AUTOMATIC CONTROL
WORLD CONGRESS 1993

Proceedings of the 12th Triennial World Congress of the
International Federation of Automatic Control
Sydney, Australia, 18-23 July 1993

(in five volumes)

Edited by
G C GOODWIN
Department of Electrical and Computer Engineering,
University of Newcastle, Australia

and

R J EVANS
Department of Electrical Engineering,
University of Melbourne, Australia

VOLUME 5
ASSOCIATED TECHNOLOGIES AND RECENT DEVELOPMENTS
- Sensing and Measuring
  Estimation
- Social Effects and Economics
  Education
  Intelligent Control
- Plenary Papers

Published for the
INTERNATIONAL FEDERATION OF AUTOMATIC CONTROL

by
PERGAMON
An Imprint of Elsevier Science Limited
# CONTENTS

## SENSING AND MEASURING

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully Automatic Magnetic-particle Inspection System for Square Billets</td>
<td>1</td>
</tr>
<tr>
<td>H. NAKATA, M. HIRATA, T. TADA</td>
<td></td>
</tr>
<tr>
<td>An Approach for the Placement of Sensors for On-line Diagnostic Purposes</td>
<td>5</td>
</tr>
<tr>
<td>A.K.A. TOGUYENI, E. CRAYE, J.C. GENTINA</td>
<td></td>
</tr>
<tr>
<td>Tactile Image Sensors for Robot Assembly: Preprocessing and Control</td>
<td>11</td>
</tr>
<tr>
<td>C. KLOMP, F.L. MULLER, P.P.L. REGTIEN</td>
<td></td>
</tr>
<tr>
<td>Categorizing Dust Particle on LSI Wafer Surfaces using Fractal Dimension</td>
<td>15</td>
</tr>
<tr>
<td>M. KAMIJO, S.I. AIHARA</td>
<td></td>
</tr>
</tbody>
</table>

## ESTIMATION

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Modelling Linear Dynamical Systems through Generalized Orthonormal Basis Functions</td>
<td>19</td>
</tr>
<tr>
<td>P.S.C. HEUBERGER, P.M.J. VAN DEN HOF, O.H. BOSGRA</td>
<td></td>
</tr>
<tr>
<td>Adaptive Orthonormal Filters</td>
<td>23</td>
</tr>
<tr>
<td>A.C. DEN BRINKER</td>
<td></td>
</tr>
<tr>
<td>Modelling of Uncertain Systems via Linear Programming</td>
<td>29</td>
</tr>
<tr>
<td>T.K. GUSTAFSSON, P.M. MAKILA</td>
<td></td>
</tr>
<tr>
<td>On Determination of Laguerre Filter Pole through Step or Impulse Response Data</td>
<td>35</td>
</tr>
<tr>
<td>Y. FU, G.A. DUMONT</td>
<td></td>
</tr>
<tr>
<td>Applications of Kautz Models in System Identification</td>
<td>41</td>
</tr>
<tr>
<td>P. LINDSKOG, B. WAHLBERG</td>
<td></td>
</tr>
<tr>
<td>On the Estimation of Discrete Parameters in Linear Systems</td>
<td>45</td>
</tr>
<tr>
<td>F. GUSTAFSSON</td>
<td></td>
</tr>
<tr>
<td>Optimality of Eigen-based Algorithms with Fully Correlated Sources</td>
<td>51</td>
</tr>
<tr>
<td>H. KRIM</td>
<td></td>
</tr>
<tr>
<td>N4SID: Numerical Algorithms for State Space Subspace System Identification</td>
<td>55</td>
</tr>
<tr>
<td>P. VAN OVERSCHEE, B. DE MOOR</td>
<td></td>
</tr>
<tr>
<td>Frequency Estimation</td>
<td>59</td>
</tr>
<tr>
<td>E.J. HANNAN, D. HUANG, B.G. QUINN</td>
<td></td>
</tr>
<tr>
<td>Performance of Subspace Based State-Space System Identification Methods</td>
<td>63</td>
</tr>
<tr>
<td>M. VIBERG, B. OTTERSTEN, B. WAHLBERG, L. LJUNG</td>
<td></td>
</tr>
</tbody>
</table>

