

Book review:

**DYNAMICAL SYSTEMS, CONTROL, CODING,
COMPUTER VISION.
NEW TRENDS, INTERFACES, AND INTERPLAY**

by

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In recent years, the fields of coding and computer vision in modern dynamical systems theory has grown and expanded in many different directions. A particularly fruitful line of development has been that of putting the new tools to use to solve several control theory, network and dynamical systems problems. The main purpose of the reviewed volume is to present an overview of recent results in this direction, and of the techniques used to derive them. It is based on the lectures given by the participants during the plenary sessions, invited sessions, and minicourses at the Mathematical Theory of Networks and Systems Symposium (MTNS-98) held in Padova, Italy, on July 6-10, 1998.

The results are presented in a series of chapters that provide an overview of how a broad variety of tools are used to study the different problems in dynamical systems, control theory, coding and computer vision. For instance, chapter "Riccati equations, network theory and Brune synthesis: old solutions for contemporary problems" exposes certain connections between linear passive multiport networks theory and matrix Riccati equations. Chapter entitled "Passive linear systems and scattering theory" contains the results for passive scattering of linear, continuous-time, time-invariant and finite-dimensional dynamical systems and also for conservative systems. In the next chapter, "Tracking control and π -freeness of infinite dimensional linear systems" several abstract linear dynamical systems over arbitrary commutative rings are considered. Finite-dimensional linear systems, delay dynamical systems and distributed parameters dynamical systems are presented within this framework. Some problems arising in Wiener-Hopf factorizations and their connections with geometry are discussed in the chapter "On canonical Wiener-Hopf factorizations". The chapter entitled "State space methods for analysis of problems involving rational matrix functions" is mainly devoted to a study of the problem of solving explicitly integral equations of convolution type, direct and inverse spectral problems for canonical systems of ordinary differential equations, and the problem of constructing exact solutions of nonlinear partial differential equations. The chapter "Stabilization of nonlinear systems using output feedback" explores several methods

for constructing robust stabilizers via output feedback. Particularly, a certain recursive stabilization scheme is proposed. A perspective of a system theoretic approach to model set based on the chain-scattering representation of the plant is presented in the chapter entitled "Towards a system theory for model set: Chain-scattering approach". In the chapter "The role of the hamiltonian in the solution of algebraic Riccati equations" several different form of Riccati equations and the properties of its solutions are considered. The chapter "The control and mechanics of human movement systems" presents modeling and analysis of the human movement system including musculotendon dynamics, the kinetics and kinematics of the biomechanical system, and the relationship with neurological control. A survey on recent results concerning the existence of Schur like forms for Hamiltonian matrices and skew-Hamiltonian pencils, and numerical methods for the computation of invariant and deflating subspaces for these matrices and pencils are given in the chapter "Numerical methods for linear quadratic and H_∞ control problems". The chapter "Nonlinear feedback stabilization revisited" is dealing with the study of the effect of large disturbances on the behavior of feedback systems. Stability, asymptotic controllability, stabilizing feedbacks and sensitivity problems are also considered. The chapter "Probabilistic robustness analysis and design of uncertain systems" describes a probabilistic approach for robustness analysis and design of uncertain control systems and explains how probabilistic robust design can be performed. In the chapter "An approach to observer design" the synthesis of an observer of the state for linear, continuous-time, time-invariant, finite-dimensional dynamical control system is presented. The notions of observability and detectability are also introduced and necessary and sufficient conditions for the existence of asymptotic observer are formulated and discussed. In the next chapter, "Group codes and behaviors", some recent developments in coding theory are introduced into a system-theoretic framework. Moreover, some basic questions about linear systems, such as controllability, observability, and duality, are addressed at the algebraic, group-theoretic level. The chapter "The Berlekamp-Massey algorithm, error-correction, keystreams and modeling" presents the connection between coding theory, cryptography and systems theory and contains an overview on the Berlekamp-Massey algorithm. In the chapter "An algebraic decoding algorithm for convolutional codes" a new iterative algebraic decoding algorithm which is capable of decoding convolutional codes is introduced and discussed. The algorithm exploits the algebraic structure of the convolution code. The main goal of the chapter entitled "Introduction to mathematical aspects of computer vision" is to present the main recent research methods and to indicate important open problems in computer vision. The chapter "The structure and motion of surfaces", discusses the problem of recovering the 3D shape and motion and the reconstruction of the surface. The chapter "Shape from texture and shading with wavelets" introduces a stochastic model for images of textured surfaces. A texture is viewed as a stationary process, which has under-

rise in the resulting image to a nonstationary process. The wavelet transform is adapted to analyze the type of nonstationarity contained in the images of textured surfaces. In the chapter "Anisotropic smoothing of posterior probabilities" a technique for introducing prior knowledge about different objects into the segmentation process is analyzed. The chapter "The accommodation cue in vision" contains observability and estimation considerations with respect to image processes. The chapter entitled "Hybrid control in automotive applications" presents methodology for the design of embedded controllers for automotive applications, this presentation encompassing all levels of design abstractions from specifications to final implementation. The last chapter, "Control synthesis for discrete event systems", gives an overview of discrete event control synthesis in the case of complete observations. Moreover, the algorithms for the synthesis of supervisory controls under complete observations are discussed:

This book contains numerous recent, quite far reaching, theorems and interesting examples from different areas of control and dynamical systems theory, as well as computer vision. The theorems are included often with complete and detailed proofs or with references to the literature for details. In addition, challenging open problems are described and explained, and promising new research directions are indicated.

This volume has something to offer a broad spectrum of readers. The book should be a valuable reference to graduate students, scientists, and professional researchers in the area of information and control engineering, and to mathematicians with an interest in the analysis and design of engineering systems.

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