This treatise of Iberall might be classified as a speculative philosophy and as an act of faith in that he speculates that A SINGLE CONCEPT aids in the understanding of all dynamic phenomena. This concept might be titled the \( a-o-a \) (for \( \text{atom-continuum-atom} \)) concept. In this concept, nonlinear dynamic instabilities in the continuum give rise to limit cycle conditions which result in quantized aggregates (called \textquoteleft \textquoteleft \text{atoms}\textquoteright\textquoteright) which come together to form the next continuum level and so on. For instance, atomic particles form a fluid mechanical continuum which eventually breaks up into turbulent vortices which are the next level of atoms. Iberall uses much space to advance the provocative hypothesis that the standard quantum mechanics could be reestablished using nonlinear limit cycle theory and need not be based upon the existence of a fundamental quantum of energy. Succeeding atomic levels are related because the stability of the intervening continuum is dependent upon \textquoteleft \textquoteleft \text{transport coefficients}\textquoteright\textquoteright which are a result of the statistical mechanics of the first atomic level.

For this reviewer, the most useful parts of the book were the chapters on socio-economic phenomena even though (because?) the \( a-o-a \) concept is not well developed in these chapters. Iberall is intelligent and sensitive and must be a man of incredible energy. In these sections he cites and reviews many references from anthropology, economics, and psycho-sociology. He criticizes classical economics for abandoning human need as a fundamental driving force and for insufficient attention to dynamics. He also indicates a bias for the ethological (as opposed to the cultural) view of behavior and a belief in the existence of a statistical mechanics of society. These views are so close to my own that I was barely able to remember, in my excitement, that the coincidence of two naive views should not be confused for the discovery of a great truth. Also, it should be remembered that a biomechanistic view of society is self-serving for those of us who wish to model society.

The social system chapters contain many useful ideas and references. However, it would have been useful to review the basic aggregation concepts of macro-economics since they are relevant to the \( a-o-a \) concept. Also a warning that a biomechanistic view of society can degenerate into social-Darwinism should have been added. In the last century social Darwinism further degenerated into European Fascism and North American Racism [3]. The work of L. F. Richardson could have been emphasized more for my taste [5].

For me, the great weakness of the book was the style. Iberall is given to definitive and imprecise statements: \textquoteleft \textquoteleft The relaxation time—for interpersonal relations—is more likely of the order of 30 days…\textquoteright\textquoteright\textquoteright Many statements can only be correct after much qualification (e.g., contrary to Iberall’s statement, hunting and gathering groups have much more leisure time than post-agricultural groups). The reader searching for a complete, precise, and rigorous development will soon be frustrated.

If pressed for an opinion, I would offer that Iberall has hit upon a concept that helps him, and possibly others, to place a great deal of information into perspective but he has not yet offered the grand synthesis.

**References**


**GENERAL SENSITIVITY THEORY**, by R. Tomović and M. Vuko-bratovic.

**REVIEWED BY W. V. LOSCUTOFF**

Although characterization of parameter-variation effects in systems is an important aspect of analysis of dynamic systems, very few books are devoted exclusively to this subject. This fact, along with greatly increased interest in sensitivity analysis in the expanding fields of engineering, provides ample justification for publishing a new book. It also happens that General Sensitivity Theory is a good reference book which should be found useful by many educators and engineers wishing to gain insight into the various aspects of sensitivity analysis.

The present monograph is the third publication in book form devoted exclusively to sensitivity.\textsuperscript{5} It examines the more recent work on sensitivity analysis and application to a number of engineering problems. This includes important additional material concerning the sensitivity of sampled data systems, synthesis of optimally sensitive systems, and system controllability, observability and invariance. It is not a complete text, but a research monograph which represents the state of the art at that time it is written.

The authors begin with fundamental definitions in Chapter 1 of sensitivity functions for continuous systems, discrete multivariable systems, and sensitivity functions for structural changes. The computational aspects of sensitivity analysis and the generation of sensitivity functions are presented in Chapter 2. Special topics include calculation of sensitivity functions based on simplified sensitivity models.

In Chapter 3, sensitivity results are presented for a special class of multivariable systems which have an oscillatory state. Sensitivities of linear, nonlinear, continuous, and discrete systems are treated here. Several excellent examples are included.

Chapter 4 considers dynamic systems from the viewpoint of system structure and its behavior in parameter space. Some of the properties included in this approach are invariance, zero sensitivity, observability, controllability, adaptivity, and parameter compensation.

For a system with a large number of parameters, it becomes difficult to determine system sensitivities to individual parameters. Hence the concept of structural sensitivity is examined as a vehicle for synthesis of large systems in Chapter 5. Unfortunately, this chapter falls far short of its heading and suggests that much more research must be done before an adequate definition of sensitivity functions of large systems can be made.

In summary, General Sensitivity Theory is an excellent monograph which is a \textquoteleft \textquoteleft must\textquoteright\textquoteright for anyone interested in sensitivity analysis.

\textsuperscript{1}University of California at Davis, Davis, Calif.


