IEEE

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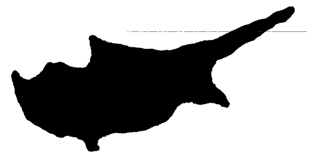

5th IEEE MEDITERRANEAN CONFERENCE ON CONTROL AND SYSTEMS

Proceedings
on
CD-ROM

Phaethon Beach Sunhotel
Paphos, Cyprus
July 21-23, 1997

THE 5TH IEEE MEDITERRANEAN CONFERENCE
ON CONTROL AND SYSTEMS

Phaethon Beach Sunotel, Paphos, Cyprus
July 21-23, 1997

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THE 5TH IEEE MEDITERRANEAN CONFERENCE
ON CONTROL AND SYSTEMS

Phaethon Beach Sunotel, Paphos, Cyprus
July 21-23, 1997

INTERNATIONAL PROGRAM COMMITTEE

IEEE MED STEERING COMMITTEE

1. WELCOME

On behalf of the Organizing and Program Committees, I welcome you to Cyprus and the 5th IEEE Mediterranean Conference on Control and Systems (5th IEEE MED). I hope that your trip to Paphos was uneventful and that you are eager to participate in an exciting technical meeting. We cannot, of course, forget that we are on Cyprus, an island with rich history, natural beauty and legendary hospitality. Therefore, my hope is that you will also have the opportunity to relax and enjoy all that Cyprus has to offer. After all, we should not "offend" the ancient Greek inhabitants of the island who used to live by the saying: το τερπνον μετα του ωφελιμου, which loosely translates to: business with pleasure.

The 1997 Mediterranean Conference on Control and Systems, is the 5th such meeting held in the Mediterranean and the second held in Cyprus. It is co-sponsored by the IEEE Control Systems Society, the University of Cyprus, The Technical Universities of Crete and Patras, the IEEE Cyprus Section, the IEE Cyprus Section and the IEEE Greek Chapter of the Control Systems Society.

The Conference is truly an international event, that attracted the attention of researchers in the field from all over the world. Authors are representing more than twenty countries and come from five continents. The technical program consists of 129 contributed and special session papers, which are arranged in 24 sessions. These papers will be presented over three days, Monday, Tuesday and Wednesday, July 21, 22 and 23 respectively. Each day is divided into morning sessions (four parallel sessions) and afternoon sessions (four parallel sessions). The topics range from Hybrid and Intelligent Systems to Robust and Adaptive Control, Automotive Systems and Digital Signal Processing. The Conference Plenary Lecture is:

Monday morning at 8:30
Professor Sanjoy Mitter of the Massachusetts Institute of Technology
Logic, Mathematical Programming and Hybrid Systems

A brief biography of the plenary speaker can be found below.

The Conference Proceedings will be published on CD-ROM, which is a first for the MED Conference. This is in response to the trend in conference publications of recent years. This medium offers expanded search capabilities for conference proceedings readers and is arguably a more efficient method to disseminate information. Most of the papers included in the CD-ROM were submitted to the CD-ROM producer electronically. In addition to the CD-ROM, each conference participant will receive a hardcopy Conference Program which includes a Book of Abstracts.

The planning, organization and running of this Conference, was done exclusively by volunteers. Without their tireless efforts this Conference would not run smoothly. I would like to give special thanks to Petros Ioannou, for handling finances, registration, hotel arrangements and special events. Many thanks go to Vassilis Syrmos, the Publicity Chair and the members of the Program Committee who helped with reviews. Thanks also go to Orhan Beker, for his help in producing the Book of Abstracts. Most importantly, many thanks go to the organizers of special sessions and all the authors, who have made this Conference a reality. Finally, let me also thank all attendees, who with their participation have ensured the success of the 5th IEEE MED.

Theodore E. Djaferis
General/Program Chair, 5th IEEE MED

2. CONFERENCE REGISTRATION

Most of the Conference attendees have pre registered for the Conference. All who pre registered are asked to go to the Conference Registration Desk, in order to obtain conference related material and publications. Those of you who chose to register on site are urged to do so as quickly as possible. The Conference Registration Desk will be open the following hours:

Sunday July 20, 6:30 p.m. to 8:30 p.m.
Monday July 21, 7:00 a.m. to 10:00 a.m. and 12:00 p.m. to 2:00 p.m.

The registration fee covers admission to all technical sessions, opening reception, coffee breaks and the gala dinner. Each registrant will also receive a copy of the Conference Program (which includes the Book of Abstracts) and one CD-ROM with the Conference Proceedings. Conference registrants may purchase additional sets of CD-ROM Proceedings at the Registration Desk for $40 (20 Cyp. Pounds) each.

3. SOCIAL EVENTS

- Opening Reception (7:00 PM, Sunday, July 20)

On Sunday, July 20, 1997, there will be an opening reception held at the Phaethon between 7:00 p.m. and 9:00 p.m. This will give the opportunity to Conference participants to meet and socialize.

- Gala Dinner (8:00 PM, Tuesday, July 22)

On Tuesday, July 22, 1997, starting at 8:00 p.m. the evening Gala Dinner will take place at the taverna Demokritos. This is located within walking distance from the Phaethon and directions will be provided at the Conference Registration desk. Extra tickets for the gala dinner cost $25 (7.5 Cyp. Pounds) each.

4. ABOUT CYPRUS AND PAPHOS

The island of Cyprus, is located in the north-eastern corner of the Mediterranean sea, about 200 miles east of the island of Rhodes, 60 miles west from Syria, 250 miles north of Egypt and 40 miles south of Turkey. In size it is the third largest island in the Mediterranean, after Sicily and Sardinia, with an area of 3,572 square miles (9,251 square kilometers). Its greatest breadth from north to south is 60 miles and its greatest length from east to west is 140 miles. The most prominent topographical features of the island are two mountain ranges, Pendadaktylos (in Greek it means “five fingers”) to the north and Troodos to the south, separated by the wide central plane Mesaoria (in Greek it means “between mountains”). The highest peak (6,401 feet) is in the Troodos range and is called Mount Olympus (or Chionistra). Average annual rainfall is about 19 inches, with the summer months being quite dry and hot.

The civilization of Cyprus dates back to the 7th millennium B.C., beginning with the Neolithic Age (5800-3000 B.C.). Its beauty, resources and strategic location have been sought after by friendly visitors and conquerors alike for thousands of years. Their passing have shaped its history, culture and civilization and evidence of their presence can be found in the literally hundreds of archeological sites throughout the island. Its Greek heritage can be traced back three and a half thousand years to Mycenaean settlers. Archeological excavations have brought to light finds of all kinds: stone and bronze tools, utensils, weapons, precious stones, gold silver coins, rings and bracelets, marble and bronze statues, etc.. Many are exhibited in the Cyprus Museum in Nicosia (the capital) and at museums at other parts of the world. One can see “history” everywhere on the island, remains of ancient cities, temples, theaters, gymnasia, palaces, mosaics, Byzantine churches and monasteries with fresco paintings, mediaeval crusader cathedrals, castles and walled cities, tekkes, aqueducts, etc..

Paphos, the Conference site, is located on the west coast of Cyprus. It was founded in the fourth century BC and was the capital of Cyprus during Roman times. Places of interest in Paphos include: The Harbor, first built in the time of Alexander the Great, rebuilt in 1592 A.D.; St. Paul's Pillar to which St. Paul was tied and scourged; the Tombs of the Kings; the mosaics of the 3rd century A.D. which are the finest in the Mediterranean. Nearby, is Petra tou Romiou where according to legend Aphrodite emerged from the waves, and the Temple of Aphrodite. In addition to its rich history and archeological sites Paphos has some of the best beaches in Cyprus.

5. ON THE RECORD

The 1997 IEEE Mediterranean Conference on Control and Systems is the 5th such meeting held in this region of the world. Even though it is relatively "young" conference it nevertheless consistently attracts leading researchers in the area of Control and Systems from all over the world. The first, was held in 1993 and plans already exist for a number of future meetings: 6th IEEE MED Sardinia, Italy (1998); 7th IEEE MED Haifa, Israel; 8th IEEE MED Porto, Portugal; 9th IEEE MED Patras, Greece; 10th IEEE MED Barcelona, Spain. Listed below are the past and present IEEE MEDs.