ix
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determining Model Uncertainty of Identified Models for Robust Control Design</td>
<td>67</td>
</tr>
<tr>
<td>R.L. KOSUT</td>
<td></td>
</tr>
<tr>
<td>Identification and Adjustment of Relative Degrees and Zero Dynamics using Bond Graphs</td>
<td>71</td>
</tr>
<tr>
<td>S.-T. WU, K. YOUSEF-TOUMI</td>
<td></td>
</tr>
<tr>
<td>On the Use of Regularization in System Identification</td>
<td>75</td>
</tr>
<tr>
<td>J. SJOBEG, T. MCKELVEY, L. LJUNG</td>
<td></td>
</tr>
<tr>
<td>A Principle for System Identification in the Behavioural Framework</td>
<td>81</td>
</tr>
<tr>
<td>E. WEYER, R.C. WILLIAMSON, I.M.Y. MAREELS</td>
<td></td>
</tr>
<tr>
<td>MIMO-Systems Identification by Minimum Error Bounds</td>
<td>85</td>
</tr>
<tr>
<td>T.J.J. VAN DEN BOOM</td>
<td></td>
</tr>
<tr>
<td>Quantification of Uncertainty in Transfer Function Estimation: A Mixed Deterministic-probabilistic Approach</td>
<td>89</td>
</tr>
<tr>
<td>D.K. DE VRIES, P.M.J. VAN DEN HOF</td>
<td></td>
</tr>
<tr>
<td>Worst-case system Identification in $H_{\infty}$: Error Bounds and Optimal Models</td>
<td>93</td>
</tr>
<tr>
<td>R.G. HAKVOORT</td>
<td></td>
</tr>
<tr>
<td>Convergent On-line Identification in $H_{\infty}$ for Discrete Systems</td>
<td>97</td>
</tr>
<tr>
<td>F.-M. LEE, I.-K. FONG, L.-C. FU</td>
<td></td>
</tr>
<tr>
<td>Adaptive Approximation of Uncertainty Sets for Linear Regression Models</td>
<td>101</td>
</tr>
<tr>
<td>A. VICINO, G. ZAPPA</td>
<td></td>
</tr>
<tr>
<td>Simultaneous Identification of Nominal Model, Parametric Uncertainty and Unstructured Uncertainty for Robust Control in Time Domain</td>
<td>105</td>
</tr>
<tr>
<td>T. ZHOU, H. KIMURA</td>
<td></td>
</tr>
<tr>
<td>Improving the Tracking Performance of Mechanical Systems by Adaptive Extended Friction Compensation</td>
<td>109</td>
</tr>
<tr>
<td>B. DE JAGER</td>
<td></td>
</tr>
<tr>
<td>Robust Discrete-time Adaptive Control Scheme for Servo Systems and its Application</td>
<td>115</td>
</tr>
<tr>
<td>S. TAKAGI, S. ESAKI</td>
<td></td>
</tr>
<tr>
<td>Excitation versus Control Issues in Closed Loop Identification of Plant Models for a Sugar Cane Crushing Mill</td>
<td>121</td>
</tr>
<tr>
<td>A.G. PARTANEN, R.R. BITMEAD</td>
<td></td>
</tr>
<tr>
<td>Toward Finite-frequency Theory of Control</td>
<td>125</td>
</tr>
<tr>
<td>A.G. ALEXANDROV</td>
<td></td>
</tr>
<tr>
<td>Closed Loop Relay Estimation of Uncertainty Bounds for Robust Control Models</td>
<td>129</td>
</tr>
<tr>
<td>R.S. SMITH, J.C. DOYLE</td>
<td></td>
</tr>
<tr>
<td>Model Validation for Robust Control: An Experimental Process Control Application</td>
<td>133</td>
</tr>
<tr>
<td>R.S. SMITH</td>
<td></td>
</tr>
<tr>
<td>Variable-structure Linear-model-following Control</td>
<td>137</td>
</tr>
<tr>
<td>S.K. TSO, M.L. LAI, P.L. LAW</td>
<td></td>
</tr>
<tr>
<td>Modelling of Combined Discrete Event and Continuous Time Dynamical Systems</td>
<td>141</td>
</tr>
<tr>
<td>M. ANDERSSON</td>
<td></td>
</tr>
</tbody>
</table>
Iterative Control Design Approaches  
R.R. BITMEAD  

Interactive Modeling Environment for Adaptive Process Control  
Y. NAKAMORI, K. SUZUKI  

Identification of Multivariable Fuzzy Systems through Fuzzy Cell Mapping  
LI-MIN JIA, XI-DI ZHANG  

Adaptive Control for Stochastic Hyperbolic Systems  
S.I. AIHARA  

State-space Adaptive Control of a Turbo-generator Pilot Plant  
Y.Y. NAZARUDDIN, H. UNBEHAUEN  

