NONLINEAR CONTROL
SYSTEMS DESIGN 1998
(NOLCOS’98)

A Proceedings volume from the 4th IFAC Symposium,
Enschede, The Netherlands, 1 - 3 July 1998

Edited by

H.J.C. HUIJBERTS
Faculty of Mathematics and Computer Science, Eindhoven University of Technology,
Eindhoven, The Netherlands

H. NIJMEIJER
Faculty of Mathematical Sciences, University of Twente,
Enschede, The Netherlands
and
Faculty of Mechanical Engineering, Eindhoven University of Technology,
Eindhoven, The Netherlands

A.J. van der SCHAF'T
Faculty of Mathematical Sciences, University of Twente,
Enschede, The Netherlands

and

J.M.A. SCHERPEN
Faculty of Information Technology and Systems, Delft University of Technology,
Delft, The Netherlands

(In two volumes)
Volume 2

Published for the
INTERNATIONAL FEDERATION OF AUTOMATIC CONTROL

by

PERGAMON
An Imprint of Elsevier Science
Noninteracting Control with Stability for Hamiltonian Systems
A. ASTOLFI, L. MENINI

OPTIMAL AND PREDICTIVE CONTROL

Control of Dynamic Systems with Unilateral Constraints and Differential Equations with Measures
J. BENTSMAN, B.M. MILLER

Output Feedback Receding-Horizon Control of Discrete-Time Nonlinear Systems
L. MAGNI, G. De NICOLAO, R. SCATTOLINI

Nonlinear Model Based Predictive Control Using Wiener and Hammerstein Models
M. WELLERS, H. RAKE

Long-Range Predictive Control of the Parametric Hammerstein Model
R. HABER, R. BARS, O. LENGYEL

PLENARY PAPER IV

Reconstruction and Observability, A Survey
F. TAKENS

NONLINEAR IDENTIFICATION

Some Results in Statistical Learning Theory with Relevance to Nonlinear System Identification
R.C. WILLIAMSON

Identifiability with Constraints
S.T. GLAD

A Structure Theory for Identification of Recurrent Neural Nets - Part 1
M. DÖRFLER, M. DEISTLER

Modelling and Adaptive Control of Biochemical Processes
A. ILCHMANN, M.-F. WEIRIG, I.M.Y. MAREELS

STABILITY

A Note on Exponential Stability of Partially Slowly Time-Varying Nonlinear Systems
J. PEUTEMAN, D. AEYELS

Sufficient Conditions for a Dynamical System to Possess an Unbounded Solution
R. ORSI, L. PRALY, I. MAREELS

Growth Rate Conditions for Global Asymptotic Stability of Cascaded Systems
E. PANTELEY, A. LORIA, L. PRALY

Stability for Homogeneous Flows Depending on a Small Parameter
L. MOREAU, D. AEYELS

A Liapunov-Like Characterization of Bounded Input Bounded State Stability
A. BACCIOTTI

FEEDBACK LINEARIZATION

Orbital Feedback Linearization of Single-Input Nonlinear Control Systems
W. RESPONDEK

Linearizability of Chemical Reactors
M. GUAY
### Passive and Dissipative Systems

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relative Flatness and Flatness of Implicit Systems</td>
<td>495</td>
</tr>
<tr>
<td>P.S. PEREIRA da SILVA, C.C. FILHO</td>
<td></td>
</tr>
<tr>
<td>Global Aspects of Feedback Linearization</td>
<td>501</td>
</tr>
<tr>
<td>A.P. KRISHCHENKO</td>
<td></td>
</tr>
<tr>
<td><strong>PASSIVE AND DISSIPATIVE SYSTEMS</strong></td>
<td></td>
</tr>
<tr>
<td>Strict Quasipassivity and Ultimate Boundedness for Nonlinear Control Systems</td>
<td>505</td>
</tr>
<tr>
<td>I.G. POLUSHIN, D.J. HILL, A.L. FRADKOV</td>
<td></td>
</tr>
<tr>
<td>New Tests of Zero-State Detectability</td>
<td>511</td>
</tr>
<tr>
<td>A.S. SHIRIAEV</td>
<td></td>
</tr>
<tr>
<td>Generalization of Impedance Matching to Nonlinear Dynamics of Robot Tasks</td>
<td>517</td>
</tr>
<tr>
<td>S. ARIMOTO, H-Y. HAN, C.C. CHEAH, S. KAWAMURA</td>
<td></td>
</tr>
<tr>
<td>Canonical Transformation and Stabilization of Generalized Hamiltonian Systems</td>
<td>523</td>
</tr>
<tr>
<td>K. FUJIMOTO, T. SUGIE</td>
<td></td>
</tr>
<tr>
<td>A Passivity Based-Sliding Mode Control Approach for the Regulation of Power Factor Precompensators</td>
<td>529</td>
</tr>
<tr>
<td>G. ESCOBAR, H. SIRA-RAMÍREZ</td>
<td></td>
</tr>
</tbody>
</table>