1st IEEE MEDITERRANEAN SYMPOSIUM ON NEW DIRECTIONS
IN CONTROL THEORY AND APPLICATIONS
June 21-23, 1993, Chania, Crete, Greece
General Chairman: M. A. Christodoulou

2nd IEEE MEDITERRANEAN SYMPOSIUM ON NEW DIRECTIONS
IN CONTROL AND AUTOMATION
June 19-21, 1994, Chania, Crete, Greece
General Chairman: K. P. Valavanis

3rd IEEE MEDITERRANEAN SYMPOSIUM ON NEW DIRECTIONS
IN CONTROL AND AUTOMATION
July 11-13, 1995, Limasol, Cyprus
General Chairman: P. A. Ioannou
Program Chairman: F. L. Lewis

4th IEEE MEDITERRANEAN SYMPOSIUM ON NEW DIRECTIONS
IN CONTROL AND AUTOMATION
June 10-13, 1996, Chania, Crete, Greece
General Chairman: F. L. Lewis
Program Co-Chairs: K. Kyriakopoulos and P. G. Voulgaris

5th IEEE MEDITERRANEAN CONFERENCE ON CONTROL AND SYSTEMS
July 21-23, 1997, Paphos, Cyprus
General and Program Chairman: T. E. Djaferis

6. BIOGRAPHY OF THE PLENARY SPEAKER

Sanjoy Mitter received his Ph.D. degree from the Imperial College of Science and Technology, University of London, in 1965. He had previously worked as a research engineer at Brown Boveri & Co. Ltd., Switzerland (now ASEA Brown Boveri) and Battelle Institute in Geneva, Switzerland. He taught at Case Western Reserve from 1965 to 1969 and joined MIT in 1969 first as a Visiting Professor and then in 1970 as Associate Professor in the Department of Electrical Engineering and Computer Science. He is currently Professor of Electrical Engineering and Co-Director of the Laboratory for Information and Decision Systems. He is also Director of the Center for Intelligent Control Systems, an inter-university (Brown-Harvard-MIT) center for research on the foundations of intelligent systems. He has held visiting positions at the Tata Institute of Fundamental Research, Bombay, India; Scuola Normale Superiore, Pisa, Italy; Imperial College of Science and Technology; Institut National de Recherche en Informatique et en Automatique, France; University of Groningen, the Netherlands and several universities in the United States.

Professor Mitter's research has spanned the broad areas of Systems, Communication and Control. Although his primary contributions have been on the theoretical foundations of the field, he has also contributed to significant engineering applications, notably in the control of interconnected power systems and automatic recognition and classification of electrocardiograms. His current research interests are theory of stochastic dynamical systems, nonlinear filtering, stochastic and adaptive control; mathematical physics and its relationship to system theory; image analysis and computer vision; and structure, function and organization of complex systems.

Professor Mitter has served on several advisory committees and editorial boards for IEEE, SIAM, AMS, NSF and ARO. He is currently Associate editor of Acta Applicandae Mathematicae; Circuits, Systems and Signal Processing; Journal of Applied Mathematics and Optimization; SIAM Review; and the Ulam Quarterly. He is a fellow of the IEEE. In 1988 he was elected to the National Academy of Engineering.

5TH IEEE MEDITERRANEAN CONFERENCE ON CONTROL AND SYSTEMS

PROGRAM AT A GLANCE

MONDAY Plenary Talk: Sanjoy Mitter Logic, Mathematical Programming and Hybrid Systems Chariot 8:20am				
Track	1	2	3	4
Room	Chariot	Apollo	Zeus	Lindos
MA 10:00 to 12:00	MA1 Hybrid Systems	MA2 Stochastic Systems	MA3 Modeling Estimation and Control of Infinite Dimens. Systems I	MA4 Digital Signal Process. I
MP 1:30 to 4:30	MP1 Discrete Event Systems	MP2 Nonlinear and Stochastic Control: Theory and Applic.	MP3 Modeling Estimation and Control of Infinite Dimens. Systems II	MP4 Control of Automot. Engines and Drivelines

5TH IEEE MEDITERRANEAN CONFERENCE ON CONTROL AND SYSTEMS

PROGRAM AT A GLANCE

TUESDAY				
Track	1	2	3	4
Room	Chariot	Apollo	Zeus	Lindos
TA 9:00 to 12:30	TA1 Intelligent Systems	TA2 Robust Systems I	TA3 Modeling Estimation and Control of Infinite Dimens. Systems III	TA4 Mobile Robots
TP 1:30 to 4:30	TP1 Max-Algebra	TP2 Robust Systems II	TP3 Linear Systems I	TP4 Robot Control
Evening Gala Taverna Demokritos 8:00 PM				

5th IEEE MEDITERRANEAN CONFERENCE ON CONTROL AND SYSTEMS

PROGRAM AT A GLANCE

WEDNESDAY				
Track	1	2	3	4
Room	Chariot	Apollo	Zeus	Lindos
WA 9:00 to 12:30	WA1 Nonlinear Systems	WA2 Applications	WA3 Linear Systems II	WA4 Automot. Systems
WP 1:30 to 4:30	WP1 Two-Dimens. Systems	WP2 Adaptive Control	WP3 Linear Systems III	WP4 Digital Signal Process. II

5th IEEE MEDITERRANEAN CONFERENCE ON CONTROL AND SYSTEMS

Monday, July 21

Chariot

Opening Remarks
8:20

Plenary Lecture
8:30-9:30

Logic, Mathematical Programming and Hybrid Systems
Sanjoy K. Mitter — Massachusetts Inst. of Tech.

Chair: Theodore E. Djaferis, — Univ. of Massachusetts Amherst
Co-Chair: Petros Ioannou, — Univ. of Southern California

Chariot

MA1
Hybrid Systems
Chair: J. B. Remmel — Sagent Corporation
Chair: C. Panayiotou — Univ. of Massachusetts Amherst

10:00
Automaton Comparison Procedure for the Verification of Hybrid Systems
Wolf Kohn — Sagent Corporation
Jeffrey B. Remmel — Sagent Corporation
Anil Nerode — Cornell Univ.

10:30
A Hybrid Systems Approach to Feedback Control of a Nonholonomic Vehicle
J. Almeida — DEEC Univ. do Porto
F. Lobo Pereira — DEEC Univ. do Porto
J. Borges Sousa — DEEC Univ. do Porto

11:00
Discrete Levels Control of Nonlinear Systems
Photis G. Skiadas — Univ. of Patras
Nick T. Koussoulas — Univ. of Patras

11:30
A Framework for Hybrid Control Design and its Relations with a Class of Fuzzy Control Systems
R. Fiero — Univ. of Texas Arlington
F. L. Lewis — Univ. of Texas Arlington
K. Liu — Univ. of Texas Arlington

Apollo

MA2
Stochastic Systems
Chair: C. D. Charalambous — McGill Univ.
Chair: R. P. Malhame — Ecole Polytech. de Montreal

10:00
Estimation of Hidden Markov Models for Partially Observed Risk Sensitive Control Problems
Bernard Frankpitt — Univ. of Maryland
John Baras — Univ. of Maryland

10:30
Linear Gaussian Quadratic Regulation Under Poisson Distributed Intermittent State Observations
M. Ades — McGill Univ.
P. E. Caines — McGill Univ.
R. P. Malhame — Ecole Polytech. de Montreal

11:00
Finite-Dimensionality of Information States in Optimal Control of Stochastic Systems
Charalambos D. Charalambous — McGill Univ.

11:30
Tracking Changing Stochastic Models via Stochastic Binary Neural Networks
Anthony Burell — Univ. of Alabama
Achilles Kogiantis — Univ. of Southwestern Louisiana
P. Papantoni-Kazakos — Univ. of Alabama

Zeus

MA3

Modeling Estimation and Control of Infinite Dimensional Systems I

Chair: M. A. Demetriou — Worcester Polyt. Inst.
Chair: S. Reich — Technion-Israel Inst. of Tech.
Org: H. T. Banks — North Carolina State Univ.
Org: M.. A. Demetriou — Worcester Polyt. Inst.

10:00
Spay Control
A. El Jai — Univ. of Perpignan

10:30
Estimation and Control of Sample-Data Systems in Infinite Dimensions
Akira Ichikawa — Shizuoka Univ.

11:00
Fault Accommodation of Output-Induced Actuator Failures for a Flexible Beam with Collocated Input and Output
Michael A. Demetriou — Worcester Polyt. Inst.
Marios M. Polycarpou — Univ. of Cincinati

11:30
Sampled Weighted Attraction Control of Distributed Thermal Scan Welding
Charalambos C. Doumanidis — Tufts Univ.

Lindos

MA4

Digital Signal Processing I

Chair: J. A. Stuller — Univ. of Missouri-Rolla
Chair: T. Kasparis — Univ. of Central Florida

10:00
Algorithms for Phase Acquisition for QAM Constellations
Costas N. Georghiades — Texas A & M Univ.

10:30
Maximum Likelihood Estimation of Scale
John A. Stuller — Univ. of Missouri-Rolla

11:00
A Novel BPSK Demodulator Using the Expectation Maximization Algorithm
Takis Kasparis — Univ. of Central Florida
Gregory Powell — Koos Tech. Services

11:30
A New Phase Model for Sinusoidal Coding of Speech Signals
Sassan Ahmadi — Arizona State Univ.
Andreas Spanias — Arizona State Univ.