A Hybrid Adaptive Control Scheme using Sampled Data and Intersampling Compensation  
JING SUN  

Design of Discrete-time Adaptive Control in Presence of Uncertain Time Delay  
G. BARTOLINI, A. FERRARA  

The Logarithm Law of Self-tuning Regulators  
LEI GUO  

A Frequency Domain Adaptive Controller  
P.-O. KALLEN, B. WITTENMARK  

Locally-optimal Adaptive Control without Persistent Excitation  
M.M. KOGAN, Ju.I. NEIMARK  

Singularity-free Multivariable Model Reference Adaptive Control  
R.G. MOCTEZUMA, R. LOZANO  

A Unified Design Method for Model Reference Adaptive Control Systems using the Coprime  
Factorization Approach  
A. INOUE, V.T. KROUMOV, S. MASUDA  

A Disturbance Attenuation Approach to Adaptive Control  
D.F. CHICHKA, J.L. SPEYER  

Frequency Domain Adaptive Control: Band-wise Compensation  
YU TANG, E.F. CAMACHO, J. FLORES  

Passivity and Parametric Robustness of a New Class of Adaptive Systems  
M. KRSTIC, I. KANELLAKOPOULOS, P.V. KOKOTOVIC  

Decentralized Simple Adaptive Control  
Z. IWAI, I. MIZUMOTO, H. DOUZONO  

On the Transient Behaviour in Discrete-time Model Reference Adaptive Control  
A. DATTA  

Stable Hybrid Adaptive Pole Assignment Control  
U. CHAISWANKIT, C. ZHANG, M. PALANISWAMI  

Robust Adaptive Pole Placement Using Fixed Compensator  
H. OHMORI, I. ISOMURA, A. SANO
Stability of Indirect Decentralized Adaptive Control Systems
CHANGYUN WEN

Adaptive Control System Design for Stable SISO Plants with Amplitude Constraints on the Inputs
YI-SHENG ZHONG, T. TAKEUCHI

Robust Stability of a Modified Clarke-Gawthrop Self-tuning Controller
XING YUAN GU, CHENG SHAO

Adaptive 2-DOF Tracking with Reference-dependent Self-excitation
E. MOSCA, JINGXIN ZHANG

Design of an Adaptive Model Matching Controller for Nonminimum Phase Systems using a Periodic Scheme
N. MINAMIDE, P.N. NIKIFORUK

Model Reference Adaptive Control for Non-minimum Phase Multivariable System by 2-delay Feedback
Y. MIYASATO

Design of Continuous-time MRACS using Zeros Placement Capabilities
T. ISHIKAWA, H. OIHMRI, A. SANO

Global Convergent Inferential Self-tuning Control Algorithm
TIAN YOU CHAI, LI XIN ZHENG

Adaptive Control of Bilinear Systems with Bounded Disturbances and its Application
Y.H. JIN, X. SUN, C.Z. FANG

The Utilisation of System-specific Information in Adaptive Control
R.W. JONES, P.J. GAWTHROP

The Sign-Sign Algorithm: Checking Persistent Excitation for Periodic Inputs
S. DASGUPTA, C.R. JOHNSON, Jr., A.M. BAKSHO

On Regularization Approach to Parameter Estimation and its Application to Design of Stable Filters
H.S. HOANG, O. TALAGRAND

Optimal Sampling Rate for System Identification Based on Decimation and Interpolation
A. SANO, H. TSUJI

Can Approximate Bayesian Estimation be Consistent with the Ideal Solution?
R. KULHAVY

On Identification of a Class of Nonlinear Systems
LANG ZI-QIANG

Robust Parameter Set Estimation: Applied to a Watervessel Process
H.M. FALKUS, A.A.H. DAMEN

Detecting Asymptotically Non-vanishing Model Uncertainty
H. HJALMARSSON

Discrete-time Linear Periodic Systems: The Realization Problem
P. COLANERI, S. LONGHI

Identification of Structure and Parameters of the Multivariable Systems
D.W. HU
On an EIV Based Structural Estimation Method
H.N. DUONG, I.D. LANDAU

Model Reduction using Rational Approximation Techniques
M.-P.C. CAI, E.B. LEE

On the Geometry of External Spectral Factors and the Riccati Inequality
A. GOMBANI

