BOOK REVIEWS

MODERN CONTROL SYSTEMS ENGINEERING, Z. Gajic and M. Lelic, Prentice-Hall, Europe, 1996, ISBN 0-13-134116-2

The book *Modern Control Systems Engineering* represents a modern treatment of the classical control theory. It is based on the state space approach where only elementary knowledge in differential equations and linear algebra is needed. Real word examples and problems are implemented practically using the MATLAB package. The dynamic systems are simulated in SIMULINK.

The authors state that the book can be used by senior students in engineering and as a first year graduate control theory text.

The book is structured to cover the fundamental control theory concepts such as state space, controllability, observability and stability. These concepts are used nowadays and will be used in the future not just in control engineering, but in many other engineering and scientific disciplines, like aerospace, robotics, commnications, etc.

In addition, the asset of the book is in showing how to use MATLAB for control system design purposes. The book can be recommended for undergraduate students and professionals in control area, also it can be used as an introductory graduate control theory text.

Chapter one presents an introduction to continuous and discrete time invariant linear control systems. The difference between closed-loop and open-loop, state space and transfer function methods, are briefly discussed. Modelling of dynamics and linearization of nonlinear control systems are presented.

Chapter two presents the transfer function approach, also know as the frequency domain technique, to give methods for finding the system transfer function based on the Laplace and Z transforms and their relationship to time derivatives. Conventional ways of representing linear time invariant systems, via block diagrams and signal flow graphs, are also considered.

Chapter three combines the differential and difference equations to describe the dynamical systems in the form of system transfer functions. The representation in discrete-time domain is given.

Chapter four deals with the stability. The basic definitions of stability of linear time invariant systems are given .The system stability in the sense of Lyapunov is also defined. Stability tests for both continuous and discrete time systems are discussed.

Chapter five introduces definitions and concepts of system controllability and observability and observability related to linear systems. The reduced order and full order estimator designs are presented.

Chapter six discusses transient and steady state responses of a dynamic system. In addition, system dominant poles and system sensitivity function are introduced. The response of a second-order system due to a unit step input is analysed in detail and the main control system specifications are summarized.

Chapter seven presents the root locus technique using only elementary mathematics. The main rules for constructing the root locus are given. The root locus technique for discrete–time control systems is also discussed.

Chapter eight presents systematic procedures for time domain controller design techniques based on the root locus method. Complete set of controller design techniques which have much simpler forms than those based on the bode diagrams, are provided. The pole placement technique is fully explained for SISO systems.

Chapter nine considers the controller design based on Bode diagrams. The frequency domain techniques are analysed and compared with the root locus method.

Chapter ten gives an overview of modern control to provide students with better insight into this extremely broad and multi—disciplinary engineering area.

The book is a good contribution to the modern control systems design. Academics or professional working in the area of control system design will find this work interesting as a source of good ideas leading to applied solutions.

M. Elfandi
Department of Electrical Engineering,
Faculty of Engineering,
Algefara Branch,
Al-fateh University, Tripoli, Libya
E-mail: m_elfandi@hotmail.com

Fuzzy control of queuing systems. Runtong Zhang, Yannis A. Phillis, Vassilis S. Kouikoglou. Springer, 2005. ISBN 1852338245

Many problems in modern society can be described in terms of queuing such as, traffic congestion, cellular phone calls, and productivity issues in a modern factory floor. An earlier text [1] addressed control of queuing based on Markov decision processes theory and computation. The book Fuzzy Control of Queuing Systems by R. Zhang, Y. Phillis, and V. Kouikoglou presents the first attempt to apply fuzzy logic control to various queuing problems systematically. The book has an excellent coverage and clear presentation. It has a comprehensive survey of relevant literature. Each chapter has detailed examples that relate the theory presented at that chapter to an application.

Chapter 1 has a good introduction of the queuing problem including the variables of the problem such as, stochastic arrival and departure of customers, number of servers, system capacity, and size of customer population. Most real-life problems have inherent large degree of dimensionality that makes closed-form solution impossible or computationally prohibitive to say the least. The chapter contains a comprehensive survey of various methodologies of queuing control including, dynamic programming, heuristic algorithms, and fuzzy logic control. The authors present a good case to show the need for fuzzy logic in dealing with complicated systems as it does not depend on having an accurate model of the system and it is not computationally expensive. Queuing problems can be also described in linguistic terms, which make them suitable for the

use of fuzzy logic. The authors also discuss the typical objections to fuzzy logic including lack of optimality and stability criteria as well as lack of clear definition of membership functions.

Chapters 2 and 3 provide a concise introduction to fuzzy logic and fuzzy logic control. Chapter 2 includes discussion of fuzzy sets, operations of fuzzy sets, linguistic variables, and fuzzy reasoning. Chapter 3 presents concepts such as, fuzzification, knowledge base, inference engine, and defuzzification. These two chapters may not be useful to a person who is familiar with fuzzy logic control but it introduces others to the basic tool of the book.

Chapter 4 addresses control of service activities where cost depends on the queue length and selected rate. The objective of the controller in this case is to minimize the average cost. The chapter starts with the simple case of single server with vacations, i.e. a server may be turned off if there are no customers. The controller has three input variables in this case: accumulated holding cost; holding cost; and traffic intensity. The output of the controller is the decision to turn the server on or not. These concepts are extended to various cases: parallel servers with vacations; single servers without switching cost; single server with switching costs; and tandem servers without and with service costs.

Chapter 5 considers the problem of optimal routing of customers in queuing systems with heterogeneous servers in parallel. The chapter starts with control of parallel servers with different service rates and an infinite buffer size. The controller has two input variables: arrivals and number of customers in the buffer. The output of the controller is the decision to allocate