Chariot

MP1

Discrete Event Systems

Chair: C. G. Cassandras — Boston Univ.
Chair: M. A. Christodoulou — Tech. Univ. of Crete

1:30
Supervisory Control Using Computationally Efficient Linear Techniques: A Tutorial Introduction
John O. Moody — Univ. of Notre Dame
Panos J. Antsaklis — Univ. of Notre Dame

2:00
Dynamic Resource Allocation in Discrete Event Systems
Christos G. Panayiotou — Univ. of Massachusetts Amherst
Christos G. Cassandras — Boston Univ.

2:30
Dynamic Neural Networks for Real-Time Manufacturing Cell Scheduling
George A. Rovithakis — Tech. Univ. of Crete
Vassilis I. Gaganis — Tech. Univ. of Crete
Stelios E. Perrakis — Tech. Univ. of Crete
Manolis A. Christodoulou — Tech. Univ. of Crete

3:00
A State Reconstruction Algorithm for Parameter Dependent Discrete Event Dynamic Systems
Francesco Martinelli — Univ. di Roma Tor Vergata
Salvatore Nicosia — Univ. di Roma Tor Vergata
Paolo Valigi — Univ. di Roma Tor Vergata

3:30
A Model for Two-stage Manufacturing Systems
Wai Ki Ching — Hong Kong Polyt. Univ.

Apollo

MP2

Nonlinear and Stochastic Control: Theory and Application

Chair: A. Lindquist — Royal Inst. of Tech.
Chair: C. F. Martin — Texas Tech Univ.
Org: A. Lindquist — Royal Inst. of Tech.
Org: C. F. Martin — Texas Tech Univ.

1:30
Dynamic Vision and Estimation Theory on Spheres
Giorgio Picci — Univ. di Padova

2:00
Generalized Wiener-Hopf Factorization of Discrete-Time All-Pass Functions
Gyorgy Michaletzky — Eotvos Lorand Univ.

2:30
Observers for Systems with Implicit Output
A. Matveev — St. Petersburg Univ.
X. Hu — Royal Inst. of Tech.
R. Frezza — Univ. di Padova

3:00
On the Covariance Extension Problem
Christopher I. Byrnes — Washington Univ.
Anders Lindquist — Royal Inst. of Tech.

3:30
Cross-Ratio Dynamics and its Applications to Calibration Free Motion Estimation
Bijoy K. Ghosh — Washington Univ.

4:00
Control of the Planar Rotation in Human Head-Eye-Coordination
Mangus Egerstedt — Royal Inst. of Tech.
Clyde F. Martin — Texas Tech Univ.

Zeus

MP3

Modeling Estimation and Control of Infinite Dimensional Systems II

Chair: C. D. Charalambous — McGill Univ.
Chair: S. Reich — Technion-Israel Inst. of Tech.
Org: H. T. Banks — North Carolina State Univ.
Org: M. A. Demetriou — Worcester Polyt. Inst.

1:30
Inverse Problems for Nonautonomous Nonlinear Distributed Parameter Systems
A. S. Ackleh — Univ. of Southwestern Louisiana
S. Reich — Technion-Israel Inst. of Tech.

2:00
A Conservative Spectral Element Method for the Approximation of Compressible Fluid Flow
Kelly Black — Univ. of New Hampshire

2:30
Adaptive Identification of Distributed Parameter Systems
Yuri Orlov — CICESE
Joseph Bentsman — Univ. of Illinois Urbana-Champaign

3:00
Parameter Estimation in a Nonlinear Structured Tree Population Model with Self Shading Effects
A. S. Ackleh — Univ. of Southwestern Louisiana

Lindos

MP4

Control of Automotive Engines and Drivelines

Chair: H. P. Geering — ETH Swiss Fed. Inst. of Tech.
Chair: L. Guzzella — ETH Swiss Fed. Inst. of Tech.
Org: H. P. Geering — ETH Swiss Fed. Inst. of Tech.
Org: L. Guzzella — ETH Swiss Fed. Inst. of Tech.

1:30
Automated Design of an Air/Fuel Controller for an SI Engine Considering the Three-way Catalytic Converter in the Hinf Approach
C. A. Roduner — ETH Swiss Fed. Inst. of Tech.
C. H. Onder — ETH Swiss Fed. Inst. of Tech.
Hans. P. Geering — ETH Swiss Fed. Inst. of Tech.

2:00
Feedback Linearization of a Multi-Input SI-Engine System for Idle Speed Control
R. Pfiffner — ETH Swiss Fed. Inst. of Tech.
Lino. Guzzella — ETH Swiss Fed. Inst. of Tech.

2:30
Influence of Manifold Pressure Pulsation to Mean Value Models in Air-to-Fuel Ratio Control
M. Scherer — Daimler-Benz AG
C. Arndt — Univ. of Siegen
O. Loffeld — Univ. of Siegen

3:00
Modelling Internal Combustion Engines via Identification Techniques
R. Scattolini — Univ. di Pavia
G. De Nicolao — Univ. di Pavia
M. Cittadini — Univ. di Pavia
C. Rossi — Magneti Marelli SpA
C. Siviero — Magneti Marelli SpA

3:30
Identification of Emission Models in a Spark Ignition Engine for Control Applications
I. Arsie — Univ. di Salerno
C. Pianese — Univ. di Salerno
G. Rizzo — Univ. di Salerno

4:00
Advanced System Design and Control Aspects in a Fuel-Optimal Hybrid Vehicle
E. Shafai — ETH Swiss Fed. Inst. of Tech.
P. Dietrich — ETH Swiss Fed. Inst. of Tech.
C. Wittmer — ETH Swiss Fed. Inst. of Tech.
S. Ginsburg — ETH Swiss Fed. Inst. of Tech.

5th IEEE MED
Tuesday, July 22

Chariot

TA1
Intelligent Systems

Chair: K. P. Valavanis — Univ. of Southwestern Louisiana
Chair: P. P. Groumpos — Univ. of Patras

9:00
A State Configured Sensor Based Control Architecture for an Autonomous Underwater Vehicle
Georgios. A. Demetriou — Univ. of Southwestern Louisiana
Kimon P. Valavanis — Univ. of Southwestern Louisiana

9:30
The Use of Fuzzy Cognitive Maps in Modeling Systems
Chrysostomos D. Stylios — Univ. of Patras
Voula C. Georgopoulos — Ohio Univ.
Peter P. Groumpos — Univ. of Patras

10:00
Fuzzy Linear Programming and Simulated Annealing
Rita Almeida Ribeiro — Univ. Nova Lisboa
Fernando Moura Pires — Univ. Nova Lisboa

10:30
State Estimation in Presence of Disturbance Using Neural Networks
B. Gaddouna Ouladsine — Univ. Henri Poincare
Gerard Bloch — Univ. Henri Poincare

11:00
On-Line Neural Network Algorithm for the Constrained Motion Planning of Redundant Manipulators
A. Ramdane-Cherif — Univ. P. & M. Curie
D. Y. Meddah — Univ. P. & M. Curie
V. Perdereau — Univ. P. & M. Curie
M. Drouin — Univ. P. & M. Curie

11:30
On the Selection of Nodes in Linear-in-the-Weight Neural Networks
Elias B. Kosmatopoulos — Univ. of Southern California
Nikitas J. Dimopoulos — Univ. of Victoria

12:00
A Simplex Trained Neural Network-Based Architecture for Sensor Fusion and Tracking of Target Maneuvers
Yee Chin Wong — Univ. of Arizona
Malur K. Sundareshan — Univ. of Arizona

Apollo

TA2

Robust Systems I

Chair: A. H. Sayed — Univ. of California Los Angeles
Chair: M. Karkoub — Kuwait Univ.

9:00
The Finite Inclusions Theorem: A Tool for Robust Design
Theodore E. Djaferis — Univ. of Massachusetts Amherst

9:30
Every Mode Stabilization of Jump Linear Systems via LMIs
M. Ait Rami — Ecole Nat. Sup. de Tech. Avancees

10:00
Robust Diagonal Stabilization and Finite Precision Problem: An LMI Approach
Stephane Dussy — Ecole Nat. Sup. de Tech. Avancees

10:30
Robust Quasi NID Aircraft 3D Fight Control Under Sensor Noise
Marian J. Blachuta — Silesian Tech. Univ.
Valery D. Yurkevich — Novosibirsk State Tech. Univ.
Konrad Wojciechowski — Silesian Tech. Univ.

11:00
Modeling And mu-Synthesis Robust Control of Two-Link Flexible Manipulators
Mansour Karkoub — Kuwait Univ.
Kumar Tamma — Univ. of Minnesota

11:30
Exponentially-Weighted Iterative Solutions for Worst-Case Parameter Estimation
Ali H. Sayed — Univ. of California Los Angeles
Andrea Garulli — Univ. di Siena
V. Nascimento — Univ. of California Los Angeles
S. Chandrasekaran — Univ. of California Santa Barbara

12:00
Some Issues on Robust Control for Nonlinear Systems
Michael Athans — Massachusetts Inst. of Tech.
Alan Chao — Massachusetts Inst. of Tech.

