Book Reviews

The following reviews were selected from those recently published in various IEEE TRANSACTIONS *and Group/Society Newsletters. They are reprinted here to make them conveniently available to the many readers who otherwise might not have ready access to them. Each review is followed by an identification of its original source.*

Systems: Decomposition, Optimization and Control—M. G. Singh and A. Titli (New York: Pergamon Press, 1978, 645 pp.). *Reviewed by R. F. Drenick, Polytechnic Institute of New York, Brooklyn, NY.*

The subtitle of this book describes it as "a handbook on the practical optimization and control of small and large scale systems." The preface specializes it a little further as an effort to bridge the gulf between standard and large-scale optimization problems. However, it proceeds to express the hope that it will appeal to students (and teachers) of control theory and operations research. In other words, the book is to be a textbook as well.

This is a rather tall order. In order to live up to it, the book is organized on an interesting plan. After some introductory topics have been treated, the chapters alternate between standard and large scale theories. To start with, one pair of such chapters treats nonlinear programming, first the conventional theory and then the decomposition methods for large problems. The next pair presents optimal control theory of linear systems, in a similarly parallel fashion; and the ensuing pair, the corresponding theory of nonlinear ones. The rhythm is broken at this point by an interpolated introduction to probability theory and stochastic process, but then proceeds to another chapter pair, this one dealing with state and parameter estimation, as well as optimal control, of small and large systems with stochastic inputs. A final topic is robust decentralized control. Many of the expositions, especially those dealing with large problems, are reinforced by nontrivial examples.

The plan of the book is certainly novel and engaging. Nevertheless, in the reviewers opinion, it does not entirely achieve its various objectives. The main reason probably is that the objectives are really not compatible. The book comes closest to being a handbook on large-scale system optimization. It covers a very broad range of topics on this field, those known to this reviewer as well as many that are new to him, in particular some of the recent ones which are largely due to the authors themselves and their collaborators. It appears to be quite unique. This reviewer at least knows of no other survey (in the English language) that can claim to be fairly comprehensive. The word "fairly" however, is intended to suggest that the range of topics is not entirely exhaustive but reflect the authors' personal technical interests to some extent, a fact which they themselves acknowledge.

The rather encyclopedic character of the book, unfortunately, may largely frustrate its aim of being not only a handbook but a textbook as well. Handbooks in general are not meant for classroom use. They are collections of compact references on the various aspects of a field, for someone who is already well informed in it but wants to read up on one of those aspects. This book will serve this purpose. The presentations of the individual subjects are (no doubt, inevitably) often brief, somewhat hurried, and lacking in the kind of detail one would expect in even an advanced textbook.

Equally inevitable is that the book is a bit repetitive. Some of this is due to its theme of confrontation between small and large optimization problems. Much of what is said about small ones must be repeated, with minor variations, for large ones. More importantly, and this may not be so much a critique of the book as of the field, the basic may not be so much a critique of the book as of the field, the basic ideas of optimization of large systems are really quite few, quite simple, and they are quite similar for static and dynamic, and for terministic and stochastic systems. Seeing them turn up in every other chapter tends to induce a "deia vu" attitude in the reader which detracts from the book more than it should.

These ideas are incidentally based on a number of sweeping assumptions which are not entirely unobjectionable and which, this reviewer feels, should have been stated more clearly than the book does. For example, most of the work assumes that the performance function(al) is a sum of terms each of which can be associated with one and only one subsystem and, with two (rather artificial) exceptions, all examples in the book are so formulated that this assumption holds. But the idea that the performance of a system is the sum of the performances of its components is intuitively inconsistent with the notion of a system. What happens if the idea fails? The book says little about that. Another typical assumption is that the optimization can always proceed on two time scales, a fast one for the subsystems and a slow one for the overall system coordinator. Why should this be so? The Dantzig-Wolf optimization, the precurser of all others, in particular does not make this assumption. Yet another assumption is that the interaction among the subsystems is fixed, and in fact linear in most cases. There are many interesting questions that arise from waivering this assumption, yet none are mentioned.

This reviewer could not escape the impression that the book was put together in somewhat of a hurry, with too little thought of what it should not encompass. There also seems to have been too little attention to the kind of detail that makes for a valuable book. Notation changes from one chapter to another, and on occasion even from one page to the next; constraints sometimes do and sometimes do not show up in the Lagrangians; assumptions needed for the validity of some statements are missing, and other statements are made so casually as to border on the incorrect.

In summary, this is a useful book, but it could have been a good deal more useful than it is. The mode of publication (as a photo-offset typescript) suggests that the authors contemplate a later and more polished version. This reviewer hopes they produce one, but recommends a presentation that is tighter and shorter.

Reprinted from *IEEE Circuits and Systems Magazine*, December 1979.

Phaselock Techniques—F. Gardner (New York: Wiley-Interscience, 1979, 285 pp., $18.50). *Reviewed by M. Davidov, Advanced Programs Department, Defense Division, Brunswick Corporation, Costa Mesa, CA.*

In writing the second edition of his very popular book (especially among practicing engineers), Dr. Gardner has accomplished his goal of providing the intended audience with an expanded and updated version of the book's first edition, as well as adding quite a few new and interesting topics not discussed previously.

Dr. Gardner has been involved in phase-lock research and circuit design for 24 years. His vast experience in this very complicated area has provided him with deep physical insight into the phenomena relating to the phase-lock loops and their mechanizations. It is very natural, therefore, for him to present his knowledge to the reader in exactly the same way—emphasizing the physical insight while using the mathematics as a tool for achieving that goal. As a result, the book has something for everyone. If you are a researcher or a student specializing in this area, it will provide you with the often missing, but very interesting and illuminating practical result approach to phase-lock loop problems, and will give you the motivation to even better understand the difficult problems and the powerful analytical techniques used to solve them, which are found in the books of Lindsey, Lindsey and Simon, Stiffler, Viterbi, and others.

If you are a practicing engineer, a systems engineer, or a design engineer who uses phase lock in his equipment, you will appreciate the discussions of the various behaviors of the phase-lock components and systems, as well as their potential and limitations. The book will provide you with the necessary insight and basic design criteria to successfully build or debug even a very exotic phase-lock system.

The book is organized in 11 chapters. In the first chapter, the author provides the motivation for using phase-lock loop (an excellent noise-rejection device) and illustrates its potential via a few numerical examples.

In Chapters 2 to 4, Dr. Gardner reviews the loop's fundamentals. Starting with the assumption that the phase error at the output of the phase detector is small, he derives such loop parameters as the transfer function, loop gain, loop bandwidth, natural frequency, loop damping factor, and the stability of the first- and second-order loops. (Third-order loops are also mentioned. Special emphasis is placed on giving physical meaning to these parameters. The performance of the loop (phase-error variation and mean time to first cycle slip) is then determined for the linear (small error) loop and is discussed for nonlinear loops.) Next, the tracking behavior of a locked loop for small error, as well as the conditions under which the loop loses lock are determined. Transient and steady-state error behavior is well documented with charts and illustrations compiled from different sources.