Filtering of the Hilbert Space-valued Singularity Perturbed Stochastic Processes over
Discrete-continuous Observations
Yu.V. ORLOV, N.Ye. NAVAROVA, D.D. RAZUMOVSKY

Recursive Prediction Error Techniques for Adaptive Estimation of Hidden Markov Models
I.B. COLLINGS, V. KRISHNAMURTHY, J.B. MOORE

Numerical Studies of Stochastic Optimization Algorithms with Averaging
K. YIN, G. YIN

Learning Nonlinearly Parametrized Decision Regions
K.L. HALLIWELL, R.C. WILLIAMSON, I.M.Y. MAREELS

Tracking using a Random Sampling Algorithm
J.A. OSULLIVAN, M.I. MILLER, A. SRIVASTAVA, D.L. SNYDER

Tracking with Consistent Converted Measurements vs the EKF
D. LERRO, Y. BA-SHALOM

Fault Detection in Linear Discrete Dynamic Systems using Generalized-likelihood-ratio Technique
S. TANAKA

Robust Fault Detection Method Accounting for Modelling Errors in Uncertain Systems
O.-K. KWON, W.H. KWON, J.H. LEE

An Approach to Residual Generator and Evaluator Design and Synthesis
X. DING, P.M. FRANK, L. GUO

Design of Redundancy Relations for Failure Detection and Isolation by Constrained Optimization
M. KINNAERT

A General Failure Detection, Isolation and Accommodation System with Model Uncertainty and
Measurement Noise
CHIA-CHI TSUI

On Construction of Sequential Procedures for Detection of a Change-point of Parameters in
Stochastic Dynamic Systems
S.E. VOROBEICHIKOV, V.V. KONEV

Nineteen ML Estimations for Model Structure Selection
F. GUSTAFSSON, H. HJALMARSSON

Identifiability in Blind Equalization
F. GUSTAFSSON, B. WAHLBERG

Simultaneous Solution of Smoothing, Filtering and Prediction Problems using Integral Equations
D.G. MAKSAROV
Discrete Frequency Formats for Linear Differential System Identification
A.E. PEARSON, Y. SHEN, J.Q. PAN

Time-optimal Stochastic Positional Control
P. KULCZYCKI

Robust Nonlinear Observer-based Fault Detection for an Overhead Crane
R. SELIGER, P.M. FRANK

Fault Diagnosis of Dynamic Systems using Neural Networks
T. SORSA, J. SUONTAUSTA, H.N. KOIVO

Nonlinear Filtering Schemes for Continuous-time Stochastic Hybrid Systems
G. KALMANOVICH, A.H. HADDAD

Optimal Auxiliary Input for On-line Fault Detection and Fault Diagnosis
K. UOSAKI, N. TAKATA, T. HATANAKA

Fault Tolerant Control in the Presence of Noise: A New Algorithm and Some Open Problems
A.W. OLBROT

PID Control Revisited
P. PERSSON, K.J. ASTROM

Dynamic Transfer among Alternative Controllers
S.F. GRAEBE, A. AHLEN

Grinding Force Control using Nonlinear Adaptive Strategy
L. GUO, A. SCHONE, X. DING

Multivariable Generalized Predictive Control with Multiple Reference Model: A Flexible Arm Application
P. CODRON, P. BOUCHER

Model Reduction for PID Design
A.J. ISAKSSON, S.F. GRAEBE

Identification of Continuous-time Systems with Partially-known State-dependent Disturbances
C. CANUDAS DE WIT, B. BROGLIATO, C.R. JOHNSON

Grey Box Modelbased Adaptive Control
H. BRABRAND, S.B. JORGENSEN

Parameter Constrained Adaptive Control
W.D. TIMMONS, H.J. CHIZECK, V. CHANKONG, P.G. KATONA

T. BOHLIN

Experiment Design for Grey-box Models
H. MELGAARD, P. SADEGH, H. MADSEN, J. HOLST