Zeus

TA3

Modeling Estimation and Control of Infinite Dimensional Systems III

Chair: C. D. Charalambous — McGill Univ.
Chair: S. Reich — Technion-Israel Inst. of Tech.
Org: H. T. Banks — North Carolina State Univ.
Org: M. A. Demetriou — Worcester Polyt. Inst.

9:00
Optimal Location of Actuators for an Active Noise Control Problem
F. Fahroo — Naval Postgraduate School

9:30
Minimax Hinf Control of Stable Distributed Systems
O. Staffans — Abo Akademi Univ.

10:00
Conditional Moment Generating Functions for Integrals and Stochastic Integrals: Maximum-Likelihood Estimation
Charalambos. D. Charalambous — McGill Univ.

10:30
Ergodic Boundary Control of Semilinear Systems
T. E. Duncan — Univ. of Kansas

Lindos

TA4

Mobile Robots

Chair: P. Valigi — Univ. di Roma Tor Vergata
Chair: T. Hamel — Univ. De Tech. De Compiegne

9:00
A Robust-Adaptive Locomotion Controller for 9-Link Bipeds with Rapidly Varying Unknown Parameters
S. G. Tzafestas — National Tech. Univ. Athens
A. E. Krikochoritis — National Tech. Univ. Athens
C. S. Tzafestas — Univ. P. & M. Curie

9:30
An Assessment of Fuzzy Logic for Collision Avoidance in a Multiple Autonomous Mobile Robot System
Chris G. Dodds — The Univ. of Western Australia
Albert Y. Zomaya — The Univ. of Western Australia

10:00
Steering of a Robotic Snake
K. Sarrigeorgides — National Tech. Univ. Athens
K. J. Kyriakopoulos — National Tech. Univ. Athens

10:30
Motion Planning for Drift-Free Nonholonomic Systems Under a Discrete Levels Control Constraint
Photis G. Skiadas — Univ. of Patras
Nick T. Koussoulas — Univ. of Patras

11:00
Dynamic Modelling of a Tricycle Mobile Robot
Andre Kamga — Univ. de Picardie Jules Verne

11:30
A Navigation System With Self-Localization Capabilities for an Autonomous Mobile Robot
Alain Betourne — Univ. di Roma Tor Vergata
Alessandro Fefe — Univ. di Roma Tor Vergata
Salvatore Nicosia — Univ. di Roma Tor Vergata
Paolo Valigi — Univ. di Roma Tor Vergata

12:00
Practical Stability for Path-Following: A New Control Algorithm for Mobile Robots
T. Hamel — Univ. de Tech. de Compiegne
P. Soueres — LAAS-CNRS
D. Meizel — Univ. de Tech. de Compiegne

Chariot

TP1

Max-Algebra

Chair: Y. Wardi — Georgia Inst. of Tech.
Chair: E. W. Kamen — Georgia Inst. of Tech.
Org: E. Wagneur — IRCyN/Ecole des Moines de Nantes

1:30
Linear Projectors in the Max-Plus Algebra
Guy Cohen — INRIA
Stephane Gaubert — INRIA
Jean-Piere Quadrat — INRIA

2:00
Equivalence Classes of Rank-3 Matrices in the Max-Algebra
Jean-Michel Prou — IRCyN/Ecole des Moines de Nantes
Edouard Wagneur — IRCyN/Ecole des Moines de Nantes

2:30
Control Synthesis Approaches Using the State Equations and the ARMA Model in Timed Event Graphs
Philippe Declerck — ISTIA

3:00
Dynamic Control of Kanban System Over Dioid Algebra
B. Cottenceau — LISA
L. Hardouin — LISA
J.-L. Boimond — LISA

3:30
Reachability and Observability of Linear Systems Over Max-Plus
M. J. Gazarik — Georgia Inst. of Tech.
Edward. W. Kamen — Georgia Inst. of Tech.

4:00
Controllability in the Max-Algebra
Jean-Michel Prou — IRCyN/Ecole des Moines de Nantes
Edouard Wagneur — IRCyN/Ecole des Moines de Nantes

4:30
Nonexpansive Maps and Option Pricing Theory
Vassili Kolokoltsov — Nottingham Trent Univ.

Apollo

TP2

Robust Systems II

Chair: R. Hernandez-Berlinches — UNED
Chair: E. Zeheb — Technion-Israel Inst. of Tech.

1:30
Robust Stability Analysis of GPC: An Application to Dead-Beat and Mean-Level Predictive Controllers
Roberto Hernandez-Berlinches — UNED

2:00
Robust Stability of Non-Linear Time Varying Systems
Ezra Zeheb — Technion-Israel Inst. of Tech.

2:30
Constrained Stabilization of a Dynamic System: A Case Study
Franco Blanchini — Univ. degli Studi di Udine
S. Cotterli — Eurotech
G. Koruza — Univ. degli Studi di Udine
S. Miani — Univ. degli Studi di Padova
R. Siagri — Eurotech
L. Tubaro — Univ. degli Studi di Udine

3:00
Robust and Reliable Hinf Output Feedback Control for Linear Systems With Parameter Uncertainty and Actuator Failure
Chang-Jun Seo — Inje Univ.
Byung Kook Kim — KAIST

3:30
Quadratic Stabilizability of Uncertain Continuous-Time Systems Under State and Control Constraints in the Presence of Disturbances
H. X. de Araujo — LAAS-CNRS
I. Queinnec — LAAS-CNRS
S. Tarbouriech — LAAS-CNRS

4:00
Delay-Dependent Robust Stability Tests and Decay Estimates for Systems With Input Delays
Kostas Hrissagis — Univ. of Florida, Gainsville
Olga I. Kosmidou — Democritus Univ. of Thrace

Zeus

TP3

Linear Systems I

Chair: M. Sebek — Inst. of Inform. Theory and Autom.
Chair: C. N. Hadjicostis — Massachusetts Inst. of Tech.

1:30
Transfer Function Equivalence of Feedback/Feedforward Compensators
Vladimir Kucera — Academy of Sciences of the Czech Rep.

2:00
Numerical Operations Among Rational Matrices: Standard Techniques and Interpolation
P. Husek — Inst. of Inform. Theory and Autom.
Michael. Sebek — Inst. of Inform. Theory and Autom.
J. Stecha — Inst. of Inform. Theory and Autom.

2:30
Design of Fault-Tolerant LTI State-Space Systems
C. N. Hadjicostis — Massachusetts Inst. of Tech.
G. C. Verghese — Massachusetts Inst. of Tech.

3:00
An Integrated Framework for Input, Output and Control Structure Selection: Advanced Control Diagnostics
N. Karcanias — City Univ.
J. Leventides — City Univ.
E. Milonidis — City Univ.

3:30
System Zeros Analysis via SVD of the First Nonzero Markov Parameter and the Kalman Decomposition Theorem
Jerzy Tokarzewski — Military Univ. of Tech. Poland

4:00
Constrained Controllability of Dynamical Systems
Jerzy Klamka — Tech. Univ. Poland

Lindos

TP4

Robot Control

Chair: A. Tornambe — Terza Univ. di Roma
Chair: P. S. Shiakolas — Univ. of Texas Arlington

1:30
Global Asymptotic Stabilisation of an Active Mass Damper for a Flexible Beam
Laura. Menini — Univ. di Roma Tor Vergata
Antonio. Tornambe — Terza Univ. di Roma
L. Zaccarian — Terza Univ. di Roma

2:00
Variable Structure Control of a Robotic Assistance System
M. L. Corradini — Univ. di Ancona
T. Leo — Univ. di Ancona
G. Orlando — Univ. di Ancona

2:30
Control of Robot Manipulators Using CMAC Neural Networks
S. Commuri — CGN & Associates
S. Jagannathan — Automated Analysis Corp.
F. L. Lewis — Univ. of Texas at Arlington

3:00
On the Development of a Quick Connect Disconnect Coupler for Rapidly Configured Modular Robots
P. S. Shiakolas — Univ. of Texas Arlington
T. W. Sharpe — Univ. of Texas Arlington
T. J. Lawley — Univ. of Texas Arlington

3:30
Robot Control Using a Sliding Mode
M. Belhocine — Centre de Dev. des Tech. Avances
M. Hamerlain — Centre de Dev. des Tech. Avances
K. Bouyoucef — Centre de Dev. des Tech. Avances

5th IEEE MED
Wednesday, July 23

Chariot

WA1
Nonlinear Systems

Chair: J. S. Shamma — Univ. of Texas Austin
Chair: M. M. Polycarpou — Univ. of Cincinnati

9:00
Set-Valued State Observers for Nonlinear Systems
Jeff S. Shamma — Univ. of Texas Austin
Kuang-Yang Tu — Univ. of Texas Austin

9:30
State Observers for Nonlinear Systems With Smooth/Bounded Input
A. Germani — Univ. degli studi dell Aquila
C. Manes — Univ. degli studi dell Aquila

10:00
Parameter Identification of Nonlinear Systems With Known Structure
Alessandro Astolfi — Imperial College
J. J. Milek — ETH Swiss Fed. Inst. of Tech.
F. J. Kraus — ETH Swiss Fed. Inst. of Tech.