**REVIEWED BY ALLEN B. GATES**

Mr. Zeines is an instructor at the RCA Institutes and has written a book intended to present various mathematical tech-

\textsuperscript{2}Head, Control Design and Analysis Branch, Code 3051, Naval Weapons Center, China Lake, Calif.
The author does not indicate the level at which he feels the text is written. It is the reviewer's opinion that the text is aimed at the beginning level for lower division students or for students engaged in a two year technical institute curriculum. The text contains several typographical errors which are obvious. It has some technical difficulties, however, a competent instructor can overcome them. In particular, the book is technically loose and covers some details superficially.

Chapter One, "Automatic Control Systems," provides the introductory comments on automatic control systems. It discusses both discontinuous and continuous control systems and attempts to provide the intuitive motivation for control system theory. Discussion is not presented in sufficient detail that a person unfamiliar with automatic control systems gains a good intuitive feeling for what control systems do. Additionally, paragraph 1.8 "Linear Systems," is technically loose. Specifically, the author defines a linear system as one whose transfer function is a constant. He goes on to say that the output is directly proportional to the input. Homogeneity and additivity are not mentioned in any way.

Chapter Two, "Laplace Transform," is inadequate for a student who has not had a previous introduction to Laplace transforms. The chapter is primarily a discussion of "how to do it" transform techniques.

Chapter Three, "Mechanical Networks," is an attempt to relate the analysis of mechanical systems to electrical systems via the mobility method. Again the discussion is centered about the "how to do it" techniques as opposed to developing the theory in any detail. In addition to inertia forces and viscous friction forces, static friction is considered.

Chapter Four, "Block Diagrams and Signal Flow Graphs," discusses block diagrams and signal flow graphs on a "how to do it" basis. Included are techniques for reducing block diagrams from complicated ones to simpler ones. The discussion of Mason flow graphs is nearly useless for someone who does not have prior background. For example, no discussion is given of how one recognizes a non-touching path. The example problems however, are quite clear and are simple to follow.

Chapters Five, Six, and Seven covering control systems components provide a superficial introduction to the theory and analysis of their operation. The author does a good job of illustrating the interconnect schematics and presenting the simplified mathematics governing component operation. Some of the real difficulties with the models in the hardware are, however, not discussed.

Chapter Eight, "Frequency Response Analysis," does a reasonably good job of illustrating how to draw Bode plots in a few pages. His definition of stability is loose and oversimplified in that he defines a stable system as one that recovers rapidly and smoothly from instantaneous varying inputs. Again this chapter is a "how to do it" chapter. No discussion of a theoretical basis for determining stability is given.

Chapters Nine and Ten covering time response and root locus analysis need supplementation by the instructor of the course. Some of the sample problems do not have a clearly stated objective.

Chapter Eleven discusses the design of compensation networks—simple lead, simple lag, and combination lead-lag—from a Bode plot point of view. This chapter is satisfactorily done for the limited coverage given the compensation theory. More discussion could be given concerning the basis for operation of the different types of compensators.

The author tries to encompass analysis, components, and design in a simple and clear fashion. The book is too short to accomplish the task. It generally lacks the rigor and depth to make it useful for serious students of automatic control systems. However, with additional material provided by the instructor, the book could be quite useful in a technical institute program or for lower division noncontrol majors.


REVIEWED BY W. V. LOSCUTOFF

A significant number of researchers in control theory, including the authors of this book, have devoted time to the development of modal control theory [1–5] and a book on the topic was long forthcoming. Porter and Crossley have written the first book on modal analysis and synthesis of linear, time-invariant systems to "present a unified treatment of modal control theory...", and also to indicate the practical relevance and scope of the theory." Consequently, a student of systems and control theory should expect perhaps not a masterful, but surely a complete exposition on modal analysis from the book. He would be sorely disappointed.

On the positive side, the book is virtually self-contained. All necessary introductory material and definitions are presented in Chapters 1–4 before modal analysis is formally presented in the subsequent two chapters. Furthermore, Chapters 10–18, Part II of the book, discuss in detail the application of modal control theory via excellent examples, Chapter 8, on integral feedback, and Chapter 9, on sensitivity characteristics, are added features.

On the negative side, the book is one of many omissions. The most serious is the exclusion of modal analysis of distributed parameter systems, although the authors do reference this material in their introduction. Among the other omissions, some of which have been published in various journals, are the following:

- controller design with reduced number of measured variables;
- optimal placement of modes;
- totally modal approach used by Takahashi, et al. [5] wherein the relationship between the desired pole ρ, the system pole λ, and the necessary feedback gain is given simply by
  \[ ρ = λ − k; \]
- time-varying systems;
- design of a state-input controller for a single output system, which could arise when dynamic observers are used;
- examples for the multi-stage modal design;
- root locus interpretation of modal control.

What does the book then include apart from the introductory material? Thirty-two pages on modal controller design nearly half of which are devoted to systems with confluent eigenvalues. Since the latter do not exist in real systems anyway, one gets a feeling that $23.75 is a very dear price to pay for this book.

1University of California at Davis, Davis, Calif.
2Numbers in brackets designate References at end of Book Review.