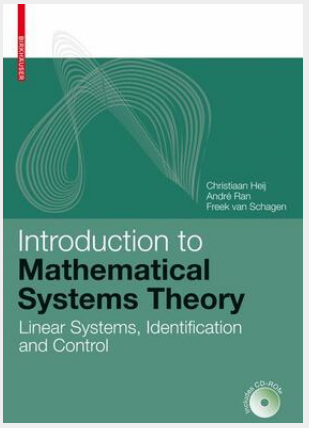
Heij / Ran / van Schagen

Introduction to Mathematical Systems Theory

Linear Systems, Identification and Control



This book provides an introduction to the theory of linear systems and control for students in business mathematics, econometrics, computer science, and engineering; the focus is on discrete time systems. The subjects treated are among the central topics of deterministic linear system theory: controllability, observability, realization theory, stability and stabilization by feedback, LQ-optimal control theory. Kalman filtering and LQC-control of stochastic systems are also discussed, as are modeling, time series analysis and model specification, along with model validation.

Thisbookhasgrownoutofmorethantenyearsofteachinganintroductorycourse in system theory, control and identi?cation for students in the areas of Business Mathematics and Computer Science, Econometrics and Mathematics at the ‘Vrije Universiteit’ in Amsterdam. The interests and mathematical background of our students motivated our choice to focus on systems in discrete time only, because the topics can then be studied and understood without preliminary knowledge of (deterministic and stochastic) di? erential equations. This book requires some preliminary knowledge of calculus, linear algebra, probability and statistics, and some parts use elementary results on Fourier series. The book treats the standardtopics ofintroductory coursesin linearsystems and control theory. Deterministic systems are discussed in the ?rst ?ve chapters, with the following main topics: realization theory, observability and controllab- ity, stability and stabilization by feedback, and linear-quadratic optimal control. Stochastic systems are treated in Chapters six to eight, with main topics: reali- tion, ?ltering and prediction (including the Kalman ?lter), and linear-quadratic Gaussianoptimal control.Chapters nine and ten discuss system identi?cation and modellingfromdata,andChapterelevenconcludeswithabriefoverviewoffurther topics. Exercises form an essential ingredient of any successful course in this area. The exercises are not printed in the book and are instead incorporated on the accompanying CD-Rom. The exercises are of two types, i.e., theory exercises to trainmathematical skills in system theory and practicalexercises applying system and control methods to data sets that are also included on the CD-Rom. Many exercises require the use of Matlab or a similar software package.

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