10:30
Design and Analysis of Incipient Fault Diagnosis Schemes Using On-Line Approximators
Marios M. Polycarpou — Univ. of Cincinnati
Michael A. Demetriou — Worcester Polyt. Inst.

11:00
On Feedback Linearization Solution
M. Hou — Loughborough Univ.
A. C. Pugh — Loughborough Univ.

11:30
On Singular Phenomena in Certain Time-Optimal Feedback System Operating by Discontinuous Resistance
Wladyslaw Hejmo — Cracow Univ. of Tech.

12:00
Emergency Control of Unstable Behavior of Nonlinear Systems Induced by Fault
Mark A. Pinsky — Univ. of Nevada Reno
Michael V. Basin — Univ. of Nevada Reno

Apollo

WA2
Applications

Chair: N. Denis — Univ. of Massachusetts Amherst
Chair: C. Vaucoret — ENSICA/DFR/AS

9:00
A Symbolic Sensor for an Antilock Brake System of a Commercial Aircraft
B. Ewers — ENSICA/DFR/AS
J. Bordeneuve-Guibe — ENSICA/DFR/AS
Corinne Langlois — Aerospatiale

9:30
Multivariable Predictive Controller for a Test Stand of Air Conditioning
Cyril Vaucoret — ENSICA/DFR/AS
Joel Bordeneuve-Guibe — ENSICA/DFR/AS

10:00
Hinf Control Design For an Adaptive Optics System
Nikolaos Denis — Univ. of Massachusetts Amherst
Douglas. Looze — Univ. of Massachusetts Amherst
Jim Huang — Alphatech
David Castanon — Boston Univ.

10:30
Optimal Fixture Design for Drilling in Elastically Deforming Plates
K. Wardak — Univ. of Maryland BC
U. Tasch — Univ. of Maryland BC
P. G. Charalambides — Univ. of Maryland BC

11:00
Development of Mold Level Controller Using Sliding Mode Control in a Continuous Casting Processing
Seung Ryeol Yoo — Tech. Research Lab. POSCO
Young Seub Kueon — Tech. Research Lab. POSCO

11:30
Modeling and Simulation of a Blood Pump for Controller Development
Yih-Choung Yu — Univ. of Pittsburgh
James F. Antaki — Univ. of Pittsburgh
J. Robert Boston — Univ. of Pittsburgh
Marwan Simaan — Univ. of Pittsburgh
Phil J. Miller — Baxter Healthcare

12:00
The Control and Structures Research Laboratory (CSRL): A Control-Oriented Test-Bed for Large Segmented Reflectors
Majdedin Mirmirani — California State Univ. Los Angeles
Helen R. Boussalis — California State Univ. Los Angeles
Khosrow Rad — California State Univ. Los Angeles
Mohiuddin Ahmed — California State Univ. Los Angeles
Anastasios Chassiakos — California State Univ. Long Beach
Petros Ioannou — Univ. of Southern California
Elias Kosmatopoulos — Univ. of Southern California

Zeus

WA3
Linear Systems II

Chair: P. G. Voulgaris — Univ. of Illinois Urbana-Champaign
Chair: B. Kouvaritakis — Univ. of Oxford

9:00
l1-Optimal Control for Multirate Systems Under Full State Feedback
Johannes Aubrecht — Univ. of Illinois Urbana-Champaign
Petros G. Voulgaris — Univ. of Illinois Urbana-Champaign

9:30
Ellipsoidal Bounding in Stable Predictive Control
M. Cannon — Univ. of Oxford
B. Kouvaritakis — Univ. of Oxford

10:00
Constrained Stable Predictive Control: An l2-Optimal Approach
B. Kouvaritakis — Univ. of Oxford
J. A. Rossiter — Loughborough Univ.
M. Cannon — Univ. of Oxford

10:30
The Performance of Generalized Minimum Variance System Identification
Odell R. Reynolds — Air Force Inst. of Techn.
Meir Pachter — Air Force Inst. of Techn.

11:00
Weighted Hinf Mixed-Sensitivity Minimization for Stable Distributed Parameter Plants Under Sample-Data Control
Delano R. Carter — Arizona State Univ.
Armando A. Rodriguez — Arizona State Univ.

11:30
On Sample-Data Control Systems With Discontinuous Output
Marian J. Blachuta — Silesian Tech. Univ.

Lindos

WA4
Automotive Systems

Chair: P. Ioannou — Univ. of Southern California
Chair: R. Majjad — Univ. of Karslruhe

9:00
Macroscopic Traffic Flow Modeling of Automated Highway Systems
H. Raza — Univ. of Southern California
Petros. Ioannou — Univ. of Southern California

9:30
Robust Prevention of Limit Cycles for Robustly Decoupled Car Steering Dynamics
Juergen Ackermann — DLR
Tilman Buente — DLR

10:00
Modular Design for the Computation of Vehicle Dynamic Behavior
R. Majjad — Univ. of Karslruhe
U. Kiencke — Univ. of Karslruhe

10:30
Identification of Parameters for Complex Vehicle Models
R. Majjad — Univ. of Karslruhe
M. Hafner — Univ. of Karslruhe

11:00
Application Car Dynamics Model
Said. Bentalba — Univ. de Picardie-Jules Verne
A. El Hajjaji — Univ. de Picardie-Jules Verne
A. Rachid — Univ. de Picardie-Jules Verne

11:30
Sliding Mode Control of a Turbocharged Diesel Engine
S. Ouenou-Gamo — Univ. de Picardie Jules Verne
A. Benchaib — Univ. de Picardie Jules Verne
A. Rachid — Univ. de Picardie Jules Verne
M. Ouladsine — Univ. de Picardie Jules Verne

Chariot

WP1

Two-Dimensional Systems

Chair: N. E. Mastorakis — Hellenic Naval Academy
Chair: N. Denis — Univ. of Massachusetts Amherst

1:30
A New Method for Computing the Stability Margin for Two-Dimensional Systems
Nikos E. Mastorakis — Hellenic Naval Academy

2:00
New Stability Test for 2-D Systems
Nikos E. Mastorakis — Hellenic Naval Academy

2:30
Reachability and Minimum Energy Control of Nonnegative 2-D Roesser Type Models
Tadeusz Kaczorek — Warsaw Univ. of Tech.

3:00
Some Results on the Dynamics of 2D Positive Systems
Ettore Fornasini — Univ. di Padova
Maria Elena Valcher — Univ. di Padova

Apollo

WP2

Adaptive Control

Chair: I. Kanellakopoulos — Univ. of California Los Angeles
Chair: R. L. Kosut — SC Solutions

1:30
Adaptive Control of Discrete-Time Output-Feedback Nonlinear Systems
Jiaxiang Zhao — Univ. of California Los Angeles
Ioannis Kanellakopoulos — Univ. of California Los Angeles

2:00
An Uncertainty Model Validation Approach to Adaptive Robust Linear Control
Robert L. Kosut — SC Solutions

2:30
Application of a Multivariable Adaptive Controller With PID Structure to a Wastewater Treatment Plant With D-N Configuration
A. M. Macarulla — CEIT
J. Florez — CEIT
J. X. Ostolaza — CEIT
E. Ayesa — CEIT

3:00
Adaptive Variable Structure Control of Robot Manipulators With Exponentially Stable Trajectories
Hongnian Yu — Liverpool John Moores Univ.

Zeus

WP3

Linear Systems III

Chair: V. L. Syrmos — Univ. of Hawaii Manoa
Chair: R. Drai — Ecole des Mines de Paris

1:30
Normalized Coprime Factorizations for Discrete-Time Periodic Systems
Baohui Xie — Univ. of Hawaii Manoa
Vassilis L. Syrmos — Univ. of Hawaii Manoa

2:00
The Tracking and Regulation Problem for a Class of Generalised Systems
Antonio Tornambe — Terza Univ. di Roma

2:30
Dynamic Output Feedback Stabilization for a Class of Saturated Linear Systems
M. Klai — IGE
Y. Ait-Amirat — IGE

3:00
Stabilization Independent of Delay for Saturated Linear Systems
M. Klai — IGE
Y. Ait-Amirat — IGE

3:30
Design of L. Q. G. Dissipative Controllers Using Linear Matrix Inequalities
Remi Drai — Ecole des Mines de Paris

Lindos

WP4

Digital Signal Processing II

Chair: C. N. Georghiades — Texas A & M Univ.
Chair: A. Spanias — Arizona State Univ.

