

Contents

Preface to the Second Edition	xiii
Acknowledgments	xv
Editorial Board	xvii
Editor	xix
Contributors	xxi

SECTION I Analysis Methods for MIMO Linear Systems

1 Numerical and Computational Issues in Linear Control and System Theory	1-1
<i>A.J. Laub, R.V. Patel, and P.M. Van Dooren</i>	
2 Multivariable Poles, Zeros, and Pole-Zero Cancellations	2-1
<i>Joel Douglas and Michael Athans</i>	
3 Fundamentals of Linear Time-Varying Systems	3-1
<i>Edward W. Kamen</i>	
4 Balanced Realizations, Model Order Reduction, and the Hankel Operator	4-1
<i>Jacquelin M.A. Scherpen</i>	
5 Geometric Theory of Linear Systems	5-1
<i>Fumio Hamano</i>	
6 Polynomial and Matrix Fraction Descriptions	6-1
<i>David F. Delchamps</i>	
7 Robustness Analysis with Real Parametric Uncertainty	7-1
<i>Roberto Tempo and Franco Blanchini</i>	
8 MIMO Frequency Response Analysis and the Singular Value Decomposition	8-1
<i>Stephen D. Patek and Michael Athans</i>	
9 Stability Robustness to Unstructured Uncertainty for Linear Time Invariant Systems	9-1
<i>Alan Chao and Michael Athans</i>	
10 Trade-Offs and Limitations in Feedback Systems	10-1
<i>Douglas P. Looze, James S. Freudenberg, Julio H. Braslavsky, and Richard H. Middleton</i>	
11 Modeling Deterministic Uncertainty	11-1
<i>Jörg Raisch and Bruce Francis</i>	

SECTION II Kalman Filter and Observers

12	Linear Systems and White Noise.....	12-1
	<i>William S. Levine</i>	
13	Kalman Filtering.....	13-1
	<i>Michael Athans</i>	
14	Riccati Equations and Their Solution.....	14-1
	<i>Vladimír Kučera</i>	
15	Observers.....	15-1
	<i>Bernard Friedland</i>	

SECTION III Design Methods for MIMO LTI Systems

16	Eigenstructure Assignment.....	16-1
	<i>Kenneth M. Sobel, Eliezer Y. Shapiro, and Albert N. Andry, Jr.</i>	
17	Linear Quadratic Regulator Control.....	17-1
	<i>Leonard Lublin and Michael Athans</i>	
18	$\mathcal{H}_2$ (LQG) and $\mathcal{H}_\infty$ Control.....	18-1
	<i>Leonard Lublin, Simon Grocott, and Michael Athans</i>	
19	ℓ_1 Robust Control: Theory, Computation, and Design.....	19-1
	<i>Munther A. Dahleh</i>	
20	The Structured Singular Value (μ) Framework.....	20-1
	<i>Gary J. Balas and Andy Packard</i>	
21	Algebraic Design Methods.....	21-1
	<i>Vladimír Kučera</i>	
22	Quantitative Feedback Theory (QFT) Technique.....	22-1
	<i>Constantine H. Houppis</i>	
23	Robust Servomechanism Problem.....	23-1
	<i>Edward J. Davison</i>	
24	Linear Matrix Inequalities in Control.....	24-1
	<i>Carsten Scherer and Siep Weiland</i>	
25	Optimal Control.....	25-1
	<i>Frank L. Lewis</i>	
26	Decentralized Control.....	26-1
	<i>M.E. Sezer and D.D. Šiljak</i>	
27	Decoupling.....	27-1
	<i>Trevor Williams and Panos J. Antsaklis</i>	
28	Linear Model Predictive Control in the Process Industries.....	28-1
	<i>Jay H. Lee and Manfred Morari</i>	

SECTION IV Analysis and Design of Hybrid Systems

29 Computation of Reach Sets for Dynamical Systems29-1
 Alex A. Kurzhanskiy and Pravin Varaiya

30 Hybrid Dynamical Systems: Stability and Stabilization30-1
 Hai Lin and Panos J. Antsaklis

31 Optimal Control of Switching Systems via Embedding into Continuous
 Optimal Control Problem31-1
 Sorin Bengea, Kasemsak Uthaichana, Milos Žefran, and Raymond A. DeCarlo

