

# Preface

Systems and control theory takes as its subject of study the analysis of natural and artificial systems, and the synthesis of control laws for their regulation. It forms a part of the set of contemporary disciplines called the information and control sciences.

Stochastic systems are defined to be those systems for which the input, state, and output processes are random. The central issues in stochastic system theory are (1) prediction; (2) regulation (or stochastic control); (3) the modeling and estimation of a system's dynamics from observations, which is called system identification; and (4) the simultaneous performance of all these tasks, which is known as stochastic adaptive control.

Restricting one's attention to the linear case yields the set of problems most susceptible to complete analysis. Moreover, linearized models often give a good first approximation to the behavior of the world. For these reasons, the theory of linear systems is both the most fully worked out and the most frequently applied part of systems and control theory.

It is the purpose of this book to give a unified account of the main results of the theory of linear discrete-time-parameter stochastic systems. We begin by laying the foundation of the subject by describing the fundamentals of stochastic processes and the construction of stochastic systems; then we give an integrated exposition of the theories of prediction, realization (modeling), parameter estimation, and control; we conclude with a presentation of stochastic adaptive control theory.

This book is written for graduate students, teachers, and research workers in the areas of systems and control theory and its applications, probability and statistics, time-series analysis, econometrics, and related areas. Readers should have a knowledge of linear algebra and of analysis and probability at the first-year graduate level. Definitions and results from probability theory, system theory, and harmonic and related analysis are reviewed in the three appendices at the end of the book.

I am deeply indebted to many people for helping me to produce this work, and I am very happy to have this opportunity to express my thanks to them.

As with many academic books, this one is an outgrowth of my Ph.D thesis, and so it is a pleasure to make my first acknowledgment to my supervisor, David Mayne, for his example of creativity, intelligence, and humanity.

\* Parts of this book first appeared in articles I have authored or co-authored. In the latter case, the references to the co-authors are quite evident, but I would like to express my thanks to all of them here for having given me the opportunity to work with them. In particular, I want to mention David Delchamps, who is co-author of those parts of Chapter 4 concerned with Lindquist-Picci theory, and who provided invaluable critical feedback when he was a teaching assistant using an earlier version of the manuscript.

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