1:30
An Application of the EM Algorithm to Sequence Estimation in the Presence of Tone Interference
Quan G. Zhang — Texas A & M Univ.
Costas N. Georghiades — Texas A & M Univ.

2:00
A Non-Linear Filtering Algorithm for the Measurement of Rainfall Drop Size Distribution
Takis Kasparis — Univ. of Central Florida
John Lane — Univ. of Central Florida

2:30
Invariant Line Matching of Consecutive Images
Djemaa Kachi — Univ. de Tech. de Compiegne
Xiao-Wei Tu — Univ. de Tech. de Compiegne

MA1 Hybrid Systems

MA1-1

Automation Comparison Procedure for the Verification of Hybrid Systems

Wolf Kohn, Jeffrey B. Remmel, Anil Nerode

Abstract

This paper describes on-going research on a procedure for the verification of Hybrid System Controllers implemented with the Kohn-Nerode extraction procedure, [8, 10, 12], implemented by the Multiple Agent Hybrid Control Architecture (MAHCA) [11]. It is an automated static verification technique based on the construction of an Intersection Unification Automaton (IUA). Given a hybrid system controller generated by a MAHCA agent and a set of control specifications for its desired behavior, the proposed verification procedure builds an IUA constructed by an automata operation on two inference automata: the automaton encoding the specifications and the control automaton constructed by the inferencer of the agent [11]. The ultimate goal of our research is to develop a verification procedure to verify a MAHCA distributed implementation to a set of global requirement specifications. In this paper we discuss an essential step, namely a procedure to verify that the controller design generated by an agent in MAHCA meets the requirements established for that agent. The paper describes the functionality of the procedure and illustrates it with an example.

MA1 Hybrid Systems

MA1-2

A Hybrid System Approach to Feedback Control of a Nonholonomic Vehicle

J. Almeida, F. Lobo Pereira, J. Borges Sousa

Abstract

This paper addresses the design of a hybrid feedback control system enabling a car-like, rectangular vehicle to perform a tight L-shaped turn maneuver. This case constitutes an effort towards the definition of a general purpose methodology for hybrid feedback control synthesis. The design effort encompasses the synthesis of a set of modalities and mechanisms to detect relevant events enabling the overall motion coordination so that a global goal is attempted. Simulations of the implemented controller have shown a strong robustness with respect to modeling uncertainty and execution errors.

MA1 Hybrid Systems

MA1-3

Discrete Levels Control of Nonlinear Systems

Photis G. Skiadas, Nick T. Koussoulas

Abstract

We study an interesting issue arising in digital implementation and hybrid control systems frameworks, namely what are the basic characteristics of the behavior of a nonlinear dynamic system when it is driven by input that can assume only discrete levels. In particular, we focus on the controllability of nilpotent systems with and without drift, whose inputs take values in a finite discrete level set. In both cases, we prove that the constrained system and the corresponding unconstrained system have the same accessibility and controllability properties. An application of these results in motion planning for nonholonomic systems appears in a companion paper.

MA1 Hybrid Systems

MA1-4

A Framework for Hybrid Control Design and its Relations with a Class of Fuzzy Logic Control Systems

R. Fierro, F. L. Lewis, K. Liu

Abstract

This paper presents a Hybrid System Framework which considers simultaneously the lower-level control and decision-making issues. This reconfigurable framework can accommodate a wide range of situations, from aircraft control systems to mobile manipulators. A continuous-state plant is supervised by a discrete-event system which is based on a theory of linked finite state machines. The composite system is viewed as an iterative process where a task is carried out by changing the structure of the continuous-state plant. An application of this framework is illustrated through a mobile manipulator example. Finally, some connections between hybrid systems and a class of fuzzy logic control systems are established.

MA2 Stochastic Systems

MA2-1

Estimation of Hidden Markov Models for Partially Observed Risk Sensitive Control Problems

Bernard Frankpitt, John Baras

MA2 Stochastic Systems

MA2-2

Linear Gaussian Quadratic Regulation under Poisson Distributed Intermittent State Observations

M. Ades, P. E. Caines, R. P. Malhame

MA2 Stochastic Systems

MA2-3

Finite-Dimensionality of Information States in Optimal Control of Stochastic Systems

Charalambos D. Charalambous

Abstract

This paper is concerned with partially observed stochastic optimal control problems. The state of the system is described by a nonlinear controlled diffusion equation. The measurement are noisy linear combinations of the state, and the rate of change of the sate of the system. Explicit representations for the information state are derived in terms of a finite-number of sufficient statistics. This allows application of Wonham's classical separation theorem.

MA2 Stochastic Systems

MA2-4

Tracking Changing Stochastic Models via Stochastic Binary Neural Networks

Anthony Burrell, Achilles Kogiantis, P. Papantoni-Kazakos

Abstract

We consider a sequential algorithm that detects changes from an acting stochastic model to any one of a number of alternatives. We adopt discrete approximations of the stochastic models and we propose the deployment of stochastic binary neural networks which are pretrained to produce the appropriate statistical measures associated with these models. The pretraining is implemented by a backpropogating supervised learning algorithm of stochastic approximation nature which converges almost surely under general conditions. The overall system performance is discussed and some numerical results are presented.

MA3 Modeling Estimation and Control of Infinite Dimensional Systems I

MA3-1

Spray Control

A. El Jai

MA3 Modeling Estimation and Control of Infinite Dimensional Systems I

MA3-2

Estimation and Control of Sample-Data Systems in Infinite Dimensions

Akira Ichikawa

MA3 Modeling Estimation and Control of Infinite Dimensional Systems I

MA3-3

Fault Accommodation of Output-Induced Actuator Failures for a Flexible Beam with Collocated Input and Output

Michael A. Demetriou, Marios M. Polycarpou

Abstract

In this note, we propose a nonlinear on-line parameter estimation method that utilizes neural network-based approximators for detecting changes due to actuator faults in a class of structured dynamical systems. The plant considered here is a cantilevered beam actuated via a pair of piezoceramic patches. We examine changes in the control input term, which provide a simple and practical model of actuator failures. Using Lyapunov redesign methods, a stable learning scheme is utilized in a control reconfiguration in order to accommodate the system's actuator failure. A numerical algorithm is provided for the implementation of the detection and accommodation scheme and simulation studies are used to illustrate the applicability of the theoretical results.

MA3 Modeling Estimation and Control of Infinite Dimensional Systems I

MA3-4

Sampled Weighted Attraction Control of Distributed Thermal Scan Welding

Charalambos C. Doumanidis

MA4 Digital Signal Processing I

MA4-1

Algorithms for Phase Acquisition for QAM Constellations

Costas N. Georghiades

Abstract

Because of their relatively good performance, large QAM constellations are being used in many current communication applications. One of the problems associated with the use of large QAM constellations is that of carrier acquisition, which for efficiency reasons must often be done without the use of preamble. The problem is further complicated for cross constellations, for which the high SNR corner points used by some simple carrier phase estimators are not available. In this paper we derive simple algorithms for carrier phase acquisition that can be used for both square and cross constellations, and compare their performance to that of the 4-th power estimator. The introduced algorithms convert the problem of carrier phase estimation into one of estimating the mode of an underlying distribution.

MA3 Modeling Estimation and Control of Infinite Dimensional Systems I

MA4-2

Maximum Likelihood Estimation of Scale

John A. Stuller

Abstract

This paper introduces the solution to the problem of maximum likelihood (ML) scale estimation. The result is obtained using coupled Karhunen-Loeve expansions, which were recently introduced in [1-3] to solve the problem of ML displacement (or time delay) estimation. The coupled Karhunen-Loeve expansions lead directly to intuitively reasonable signal processors associated with ML displacement and ML scale estimation. Simulations results that demonstrate the performance of ML scale estimation are included in this paper.

MA4-3

A Novel BPSK Demodulator Using the Expectation Maximization Algorithm

Takis Kasparis, Gregory Powel

Abstract

A novel coherent demodulator is proposed which utilizes the expectation-maximization (EM) algorithm for carrier phase recovery. The EM algorithm is feed-forward, and therefore produces no carrier phase error to be fed back to the down conversion process. The algorithm produces a maximum likelihood estimate of the modulating bit sequence, given the received in-phase and quadrature-phase data. Previously, the EM algorithm has been used to demodulate Binary Phase Shift Keying (BPSK) modulated signals, but assumed perfect symbol synchronization. This work combines the EM algorithm with a symbol timing estimation (TE) algorithm to produce a complete BPSK demodulator. The results of the TE algorithm are used to control a polyphase matched filter, which performs root-raised cosine matched filtering as well as symbol timing correction. Simulation results show that the proposed demodulator performs within 1 dB of theory, given constant carrier phase error and/or constant symbol timing error. The demodulation performs within 0.75 dB of theory given a carrier frequency offset of 1.5% of the symbol rate.