Grey Dynamics of Heat Exchanger Networks
E.I. VARGA, J. BOKOR, K.M. HANGOS
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development of Control Technology in a Small Developing Country</td>
<td>669</td>
</tr>
<tr>
<td>S. STRMCNIK, R. KARBA, J. CERNETIC, K. JEZERNIK</td>
<td></td>
</tr>
<tr>
<td>The Application of Induction Generators for Remote Micro-Hydro Systems in Developing Countries</td>
<td>677</td>
</tr>
<tr>
<td>D. SUTANTO, C. GRANTHAM</td>
<td></td>
</tr>
<tr>
<td>Experiences in Asia - Education and Industry</td>
<td>681</td>
</tr>
<tr>
<td>T.J. WILLIAMS</td>
<td></td>
</tr>
<tr>
<td>Identification and Control Algorithm for Bilinear Delta Operator Systems</td>
<td>685</td>
</tr>
<tr>
<td>M.A. HERSH</td>
<td></td>
</tr>
<tr>
<td>Parameter Identification of Fuzzy Autoregressive Models</td>
<td>689</td>
</tr>
<tr>
<td>T. FUKUDA, Y. SUNAHARA</td>
<td></td>
</tr>
<tr>
<td>On the Studying of Mass Phenomena</td>
<td>693</td>
</tr>
<tr>
<td>V.I. IVANENKO, V.A. LABKOVSKY</td>
<td></td>
</tr>
<tr>
<td>Experimental Identification of Variable Parameter Flow Processes</td>
<td>697</td>
</tr>
<tr>
<td>A.J. NIEMI, L. TIAN, P. JUTILA, R. YLINEN</td>
<td></td>
</tr>
<tr>
<td>An Extension of Estimation Theory on Unknown but Bounded Uncertainty</td>
<td>703</td>
</tr>
<tr>
<td>WANG SHUNING, DAI JIANSHE, HU PING</td>
<td></td>
</tr>
</tbody>
</table>

**EDUCATION**

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Cost CACSD Software for the Apple Macintosh</td>
<td>707</td>
</tr>
<tr>
<td>W. SCHAUFELBERGER</td>
<td></td>
</tr>
<tr>
<td>Tutorial on the Digraph Approach to Multivariable Control</td>
<td>711</td>
</tr>
<tr>
<td>J. JANTZEN</td>
<td></td>
</tr>
<tr>
<td>Inspect: An Interactive System for Pre-examination Exercises on Control Theory</td>
<td>715</td>
</tr>
<tr>
<td>R.P. ESSENIUS, G. HONDERD, W. JONGKIND</td>
<td></td>
</tr>
<tr>
<td>Training Materials for Process Automation in Hyper-media Environment</td>
<td>719</td>
</tr>
<tr>
<td>K. LEIVISKA, L. YLINIEI, J. LINDFORS</td>
<td></td>
</tr>
<tr>
<td>A Hyperbook on Automatic Control</td>
<td>723</td>
</tr>
<tr>
<td>R. KORNEFORS, M. LENELLS, A. HULTGREN</td>
<td></td>
</tr>
<tr>
<td>University and Industry Joint Project for Control Education</td>
<td>727</td>
</tr>
<tr>
<td>MING RAO, HAIMING QIU</td>
<td></td>
</tr>
<tr>
<td>Expert-system-assisted Open-learning in Control</td>
<td>731</td>
</tr>
<tr>
<td>N. SADAQUI, N.E. GOUGH, I.H. TING, G.M. DIMIROVSKI</td>
<td></td>
</tr>
<tr>
<td>A Fuzzy Logic Control Laboratory Experiment for Undergraduate Students</td>
<td>735</td>
</tr>
<tr>
<td>K.H. FASOL, R. KNOF</td>
<td></td>
</tr>
<tr>
<td>Control of Complex Mechanical Systems</td>
<td>741</td>
</tr>
<tr>
<td>D.M. AUSLANDER, M. LEMKIN, AN-CHYAU HUANG</td>
<td></td>
</tr>
<tr>
<td>A Role for Mini Projects in Control Engineering Education</td>
<td>745</td>
</tr>
<tr>
<td>R.J. WYNNE</td>
<td></td>
</tr>
</tbody>
</table>
Studying Kalman Filtering - A Laboratory Experiment
A. HULTGREN

Teaching Fuzzy Logic Control Design through Laboratory Experiments and Student Projects
G. SCHMIDT, U. HANEBECK

A New Strategy for Swinging Up an Inverted Pendulum
M. WIKLUND, A. KRISTENSON, K.J. ASTROM

Real-time Microprocessor Control Laboratory
P.H. MECKL, R. SHOURESHI

Teaching Multi-degree-of-Freedom Dynamics: A Laboratory Demonstration Tool
R.K.G. BOLLICH, M.J. RABINS

INTELLIGENT CONTROL

VLSI Hardware Realization of Self-learning Recursive Fuzzy Model for Dynamic Systems
M.F. SCHEFFER, I.S. SHAW

Further Evaluation of the Self Organizing Qualitative Control
G. NAGIB, W. GHIARIEB

