De Neufville is Associate Professor and Director of the Civil Engineering Systems Laboratory at M.I.T.; Stafford is Associate Professor and Assistant Dean at the University of Florida. Both have had extensive experience in systems analysis in the design of large public systems. Although their engineering and economic backgrounds are quite different, their separate contributions are beautifully complementary and coherent. Their book developed from the lecture notes of a two-semester course the authors had been giving (jointly) at M.I.T. The course began as a graduate course but was considered so fundamentally important in the education of a proper modern engineer that it has been made a required core course for undergraduate civil engineers at M.I.T. We oldsters had better get with it too, and soon; or, as methods and attitudes like those expounded in this book become more widespread among lower classmen in engineering, we may be left further and further behind.

Stochastic Optimal Linear Estimation and Control—James S. Meditch (New York: McGraw-Hill, 1969, 394 pp.) *Reviewed by E. C. Tacker, Department of Electrical Engineering and Department of Chemical Engineering, Louisiana State University, Baton Rouge, La.*

As the title suggests, with the exception of a short section on linearization, attention is restricted to linear problems. The elements of estimation theory as applied to finite-dimensional linear systems are presented in highly readable format, and the last two chapters of the book comprise an effective introduction to stochastic control theory—again restricting attention to finite-dimensional linear systems.

The level of treatment is appropriate for beginning graduate students in engineering and under appropriate conditions could be used by advanced undergraduate students. I have twice employed this book as the primary text in the first semester of our sequence of graduate courses on stochastic systems and control theory. Due to the easy to read style of the book, I have been able to cover a considerable amount of this material via assigned readings, thereby leaving a large portion of class time for teaching some of the mathematical foundations for the more advanced theory of nonlinear estimation and control.

Chapter 1 provides a useful introduction, both to the problems to be covered in the book and to the procedures to be used, while Chapter 2, entitled "Elements of Linear System Theory," provides a good summary of the subset of general system theory that is needed in reading the subsequent chapters. Chapter 3, "Elements of Probability Theory," provides most of the information needed in understanding the stochastic estimation and control formulations presented later in the book. The treatment of Gaussian random vectors is especially well suited for subsequent usage.

Chapter 4 is entitled "Elements of the Theory of Stochastic Processes and Development of System Models." An intuitive introduction to stochastic processes is given, and methods of describing such processes are discussed. In keeping with the author's desire to keep the treatment suitable for readers with a modest mathematical background, all subsequent problem formulations involve linear systems and Gaussian processes. A very readable and effective development of discrete-time Gauss–Markov models is presented. This is followed by an attempt to use this formulation to describe continuous-time Gauss–Markov processes. Here it is felt that it would have been more effective to have replaced the "plausibility argument" on page 140 with a short section on stochastic differential equations. After being made aware of the pathological nature of Gaussian white noise processes, the reader should then be referred to the appropriate references on Wiener processes and stochastic integrals. The formal treatment wherein the Dirac delta function is employed in describing the process covariance functions does not depend on these matters and would not need to be modified.

Chapter 5, "Optimal Prediction and Filtering for Discrete Linear Systems," states a reasonably general formulation of the problem of optimal estimation. Kalman's (1960–1961) work on discrete-time linear filtering and prediction is featured in this chapter and is presented in a very effective format. In particular, Kalman filtering algorithms for both uncorrelated and correlated noise sequences are derived, and several appropriate numerical examples are presented. Also, a number of quite pertinent comments are given relative to practical application of the Kalman algorithms.

Chapter 6, "Optimal Smoothing for Discrete Linear Systems," considers three classes of optimal smoothing problems. Namely, the problems of fixed-interval smoothing, fixed-point smoothing, and fixed-lag smoothing are discussed. As in the derivation of Kalman's algorithms for prediction and filtering, the general results on optimal estimation derived in Chapter 5 are employed to obtain recursive algorithms for these smoothing problems. The treatment of this material, like much of the remainder of the book, is pedagogically sound and represents a convenient reference on these results. As in Chapter 5, comments are given that pertain to practical application of these algorithms.

Chapter 7, "Optimal Estimation for Continuous Linear Systems I," involves an easy to follow modification of the results of Chapters 5 and 6 (by taking appropriate limits as $\Delta t \to 0$) to accomodate continuous-time problems in linear prediction, filtering, and smoothing. In places the treatment is necessarily formal—for the same reasons mentioned in the discussion of Chapter 4.

Chapter 8, "Optimal Estimation for Continuous Linear Systems II," features the (1961) work of Kalman and Bucy. In particular, the Kalman–Bucy filtering algorithm is generalized to include the case wherein the disturbance and measurement noises are correlated. The Wiener–Hopf equation is also used to derive a continuous-time algorithm for the problem of optimal fixed-point smoothing.

Chapter 9 is entitled "Stochastic Optimal Control for Discrete Linear Systems." A review is given of the pertinent parts of deterministic optimal control theory. In particular, dynamic programming formalism is applied to the discrete-time deterministic regulator problem to obtain its well-known closed-loop optimal control algorithm. The stage is then set to use this same type of formalism to obtain the solution of the discrete-time stochastic linear regulator problem and in so doing prove a special case of the separation theorem.

The final chapter of the book, Chapter 10, "Stochastic Optimal Control for Continuous Linear Systems," is to Chapter 9 as Chapter 7 is to Chapters 5 and 6. That is, the results of Chapter 9 are formally modified (by appropriately letting $\Delta t \to 0$) to determine the optimal control algorithm for the continuous-time stochastic linear regulator problem and in so doing derive another special case of the separation theorem.

As a final comment, the book is well written, easy to use for reference purposes, contains a large number of helpful examples and interesting problems, and is definitely a useful contribution to the literature on estimation and control theory.

Mathematical Methods in Nuclear Reactor Dynamics—Ziya Akcasu, Gerald S. Lellouche, and Louis M. Shotkin (New York: Academic Press, 1971, 460 pp.) *Reviewed by Charles E. Cohn, Argonne National Laboratory, Argonne, Ill.*

This book treats the theory of nuclear reactor dynamics in its space-independent and nonstatistical aspects. It begins with a review of underlying physical concepts, including neutron transport, delayed neutron properties, heat production, burnup, fission-product accumulation, and temperature effects on cross sections. The kinetic equations are derived from first principles, and some of the common simplifications (diffusion, Fermi age) are discussed.

From these the space-independent or point-reactor kinetic equations are developed in a rigorous manner. The approximations underlying the common simplified forms are thoroughly examined. The equations