MA3 Modeling Estimation and Control of Infinite Dimensional Systems I

MA4-4

A New Phase Model for Sinusoidal Transform Coding of Speech Signals

Sassan Ahmadi, Andreas S. Spanias

Abstract

A new phase modeling algorithm for sinusoidal analysis/synthesis of speech is presented. Short-time sinusoidal phases are approximated using a combination of linear prediction, spectral sampling, delay compensation and phase correction techniques. The algorithm is different than phase compensation methods proposed for source-system LPC in that it has been optimized for sinusoidal representation of speech. Performance analysis on a large speech database indicates considerable improvement subjective quality of the reconstructed speech. The extra parameter used for representation of the sine wave phases require a small number of bits. The method can be applied to enhance phase matching in low-bit rate sinusoidal coders, where underlying sine wave amplitudes are extracted from an all-pole model.

MP1 Discrete Event Systems

MP1-1

Supervisory Control Using Computationally Efficient Linear Techniques: A Tutorial Introduction

John O. Moody, Panos J. Antsaklis

Abstract

This paper provides an overview of a computationally efficient method for synthesizing supervisory controllers for discrete event systems (DES). The DES plant and controller are described by Petri nets which provide a useful linear algebraic model for both control analysis and synthesis. It is shown how a set of linear constraints on the plant's behavior can be enforced, accounting for possibly uncontrollable or unobservable transitions in the plant net, using techniques from Petri net theory, integer programming, and linear systems. The paper is written as a tutorial introduction to the approach. Several results here have been reported elsewhere in the literature.

MP1 Discrete Event Systems

MP1-2

Dynamic Resource Allocation in Discrete Event Systems

Christos G. Panayiotou, Christos G. Cassandras

Abstract

In this paper we develop a controller for dynamic resource allocation in Discrete Event Systems (DES) operating in a stochastic environment. The controller's objective is to allocate a finite number of discrete resources to a set of users so as to achieve optimal systems performance. The derived controller uses concurrent estimation, a sample path constructability technique for DES, to obtain estimates of the system's performance under a set of hypothetical parameter settings using only information observed from the real system. Subsequently, these estimates are used by an on-line algorithm which reallocates the resources among the various users to achieve our objective. An application to a buffer allocation problem is included along with explicit numerical results illustrating the use of this dynamic allocation scheme.

MP1 Discrete Event Systems

MP1-3

Dynamic Neural Networks for Real-Time Manufacturing Cell Scheduling

George A. Rovithakis, Vassilis I. Gaganis, Stelios E. Perrakis, Manolis A. Christodoulou

Abstract

In this paper, a control aspect of the non-acyclic FMS scheduling problem is considered. Based on a dynamic neural network model derived herein, an adaptive, continuous time neural network controller is constructed. The actual dispatching times are determined from the continuous control input discretization. The controller is capable of driving system production to the required demand and guaranteeing system stability and boundedness of all signals in the closed loop system. Modeling errors and discretization effects are taken into account thus rendering the controller robust. A case demonstrates the efficiency of the proposed technique.

MP1 Discrete Event Systems

MP1-4

A State Reconstruction Algorithm for Parameter Dependent Discrete Event Dynamic Systems

Francesco Martinelli, Salvatore Nicosia, Paolo Valigi

Abstract

In this paper, the problem of state reconstruction for the class of parameter dependent discrete event systems that can be modeled by means of queuing networks is considered, and a novel solution is proposed, based on the use of data extracted from the observation of a real system. The algorithm allows to accurately reconstruct the state behavior of a queuing network, for values of the parameters of the system different from the nominal ones. The proposed approach has been applied to the on-line control problems for real systems, and a complete control procedure is proposed.

MP1 Discrete Event Systems

MP1-5

A Model for Two-stage Manufacturing Systems

Wai Ki Ching

Abstract

This paper studies a two-stage (two machines in tandem) manufacturing systems under hedging point production policy. The manufacturing system produces one type of product and its demand is modeled as a Poisson process. Each product has to go through the manufacturing process by a reliable machine in each stage. Preconditioned Conjugate Gradient (PCG) method is employed to solve the steady state probability distribution of systems. Preconditioner is constructed by taking circulant approximation of the generator matrix of the system. We prove that the preconditioned linear system has singular values clustered around one when the number of inventory levels tend to infinity. Hence conjugate gradient methods will converge very fast when apply to solving the preconditioned linear system. Numerical examples are given to verify our claim. The average running cost can be written in terms of this probability. By varying different possible values of hedging point h, the optimal value of h which minimizes the average running cost can be obtained. Extension to multiple parallel machines in each stage is also discussed.

MP2 Nonlinear and Stochastic Control: Theory and Application

MP2-1

Dynamic Vision and Estimation Theory on Spheres

Giorgio Picci

MP2 Nonlinear and Stochastic Control: Theory and Application

MP2-2

Generalized Wiener-Hopf Factorization of Discrete-Time All-Pass Functions

Gyorgy Michaletzky

MP2 Nonlinear and Stochastic Control: Theory and Application

MP2-3

Observers for Systems with Implicit Output

A. Matveev, X. Hu, R. Frezza

Abstract

In this paper we consider a system whose output is implicitly defined. The system is assumed to be Lyapunov stable but not asymptotically stable. The problem we consider is to construct a dynamical observer. This system is somehow similar to a linear time-varying system. However, the difference is that the C matrix varies with output here. As far as we know, even for linear time-varying systems, constructing an observer is far from trivial.

MP2 Nonlinear and Stochastic Control: Theory and Application

MP2-4

On the Covariance Extension Problem

Christopher I. Byrnes, Anders Lindquist

MP2 Nonlinear and Stochastic Control: Theory and Application

MP2-5

Cross-Ratio Dynamics and its Applications to Calibration Free Motion Estimation

Bijoy K. Ghosh

MP2 Nonlinear and Stochastic Control: Theory and Application

MP2-6

Control of the Planar Rotation in Human Head-Eye-Coordination

Magnus Egerstedt, Clyde F. Martin

Abstract

In this article, the problem of how to model and control the combined motion of the human head and eye is being investigated. Based on a simplified physical model and an assumption that the muscles can be modeled as damped springs with a second order linear dynamics, we derive models, for which we then can find control laws that both make the combined pupil-movement follow a given trajectory, and make the separate head eye trajectories three times continuously derivable. Our control also make the energy produced in the movement small, since we believe that to be a reasonable, physical control-criterion. We also investigate what role time delay plays when it comes to switching between active and inactive muscles.

MP3 Modeling Estimation and Control of Infinite Dimensional Systems II

MP3-1

Inverse Problems for Nonautonomous Nonlinear Distributed Parameter Systems

Azmy S. Ackleh, Simeon Reich

Abstract

We will consider inverse problems involving the identification of time dependent, nonlinear, distributed parameter systems. A general convergence result for parameter estimates obtained using Galerkin approximations is presented. The application of our theory to an example is discussed.

MP3 Modeling Estimation and Control of Infinite Dimensional Systems II

MP3-2

Minimax H-Infinity Control of Stable Distributed Systems

Kelly Black

MP3 Modeling Estimation and Control of Infinite Dimensional Systems II

MP3-3

Adaptive Identification of Distributed Parameter Systems

Yuri Orlov, Joseph Bentsman

Abstract

This work presents synthesis of adaptive identifiers for distributed parameter systems (DPS) described by partial differential equations (PDE's) of parabolic, elliptic, and hyperbolic type. The novel feature of the identification algorithms presented is the lack of a need for computing second spatial derivatives for the cases of several unknown parameters. This feature makes the algorithms much more applicable in the presence of measurement nonlinearities. The fundamental concept of identifiability is studied. Adjustable parameters in the adaptive identifiers proposed are shown to admit simultaneous convergence to their nominal space-varying values when an appropriate input signal is used. The class of sufficiently rich input signals referred as generators of persistent excitation is defined. This class guarantees the existence of a unique zero steady state for the parameter errors, thereby yielding unknown plant parameters.

MP3 Modeling Estimation and Control of Infinite Dimensional Systems II

MP3-4

Parameter Estimation in a Nonlinear Structured Tree Population Model With Self Shading Effects

Azmy S. Ackleh

Abstract

We discuss a least square method for identifying the growth function in a nonlinear hyperbolic initial-boundary value problem that describes the dynamics of tree population with self shading effects. Furthermore, we present numerical results of estimating this parameter from computationally generated data.

MP4 Control of Automotive Engines and Drivelines

MP4-1

Automated Design of an Air/Fuel Controller for an SI Engine Considering the Three-way Catalytic Converter in the Hinf approach

C. A. Roduner, C. H. Onder, H. P. Geering

Abstract

The correct operation of the emissions reduction system of an SI engine depends on the capability of the three-way catalyst (TWC) to store and release oxygen. Either one or the other is lost if the oxygen storage of the TWC is completely full or completely empty. In order to optimally handle upstream air-to-fuel ratio (lambda) excursions in either direction (lean or rich), the stored oxygen mass should be kept near the middle of the current oxygen storage capacity. An Hinf controller is developed which takes into account the dynamic behavior of the TWC. The main design goal is to compensate the disturbance impact on the relative oxygen storage level by first measuring the upstream air-to-fuel ratio only. For this purpose the TWC is regarded as a limited integrator. The dynamics of the fuel-path subsystem of the engine (between fuel injection and measured upstream air-to-fuel ratio) is modeled by lowpass element and a time delay connected in series. Since the measurements on an engine test bench illustrate the performance of the control system.