SECTION V Adaptive Control

32 Automatic Tuning of PID Controllers.....32-1
 Tore Hägglund and Karl J. Åström

33 Self-Tuning Control.....33-1
 David W. Clarke

34 Model Reference Adaptive Control.....34-1
 Petros Ioannou

35 Robust Adaptive Control35-1
 Petros Ioannou and Simone Baldi

36 Iterative Learning Control.....36-1
 Douglas A. Bristow, Kira L. Barton, and Andrew G. Alleyne

SECTION VI Analysis and Design of Nonlinear Systems

37 Nonlinear Zero Dynamics37-1
 Alberto Isidori and Christopher I. Byrnes

38 The Lie Bracket and Control38-1
 V. Jurdjevic

39 Two Timescale and Averaging Methods.....39-1
 Hassan K. Khalil

40 Volterra and Fliess Series Expansions for Nonlinear Systems.....40-1
 Françoise Lamnabhi-Lagarigue

41 Integral Quadratic Constraints.....41-1
 Alexandre Megretski, Ulf T. Jönsson, Chung-Yao Kao, and Anders Rantzer

42 Control of Nonholonomic and Underactuated Systems42-1
 *Kevin M. Lynch, Anthony M. Bloch, Sergey V. Drakunov, Mahmut Reyhanoglu,
 and Dmitry Zenkov*

SECTION VII Stability

43 Lyapunov Stability43-1
 Hassan K. Khalil

44 Input–Output Stability44-1
 A.R. Teel, T.T. Georgiou, L. Praly, and Eduardo D. Sontag

45 Input-to-State Stability45-1
 Eduardo D. Sontag

SECTION VIII Design

46 Feedback Linearization of Nonlinear Systems46-1
 Alberto Isidori and Maria Domenica Di Benedetto

47 The Steady-State Behavior of a Nonlinear System47-1
 Alberto Isidori and Christopher I. Byrnes

48 Nonlinear Output Regulation48-1
 Alberto Isidori and Lorenzo Marconi

49 Lyapunov Design49-1
 Randy A. Freeman and Petar V. Kokotović

50 Variable Structure, Sliding-Mode Controller Design50-1
 Raymond A. DeCarlo, S.H. Žak, and Sergey V. Drakunov

51 Control of Bifurcations and Chaos51-1
 Eyad H. Abed, Hua O. Wang, and Alberto Tesi

52 Open-Loop Control Using Oscillatory Inputs52-1
 J. Baillieul and B. Lehman

53 Adaptive Nonlinear Control53-1
 Miroslav Krstić and Petar V. Kokotović

54 Intelligent Control54-1
 Kevin M. Passino

55 Fuzzy Control55-1
 Kevin M. Passino and Stephen Yurkovich

56 Neural Control56-1
 Marios M. Polycarpou and Jay A. Farrell

SECTION IX System Identification

57 System Identification57-1
 Lennart Ljung

SECTION X **Stochastic Control**

58 Discrete Time Markov Processes58-1
 Adam Shwartz

59 Stochastic Differential Equations59-1
 John A. Gubner

60 Linear Stochastic Input–Output Models 60-1
 Torsten Söderström

61 Dynamic Programming61-1
 P.R. Kumar

62 Approximate Dynamic Programming62-1
 Draguna Vrabie and Frank L. Lewis

63 Stability of Stochastic Systems63-1
 Kenneth A. Loparo

64 Stochastic Adaptive Control for Continuous-Time Linear Systems64-1
 T.E. Duncan and B. Pasik-Duncan

65 Probabilistic and Randomized Tools for Control Design65-1
 Fabrizio Dabbene and Roberto Tempo

66 Stabilization of Stochastic Nonlinear Continuous-Time Systems66-1
 Miroslav Krstić and Shu-Jun Liu

SECTION XI **Control of Distributed Parameter Systems**

67 Control of Systems Governed by Partial Differential Equations67-1
 Kirsten Morris

68 Controllability of Thin Elastic Beams and Plates68-1
 J.E. Lagnese and G. Leugering

69 Control of the Heat Equation69-1
 Thomas I. Seidman

70 Observability of Linear Distributed-Parameter Systems70-1
 David L. Russell

71 Boundary Control of PDEs: The Backstepping Approach71-1
 Miroslav Krstić and Andrey Smyshlyaev

72 Stabilization of Fluid Flows72-1
 Miroslav Krstić and Rafael Vazquez

SECTION XII **Networks and Networked Controls**

73 Control over Digital Networks73-1
 Nuno C. Martins

74 Decentralized Control and Algebraic Approaches74-1
Michael C. Rotkowitz

75 Estimation and Control across Analog Erasure Channels75-1
Vijay Gupta

76 Passivity Approach to Network Stability Analysis and Distributed
Control Synthesis76-1
Murat Arcak

Index.....Index-1