### Modelling and Control of Mechanical Systems

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vibrational Smoothing in Systems with Dynamic Friction</td>
<td>535</td>
</tr>
<tr>
<td>A. PEROVZVANSKI, C. CANUDAS-DE-WIT</td>
<td></td>
</tr>
<tr>
<td>Adaptive and Filtered Visual Servoing of Planar Robots</td>
<td>541</td>
</tr>
<tr>
<td>E. LEFEBER, R. KELLY, R. ORTEGA, H. NJUMEIJER</td>
<td></td>
</tr>
<tr>
<td>Stabilizing the 1-Periodic Response of a Beam with One-Sided Spring: Experiment Versus Simulation</td>
<td>547</td>
</tr>
<tr>
<td>M. HEERTJES, R. van de MOLENGRAFT</td>
<td></td>
</tr>
<tr>
<td>Discrete-Time Sliding Mode Control of a Nonholonomic Mobile Robot</td>
<td>553</td>
</tr>
<tr>
<td>T. LEO, G. ORLANDO</td>
<td></td>
</tr>
<tr>
<td>Lagrangian Mechanics and Carangiform Locomotion</td>
<td>559</td>
</tr>
<tr>
<td>S.D. KELLY, R.M. MURRAY</td>
<td></td>
</tr>
</tbody>
</table>

### PLENARY PAPER V

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Developments in Time-Varying Feedback Stabilization of Nonlinear Systems</td>
<td>565</td>
</tr>
<tr>
<td>P. MORIN, J-B. POMET, C. SAMSON</td>
<td></td>
</tr>
</tbody>
</table>

### Physical Systems Theory and Control

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coupled Stability of Non-Nodic Physical Systems</td>
<td>573</td>
</tr>
<tr>
<td>J. WON, N. HOGAN</td>
<td></td>
</tr>
<tr>
<td>On the Spatial Impedance Control of Levitated Platforms</td>
<td>579</td>
</tr>
<tr>
<td>E.D. FASSE</td>
<td></td>
</tr>
<tr>
<td>A Physical-Based Model Reduction Metric with an Application to Vehicle Dynamics</td>
<td>585</td>
</tr>
<tr>
<td>L.S. LOUCA, J.L. STEIN, O.M. HULBERT</td>
<td></td>
</tr>
<tr>
<td>Passive Output Feedback and Port Interconnection</td>
<td>591</td>
</tr>
<tr>
<td>S. STRAMIGIOLI, B. MASCHKE, A. van der SCHAAF</td>
<td></td>
</tr>
</tbody>
</table>
### STABILIZATION I

- Global Stabilization of Nonlinear Cascade Systems: Limitations Imposed by Right Half Plane Zeros 597  
  R. SEPULCHRE, M. ARCAK
- Stabilization of Nonlinear Systems Using Vector Lyapunov Functions 603  
  Z. RETCHKIMAN, G. SILVA-NAVARRO
- On Equilibria Set and Feedback Stabilizability of Nonlinear Control Systems 609  
  M. ISHIKAWA, M. SAMPEI
- Semiglobal Practical Stabilization of Uncertain Non-Minimum-Phase Nonlinear Systems via Output Feedback 615  
  A. ISIDORI
- Exponential Stabilization of High-Order Chained Systems 621  
  M.C. LAIOU, A. ASTOLFI

### ADAPTIVE CONTROL

- Smooth Output-Feedback Adaptive Compensator of External Disturbances for Nonlinear Systems 627  
  A.Yu. POGROMSKY, V.O. NIKIFOROV
- Certainty Equivalence Implies Detectability 633  
  J.P. HESPANHA, A.S. MORSE
- Adaptive Sliding-Mode Control of the Absolute Gain 639  
  H. LENZ, R. BERSTECHER, M.K. LANG
- Robust Adaptive Tracking by Measurement Feedback for a Class of Nonlinear Systems 645  
  R. MARINO, P. TOMEI
- Control and State Performance Measures in Unmatched Approximate Adaptive Nonlinear Control 651  
  M. FRENCH, E. ROGERS

### SYSTEMS WITH CONTROL LIMITATIONS

- A Note on Stabilizing and Time-Optimal Controllers for Discrete-Time Linear Systems with Positive Controls 657  
  P. De LEENHEER, D. NEŠIĆ
- Nonlinear Rescaling of Control Laws with Application to Stabilization in the Presence of Magnitude Saturation 663  
  P. MORIN, R.M. MURRAY, L. PRALY
- Analysis of Rate Limiters Using Integral Quadratic Constraints 669  
  A. RANTZER, A. MEGRETSKI
- Linear Conditioning Schemes for Systems Containing Saturating Actuators 675  
  P. WESTON, I. POSTLETHWAITE

