

Contents

I	Bifurcation Problems	1
	Controlling an Inverted Pendulum with Bounded Controls ...	3
	<i>Diego M. Alonso, Eduardo E. Paolini, Jorge L. Moiola</i>	
1	Introduction	3
2	Description of the system	4
3	Bounded control law	5
4	Local nonlinear analysis	7
5	Numerical analysis of the global dynamical behavior	8
6	Desired operating behaviour	14
7	Conclusions	15
	References	16
	Bifurcations of Neural Networks with Almost Symmetric Interconnection Matrices	17
	<i>Mauro Di Marco, Mauro Forti, Alberto Tesi</i>	
1	Introduction	17
2	Neural network model and preliminaries	19
3	Limit cycles in a competitive neural network	23
4	Hopf bifurcations in sigmoidal neural networks	26
5	Period-doubling bifurcations in a third-order neural network	30
6	Conclusion	32
	References	32
	Bifurcations in Systems with a Rate Limiter	37
	<i>Francisco Gordillo, Ismael Alcalá, Javier Aracil</i>	
1	Introduction	37
2	Behaviour of rate limiters	38
3	Describing function of rate limiters	41
4	Limit cycle analysis of systems with rate limiters	42
5	Bifurcations in systems with a rate limiter	43
6	Conclusions	49
	References	50
	Monitoring and Control of Bifurcations Using Probe Signals ..	51
	<i>Munther A. Hassouneh, Hassan Yaghoobi, Eyad H. Abed</i>	
1	Introduction	51
2	Hopf bifurcation	52
3	Analysis of the effects of near-resonant forcing	54
4	Numerical example	57
5	Combined Stability Monitoring and Control	58

6	Detection of Impending Bifurcation in a Power System Model	60
7	Conclusions	64
	References	64
Normal Form, Invariants, and Bifurcations of Nonlinear Control Systems in the Particle Deflection Plane		
	<i>Wei Kang</i>	67
1	Introduction	67
2	Problem formulation	68
3	Normal form and invariants	70
4	Bifurcation of control systems	75
5	Bifurcation control using state feedback	77
6	The cusp bifurcation and hysteresis	81
7	Other related issues	83
8	Conclusions	84
	References	85
Bifurcations of Reachable Sets Near an Abnormal Direction and Consequences		
	<i>Emmanuel Trélat</i>	89
1	Setup and definitions	89
2	Asymptotics of the reachable sets	91
3	Applications	94
	References	98
II Stabilization and Robustness		
	Oscillation Control in Delayed Feedback Systems	103
	<i>Fatihcan M. Atay</i>	
1	Introduction	103
2	Perturbations of linear retarded equations	105
3	The harmonic oscillator under delayed feedback	106
4	Controlling the amplitude and frequency of oscillations	111
5	Conclusion	115
	References	115
	Nonlinear Problems in Friction Compensation	117
	<i>Antonio Barreiro, Alfonso Baños, Francisco Gordillo, Javier Aracil</i>	
1	Introduction	117
2	Conic analysis of uncertain friction	121
3	Harmonic balance	124
4	Frequencial synthesis using QFT	127
5	Discussion	128
	References	129

Time-Optimal Stabilization for a Third-Order Integrator: a Robust State-Feedback Implementation	131
<i>Giorgio Bartolini, Siro Pilloso, Alessandro Pisano, Elio Usai</i>	
1 Introduction	131
2 Closed loop time-optimal stabilization for a third-order integrator ..	133
3 Sliding-mode implementation of the time-optimal controller	137
4 Simulation results	141
5 Conclusions	143
References	144
Stability Analysis of Periodic Solutions via Integral Quadratic Constraints	145
<i>Michele Basso, Lorenzo Giovanardi, Roberto Genesio</i>	
1 Introduction	145
2 A motivating example	146
3 Problem formulation and preliminary results	148
4 Sufficient conditions for stability of periodic solutions	151
5 Application example	154
6 Conclusions	156
References	156
Port Controller Hamiltonian Synthesis Using Evolution Strategies	159
<i>José Cesáreo Raimúndez Álvarez</i>	
1 Introduction	159
2 Port controlled Hamiltonian systems	160
3 Controller design	160
4 Preliminaries on evolution strategies	162
5 Evolutionary formulation	165
6 Case study - ball & beam system	167
7 Conclusions	169
References	170
Feedback Stabilization and \mathcal{H}_∞ Control of Nonlinear Systems Affected by Disturbances: the Differential Games Approach ..	173
<i>Pierpaolo Soravia</i>	
1 Introduction	173
2 Differential games approach to nonlinear \mathcal{H}_∞ control	175
3 Other stability questions	181
4 Building a feedback solution for nonlinear \mathcal{H}_∞ control	182
References	188
A Linearization Principle for Robustness with Respect to Time-Varying Perturbations	191
<i>Fabian Wirth</i>	
1 Introduction	191

2	Preliminaries	192
3	The discrete time case	195
4	Continuous time	197
5	Conclusion	199
	References	200
III Global Dynamics of Control Systems		201
On Constrained Dynamical Systems and Algebroids		203
<i>Jesús Clemente-Gallardo, Bernhard M. Maschke, Arjan J. van der Schaft</i>		
1	Introduction: Constrained Hamiltonian systems	203
2	What is a Lie algebroid?	205
3	Dirac structures and Port Controlled Hamiltonian systems	208
4	Constrained mechanical systems and algebroids	213
5	Control of constrained mechanical systems	214
	References	216
On the Classification of Control Sets		217
<i>Fritz Colonius, Marco Spadini</i>		
1	Introduction	217
2	Basic definitions	218
3	Strong inner pairs	219
4	The dynamic index	221
5	The index of a control set near a periodic orbit	224
	References	230
On the Frequency Theorem for Nonperiodic Systems		233
<i>Roberta Fabbri, Russell Johnson, Carmen Núñez</i>		
1	Introduction	233
2	Nonautonomous Hamiltonian systems	235
3	Generalization of Yakubovich's theorem	238
	References	240
Longtime Dynamics in Adaptive Gain Control Systems		241
<i>Gennady A. Leonov, Klaus R. Schneider</i>		
1	Introduction	241
2	Assumptions and preliminaries	242
3	Localization of the global attractor	245
4	Longtime behavior and estimates of the Hausdorff dimension of the global attractor	248
	References	253

Model Reduction for Systems with Low-Dimensional Chaos ..	255
<i>Carlo Piccardi, Sergio Rinaldi</i>	
1 Introduction.....	255
2 Peak-to-peak dynamics	256
3 The control problem.....	260
4 Examples of application	261
5 Delay-differential systems	263
6 Concluding remarks	265
References	267
Feedback Equivalence to Feedforward Forms for Nonlinear Single-Input Control Systems	269
<i>Issa Amadou Tall, Witold Respondek</i>	
1 Introduction.....	269
2 Definitions and notations	271
3 Feedforward normal form	274
4 m -invariants.....	275
5 Main results.....	276
6 Examples	281
7 Feedforward systems in \mathbb{R}^4	283
References	285
Conservation Laws in Optimal Control	287
<i>Delfim F. M. Torres</i>	
1 Introduction.....	287
2 Preliminaries	289
3 Main results.....	291
4 Examples	294
References	295
List of Participants	297