Intelligent Regulators: Design and Evaluation
F. MORANT, P. ALBERTOS, J.L. NAVARRO, A. CRESPO

Complex Dynamics in a Hopfield’s Neuron
R. KELLY, G. DAVILA

Fuzzy Identification of Hydraulic Systems
T. BERTRAM, H. SCHWARZ

Fuzzy Bang-bang Controller for Time Optimal and Minimum Chattering Servo Systems
TSONG-YAU HWANG, JIA-YUSH YEN, SHUI-SHONG LU

A Graph Oriented Knowledge-based System to Assist Restoration of Distribution Systems
C. CAVELUCCI, C. LYRA

Aids to the Surveillance of the Traffic from VTS by Means of a Knowledge Based System
T. DEGRE, B. SCHNETZLER

A New Fuzzy Reasoning Model for Decision Support System
XIAOZHE ZHAO, ZHONGTUO WANG

Decision in Complex Environment: Integrate Quantitative Model with Qualitative Judgement
SHIJING ZHU, TING CHEN

Multifrequency Binary Testing with Phase and Frequency Shift Keyed Modulation
I.A. HENDERSON, J. McGHEE

On-Line Multiple Component and Instrument Fault Diagnosis in Dynamic Systems
M.N. BARKESSEH, N.A. KHEIR

Using Condition Monitoring to Enhance Robot Position Control
A. STARR, R.J. WYNNE, I. KENNEDY
Fault Diagnosis in HVDC Systems with Neural Networks
L.L. LAI, F. NDEH-CHE, K.S. SWARUP, H.S. CHANDRASEKHARIAH

Generic Model of an Intelligent Sensor using the Object Oriented Paradigm
J.F. FIGUEROA, P.P. EGUI

Local Map Building for Mobile Robot Autonomous Navigation by using a 2D Laser Range Sensor
J. GONZALEZ, A. OLLERO, P. HURTADO

An Intelligent Supervisor for Adaptive Mode-switch Control
J. VAN AMERONGEN, R.A. HILHORST, P. LOHNBERG, H.J.A.F. TULLEKEN

Objet-Scxi: Objects, Rules and Fuzzy Functions for Identification
K. SZAFNICKI, S. GENTIL

Development of a Knowledge-based Approach for Real-time Predictive Process Control
T.H. LEE, C.C. HANG, S. NUNGAM

A Reward/Punishment Learning Method to Swing Up a Pendulum into its Upright Position
K. KRATOCHWIL, R. ENGELBRECHT, H.P. JORG

Novel Configuration of Nonlinear Adaptive Control Incorporating Neural Network
T. ISHIKAWA, J. TSUJI, H. OHMORI, A. SANO

Intelligent Control of Contamination Level in Hydraulic Control Systems
CHAO LIU, P. DRANSFIELD, J.S. STECKI

CAP-AC: Computer Aided Planning of Assembly Cells
P. KOPACEK, R. PROBST, D. NOE, R. STANGL

An Expert System for Diagnosis in Assembly Cells
M. BENEDER, R. PROBST, P. KOPACEK

Communication in Low-cost CIM Systems - A New Approach
N. GIRSULE, R. PROBST

A Modular CIM-concept for Small and Medium Sized Companies
M. ZAUNER, J. HOLZL, P. KOPACEK, G. KRONREIF

Architectures for Integrating Manufacturing Activities and Enterprises

On Fuzzy Multiobjective Predictive Control and its Adaptive Alternative
LI-MIN JIA, XI-DI ZHANG

Adaptive Control of Nonlinear Continuous-time Systems using Neural Networks - General Relative Degree and MIMO Cases
FU-CHUANG CHEN, CHEN-CHUNG LIU

Control of a pH Plant using Connectionist Representations
D. SBARBARO

CEINT: A General Purpose Modeling Program
C.S. BERGER
Hierarchical Intelligent Control with Flexible AC Transmission Systems Application
R.R. ZAKRZEWSKI, R.R. MOHLER, W.J. KOLODZIEJ

Fuzzy Anti-Reset Windup for PID Controllers
A. HANSSON, P. GRUBER, J. TODTLLI

Plenary Papers

Optimization Based Design and Control
D.Q. MAYNE, E. POLAK

Perspectives on the Process of Identification
L. LJUNG

Process Control: Theories and Profits
M.L. BRISK

Recent Developments in Digital Control Theory
M. ARAKI

Author Index of Volumes 1-5

Keyword Index of Volumes 1-5