an attack on multiple-input multiple-output systems using time-response methods based on the work of Kalman, Pontryagin, and Bellman. Recently, the progression has reached the point where a systematic development of multiple-input multiple-output frequency response methods has begun. Rosenbrock's book on state-space and multivariable theory is a pioneering, highly original, and valuable contribution to these latter developments. It is one of the series on dynamical systems edited by Rosenbrock and Brockett, an earlier volume[1] of which provides the necessary mathematical background for the present work. However, the basic mathematical results required are summarized in the first chapter of this book, and reference to the earlier text should only be necessary if detailed proofs are required.

The chief object of this book is to achieve a working synthesis between time- and frequency-response methods for multivariable systems analysis. Both constant-differential and discrete-time systems are treated. Much of the material presented is original and will be of great interest and value to engineers and applied mathematicians working on control theory. His basic aim, is however, the very practical one of laying the foundations for a broad engineering design method applicable to a wide range of industrial problems. This technique, the inverse Nyquist array method and its subsequent development, will be treated in a forthcoming book.

[1] H. H. Rosenbrock and C. Storey, *Mathematics of Dynamical Systems*. London: Nelson, 1970.