



## book reviews

**HYPERSTABILITY OF CONTROL SYSTEMS**, by V. M. Popov, Springer-Verlag, 1973, 400 pp.

REVIEWED BY M. R. POSEHN<sup>1</sup>

Eleven years have elapsed since the author first defined the concept of hyperstability. Succeeding publications by the author have expanded the applicability of the theory in a fragmentary fashion. Now, with the publication of this monograph, the reader has available a complete and thoroughly rigorous presentation of the concept of hyperstability.

In Chapter I the author presents a brief outline of his motivation for considering stability as a property of a family of systems. He discusses the conventional feedback system composed of a linear block and a non-linear block. Through a series of intuitive arguments he proceeds to generalize the specification of the non-linear characteristic. Unfortunately, the reader must painstakingly make his way through Chapters 2, 3, and 4 without the aid of further example problems or intuitive reasoning.

Chapter 2 lays a foundation for the author's theorems on hyperstability by discussing classes of equivalent systems and transformations between equivalent forms. In this chapter and throughout the monograph the presentation is simplified to an extent by first considering single-input systems and then considering in order multi-input, discrete, and time varying systems. Chapter 3 completes the preliminaries by defining a positive system and presenting conditions which guarantee positiveness for a class of systems described by a differential equation and an integral.

In Chapter 4 the author presents an extensive study of the properties of hyperstable systems and hyperstable blocks. He then proceeds to give several sets of necessary and sufficient conditions for hyperstability not previously published. He follows with a discussion of allowable configurations of hyperstable blocks which when combined constitute a hyperstable system. The generality of the theorems presented in this chapter suggests the possibility of applications far beyond those realized to date.

Chapter 5 contains a discussion of several applications of hyperstability. Included are necessary and sufficient conditions for the existence of certain Liapunov functions, and analysis of the stability of systems containing nuclear reactors, systems with certain nonlinearities, and the application of hyperstability to optimization of systems with integral performance indices. In addition, Appendix A contains an excellent discussion of controllability and observability.

Hopefully, before attempting this book the reader will have some knowledge of hyperstability derived from the several papers that have been published in the past. It is suggested that the reader begin by first examining Chapters 1, 5, and 4 before he embarks upon a thorough reading.

There is no doubt about the importance of the concept of hyperstability; therefore, it is essential that the information contained in this monograph is widely understood so that the full potential of hyperstability can be realized.

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**CLASSICAL MECHANICS—A MODERN PERSPECTIVE**, by Vernon D. Barger and Martin G. Olsson, McGraw-Hill Book Company, 1973, 320 pp.

REVIEWED BY JAMES CASEY<sup>2</sup>

This book is intended as a text for an intermediate-level course in classical theoretical mechanics "for physics majors and students from other disciplines." The authors emphasize the application of mechanical ideas to challenging problems. In addition to the more traditional type of worked example, they include applications of the theory to such topics as the boomerang, "superballs," "tippee-tops," the tides, skydiving and the "grand tour of the outer planets." A simple analytical treatment of these problems is presented and is accompanied by physical interpretations to which most students should easily relate. By doing so the authors succeed in portraying the strength of the simple mechanical analysis and its relevance to important practical problems.

Simple analyses are acceptable provided that they are not represented as entirely capturing the essence of a problem. Barger and Olsson, in their enthusiasm, occasionally arouse one's expectations to such a degree that the subsequent analysis of a problem is anti-climactic in its simplicity.

My overall attitude towards the book stems from some differences of opinion as to the *spirit* in which mechanics is conveyed to students at the intermediate level.

When applications are being taught the stress should be on the *process* of applying mechanical ideas. This book fails to communicate the fundamental difficulty that the mechanicist encounters in casting his physical notions into a form that falls within the scope of the laws of mechanics and yet retain some of the essential features of a physical problem. The authors do not elucidate the delicacy and the severity of the simplifying assumptions which are employed in working their examples. One is presented with a set of assumptions and a method that solves a particular type of problem without an appreciation of the genesis or generality of such assumptions and methods.

With regard to the theory of classical mechanics and its presentation, "Classical Mechanics" lacks a rigorous statement of the laws and theorems of mechanics. Neither are the derivations always satisfactory. For instance, Lagrange's equations are introduced early in the book to allow students some time to become familiar with applications of these equations. However, there is no discussion of the notions of constraints and virtual work, and no mention is made of the difference in the categorization of forces that distinguishes the Lagrangean from the Newtonian approach. The equations are derived for the one-dimensional motion of a single particle and are then "generalized."

In the presentation of the concepts and principles of mechanics, "Classical Mechanics" represents them as established and irrevocable "facts." Mechanics can also be regarded as a sequence of formations based on deep presuppositions and reflecting the cultural prejudices of its creators. By emphasizing mechanics as a *constructive* endeavour, one inspires one's students to re-

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