CONTROL OF COMPLEX SYSTEMS

Methods and Technology

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CONTROL OF COMPLEX SYSTEMS: Methods and Technology
M. Drouin, H. Abou-Kandil, and M. Mariton

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PREFACE

Since the begining of the sixties, control theorists have developed a large body of knowledge concerning complex or large-scale systems theory. Using the state space approach, their purpose was to extend methods to cope with the increasingly sophisticated automation needs of man-made systems. Despite several remarkable contributions, and some successful applications, it can be stated that this theory has not yet become an engineering tool.

On the other hand, the emergence of cheap and reliable microprocessors has profoundly transformed industrial instrumentation and control systems. Process control equipment is organized in multilevel distributed structures, closely related to the concepts introduced by complex systems control theory. This similarity should favor a fruitful intersection for practical applications. However, a gap still exists between the literature on control theory and the world of technological achievements. In the many books on complex systems, few have given attention to the technological aspects of a practical control problem. The present book is an attempt to fill this gap.

To do this, it consistently reflects the viewpoints that:

- Theory and technology are two indivisible facets of the same problem.
- On-line implementation for real time applications is the ultimate goal of a control study.

In consequence, the notion of control structure is heavily emphasized. It is shown how the overall control task can be split into several tasks in order fully to exploit the advantages of a distributed computing power. Typical of the philosophy behind the book is the feedback effect of technology on theory, described in chapters VI and VII: through the introduction of Local Area Networks, the information constraints which strongly influenced the early work in large-scale systems theory become less significant. No ex-abrupto presentation of control theories is attempted. The general philosophy of the present text is to introduce additional theoretical developments only when they are needed in an application. An exception is chapter II, which was included to make the book more self-sufficient, and also to provide a condensed review of discrete-time optimal control results previously scattered in various papers or more general books.

In this sense, the book is addressed to several audiences. First, it can serve as a complement to more classical graduate textbooks on complex systems theory. Chapters I and II could then be overlooked, while the material of chapters IV to VII would provide some ideas on how to implement control solutions. Research workers could find some interest in the original method presented in chapter III and in its refinements given in subsequent chapters. Finally, control engineers should find that the complete book provides a convenient bridge between theory and practice.

If the reader is convinced that theory and technology should be combined in a practical control study, and if work on the application of complex systems theory is stimulated, this book will have fulfilled its ambition.

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