

**MATHEMATICS
IN SCIENCE
AND
ENGINEERING**
Volume 27B

**Control Systems Functions
and
Programming Approaches**

**VOLUME B
Applications**

MATHEMATICS IN SCIENCE AND ENGINEERING

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Edited by **Richard Bellman**

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CONTROL SYSTEMS FUNCTIONS AND PROGRAMMING APPROACHES

Dimitris N. Chorafas

CORPORATE CONSULTANT IN ENGINEERING
AND MANAGEMENT, PARIS

VOLUME B
Applications

1966



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To H. Brainard Fancher

FOREWORD

A striking feature of the scientific and technological development of the past 25 years is an increasing concern with the study of complex systems. Such systems may be biological, social, or physical and indeed it is easy to give examples of systems which combine elements from more than one of these areas. For instance, an unmanned satellite such as "Telstar" or "Nimbus" can be considered in purely physical terms. However, when an "astronaut" is to be involved in the system, a whole new realm of biological problems must be considered and, even more, the interaction between the biological and the physical subsystems must be taken into account. As we advance to large space stations involving crews of several men, we must add the complication of social problems to the systems analyses.

A characteristic feature of most complex systems is the fact that individual components cannot be adequately studied and understood apart from their role in the system. Biologists have long appreciated this property of biological systems and in recent years have attached considerable importance to the study of ecology or the biology of organisms in relation to their environment. Engineers and social scientists have profited from adopting this point of view of the biologists, and biological and social scientists are coming to an increased appreciation of the utility of mathematical models which have long been a principal tool of the physical scientist and engineer.

In recent years there has emerged the beginning of a general theory of systems and a recognition of the fact that, whatever their differences, all goal-directed systems depend for their control upon information. Its encoding, storage, transmission, and transformation provide the basis for the essential decisions and operations by which a system functions. As the volume of information necessary to control a system has increased and as the transformations that are required to be performed on this information

have become more intricate and time-consuming, systems designers have turned more and more to that information processor “par excellence”—the digital computer.

In fact, the problems of control have become so complex that it is now necessary to consider in some detail the subject of Information and Control Systems. The designer of an information and control system must be concerned with such questions as, “What is the nature of the information that can be obtained about the system I hope to control?”, “Where and how can it be obtained and how can it be transmitted to a digital computer?”, “What transformations of the input information are required in order to provide the output information necessary to control the system?”, “What are the timing requirements on the output information?”, “How do the answers to the above questions affect the design of hardware and programs for the digital computer?” It is to problems such as these that Professor Chorafas, drawing on his wide background as an industrial consultant, directs his attention in this book.

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Professor of Information Science
and Mathematics
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