### NONLINEAR CONTROL DESIGN

- Lateral Acceleration Control Design of a Non-Linear Homing Missile 681  
  B.A. WHITE, A. TSOURDOS, A. BLUMEL
- Robust Stabilization of the Angular Velocity for an Underactuated Rigid Spacecraft 687  
  P. LUCIBELLO, G. ORIOLO
- Discrete Time State Observer and Torque Estimator of Induction Motors with Parameter Perturbation Rejection 693  
  S.I. SELEME Jr., A. do PRADO Jr., L.C. de SOUZA MARQUES, E. de PIERI
- Exponentially Stable Output Feedback Control of Induction Motor 699  
  S. PERESADA, A. TONIELLI
Nonlinear Control of Ships: A Locally Optimal Design
J.P. STRAND, K. EZAL, T.I. FOSSEN, P.V. KOKOTOVIĆ

PLENARY PAPER VI

Research on Gain Scheduling: Quiet Past. Noisy Present! Symphonic Future?
W.J. RUGH

CONTROL OF CHAOS AND SYNCHRONIZATION

Adaptive Control of Chaotic Systems Based on Poincaré Map and Controlled Closing Lemma
A.L. FRADKOV, P.Yu. GUZENKO, A.V. PAVLOV

Linear Dynamically Varying $H_\infty$ Control of Chaos
S. BOHACEK, E. JONCKHEERE

Output Feedback Adaptive Variable Structure Control of Chaos in Lorenz System
A.D. de ARAUJO, S.N. SINGH

A Gain Selection Scheme for High-Gain Nonlinear Observers
E. SOLAK, Ö. MORGUL

Control, State Estimation and Laboratory Experiments with Oscillatory Mechanical System
B.R. ANDRIEVSKY, V.A. KONOPOLEV, A.P. KONIUKHOV, A.L. FRADKOV

NONHOLONOMIC SYSTEMS

Redundant Nonholonomic Mechanical Systems: Characterization and Control
R. COLBAUGH, M. TRABATTI, K. GLASS

Learning Control for Nonholonomic Mechanical Systems
R. COLBAUGH, K. GLASS

Nilpotent Approximation of Nonholonomic Systems with Singularities: A Case Study
M. VENDITTELLI, J.P. LAUMOND, G. ORIOTO

A Control of a Class of Nonholonomic Systems with Drift Using Time-State Control Form
H. KIYOTA, M. SAMPEI

Applications of the Geometry of Goursat Structures to Nonholonomic Control Systems
W. PASILLAS-LÉPINE, W. RESPONDEK

OBSERVERS

A Continuous-Discrete Observer for a Class of Nonlinear Systems
M. PENGOV, E. RICHARD, J-C. VIVALDA

Observable Systems Transformable into Implicit Affine Forms
D. GUILLAUME, P. ROUCHON

A Simple Adaptive Observer for Nonlinear Systems
E. BULLINGER, A. ILCHMANN, F. ALLGÖWER

Robustness of Nonlinear Observers
V.G. RYCKAERT, T. BOELEN, R. SEPULCHRE, J.F. Van IMPE

Nonlinear Observers and Output Feedback Control with Application to Dynamically Positioned Ships
A. ROBERTSSON, R. JOHANSSON
STABILIZATION II

Strict Control Lyapunov Functions for Homogeneous Jurdjevic-Quinn Type Systems
L. FAUBOURG, J-B. POMET

Nested Linear Low-Gain Design for Semiglobal Stabilization of Feedforward Systems
F. GROGNARD, R. SEPULCHRE, G. BASTIN, L. PRALY

Moving the State Between Equilibria
M. JIRSTRAND, S.T. GLAD

A New Method for Qualitative Stabilization of Nonlinear Systems
S. BAKHTIARI, P. JABEDAR-MARALANI

A General Theorem on the Semiglobal Stabilization of Uncertain Nonlinear Systems via Measurement Feedback
S. BATTILOTTI

ROBUST CONTROL II

Robust Digital Controller Design for MIMO Non-Linear Time-Varying Systems
V.D. YURKEVICH, M.J. BLACHUTA, K. WOJCIECHOWSKI

The Asymptotically Robust Perfect Tracking for Minimum-Phase Nonlinear Systems
L. MARCONI, A. ISIDORI

Robust Adaptive Control of Passive Systems with Unknown Disturbances
A. LORIA, E. PANTELEY, H. NIJMEIJER, T.I. FOSSEN

Decentralized Robust Disturbance Attenuation for Large-Scale Nonlinear Systems
Y. GUO, Z.P. JIANG, D.J. HILL

Robust Decoupling Control of an Image-Based Visual System
B. ALLOTTA, F. CONTICELLI, C. COLOMBO

Author Index