MP4 Control of Automotive Engines and Drivelines

MP4-2

Feedback Linearization of a Multi-Input SI-Engine System for Idle Speed Control

R. Pfiffner, L. Guzzella

Abstract

The idle speed control problem is a classical example of an automotive control application. The set-up corresponds to a disturbance rejection problem where the main plant output (engine speed) has to be maintained at a (low) constant value despite the torque disturbances acting on the engine crank-shaft (servo-steering pump, air-conditioning compressor etc.). The relevance (comfort, fuel consumption etc.) and the technical challenges (nonlinear plant with large time delays and uncertainties) of this control problem have led to many different control strategies. PID, LQ, Hinf, fuzzy control, adaptive control, sliding mode and neural networks are some of the frameworks used to tackle this problem. Feedback linearization was also investigated in some papers, but the engine's induction power stroke delay was neglected. Unfortunately, this effect, that depends in addition on the engine speed, is often the limiting factor for the controller design. For this reason in the here presented work, this delay is approximated with a cascade of two first order low pass elements, which have engine-speed dependent time constants. The resulting nonlinear fourth order plant with two inputs (air bypass valve and spark advantage) is not affine in both inputs. Nevertheless, by introducing additional static compensations the plant is shown to be exactly feedback linearizable. The linearized plant permits the application of well-known linear control design methods. In this paper the different bandwidths of the two inputs are used in an Hinf design to guarantee an optimal engine operation both under transient and steady-state conditions.

MP4 Control of Automotive Engines and Drivelines

MP4-3

Influence of Manifold Pressure Pulsation to Mean Value Models in Air-to-Fuel Ratio Control

M. Scherer, C. Arndt, O. Loffeld

MP4 Control of Automotive Engines and Drivelines

MP4-4

Modelling Internal Combustion Engines via Identification Techniques

R. Scattolini, G. De Nicolao, M. Cittadini, C. Rossi, C. Siviero

Abstract

This paper deals with the identification of NARX (Nonlinear Autoregressive eXogeneous) models for describing the pressure inside the intake manifold and the crankshaft speed of Internal Combustion car engines. The proposed method is based on stepwise regression and has been applied to real data collected on a 1200 cm^3 commercial engine. A number of experimental results witness the applicability of the approach.

MP4 Control of Automotive Engines and Drivelines

MP4-5

Identification of Emission Models in a Spark Ignition Engine for Control Applications

I. Arsie, C. Pianese, G. Rizzo

MP4 Control of Automotive Engines and Drivelines

MP4-6

Advanced System Design and Control Aspects in a Fuel-Optimal Hybrid Vehicle

E. Shafai, P. Dietrich, C. Wittmer, S. Ginsburg

Abstract

Electric vehicles today clearly represent the only solution fulfilling the zero emission vehicles (ZEV) standard. However, they still are not an equivalent alternative to the gasoline driven cars due to the well known problems of today's batteries. The concept of a parallel hybrid drive line can be an optimal combination of both principles of propulsion in that the gasoline engine guarantees for a wide range of operation, while the electric propulsion can be used within the restricted zero emission zones. The parallel hybrid solution described here has been realized in the "Hybrid III" research and development project at the Swiss Federal Institute of Technology (ETH), Zurich, Switzerland. The drive line consists of a gasoline engine, an electric asynchronous motor/generator, a flywheel, and a wide range continuously variable transmission. It is shown how these components cooperate in a fuel-optimal way. This drive line is now about to be integrated in a vehicle for real road testing. This paper describes the experimental results on a dynamic test bench verifying its operation under realistic traffic conditions.

TA1 Intelligent Systems

TA1-1

A State Configured Sensor Based Control Architecture for an Autonomous Underwater Vehicle

G. A. Demetriou, K. H. Valavanis

Abstract

A new embedded control system hardware and software control architecture suitable for an AUV is presented. The proposed scheme is based on the shared memory principle and consists of three components, a supervisory controller, a functional and a hardware/execution component. Off-the-shelf technology has been used to build and implement the described AUV control architecture. Key features of the proposed architecture include: autonomy, learning, recovery, multiple goals in a single mission, use of multiple sensors for data collection. This embedded architecture is modular, reconfigurable, expandable and cost-effective.

TA1 Intelligent Systems

TA1-2

The Use of Fuzzy Cognitive Maps in Modeling Systems

Chrysostomos D. Stylios, Voula C. Georgopoulos, Peter P. Groumpos

Abstract

This paper investigates a new theory, Fuzzy cognitive Map (FCM) Theory, and its implementations in modeling systems. First the description and the methodology that this theory suggests is examined and then the application of FCM in a process control problem is described. The presentation indicates how powerful FCMs are and some interesting points for further research are included. In the recent years, a wide discussion has started about the autonomy and intelligence of systems, so the application of FCM in the field of control and systems may contribute in the development of more intelligent and autonomous control systems.

TA1 Intelligent Systems

TA1-3

Fuzzy Linear Programming and Simulated Annealing

Rita Almeida Ribeiro, Fernando Moura Pires

Abstract

This paper shows how the simulated annealing (SA) algorithm provides a simple tool for solving fuzzy optimization problems. Often, the issue is not so much how to fuzzify or remove the conceptual imprecision, but which tools enable simple solutions for these intrinsically uncertain problems. A well-known linear programming example is used to discuss the suitability of the SA algorithm for solving fuzzy optimization problems.

TA1 Intelligent Systems

TA1-4

State Estimation in Presence of Disturbance Using Neural Networks

B. Gaddouna Ouladsine, G. Bloch

Abstract

A state reconstruction method of non-linear systems is proposed. It concerns the systems which can be decomposed into linear and non-linear parts and requires the implementation of two observers. The first one is used for determining approximately the target of a neural network providing the estimation of the nonlinearity. This one can be the consequence of modeling errors of the system parameters. The second one allows to reconstruct the state of the nonlinear system.

TA1-5

On-Line Neural Network Algorithm for the Constrained Motion Planning of Redundant Manipulators

A. Ramdane-Cherif, D. Y. Meddah, V. Perdereau, M. Drouin

Abstract

In this paper, we propose an iterative method using a neural network to solve the inverse kinematic problem for redundant manipulators in presence of motion constraints such as joint limits or obstacles. A constrained optimization scheme with penalty functions based on neural network is formulated. The neural network is adapted in the direction of decreasing a Lyapunov function to move the end-effector to the desired position while avoiding a collision with respectively a workspace object and a contact environment surface. This approach offers substantially better accuracy and avoids the computation of the inverse or pseudoinverse Jacobian matrix. The application of this scheme to a 3 degrees of freedom redundant manipulator is demonstrated through simulation results.

TA1-6

On the Selection of Nodes in Linear-in-the-Weight Neural Networks

Elias B. Kosmatopoulos, Nikitas J. Dimopoulos

Abstract

Linear-in-the-weights neural networks are known to possess certain advantages over classical multilayer neural networks. In the past, there have been many learning algorithms proposed for training linear-in-the-weights neural networks [12, 8, 9, 10]; among the nice properties of those algorithms are their stability, convergence and robustness properties and, most important, their convergence to the -unique - global minimum. However, all these algorithms deal with the case where the neural network has fixed regressor terms (nodes). The problem of selecting the regressor terms in neural networks is still an open and unsolved problem. In this paper, we propose algorithms for selecting the regressor terms in linear-in-the-weight neural networks. These algorithms are accompanied by appropriate learning algorithms for adjusting the weights of the neural network. By analyzing an appropriate error functional, we investigate the convergence properties of the proposed algorithms; moreover, we investigate the optimality of these algorithms and we construct conditions - regarding the nature of the regressor terms - under which the proposed algorithms are optimal.

TA1 Intelligent Systems

TA1-7

A Simplex Trained Neural Network-Based Architecture for Sensor Fusion and Tracking of Target Maneuvers

Yee Chin Wong, Malur K. Sundareshan

Abstract

One of the major applications for which neural network-based methods are being successfully employed is in the design of intelligent integrated processing architectures that efficiently implement sensor fusion operations. In this paper we shall present novel scheme for developing fused decisions for surveillance and tracking in typical multi-sensor environments characterized by the disparity in the data streams arriving from various sensors. This scheme employs an integration of a multilayer neural network trained with features extracted from this multi-sensor data and a Kalman filter in order to permit reliable tracking of maneuvering targets, and provides an intelligent way of implementing an overall nonlinear tracking filter without any attendant increases in computational complexity. A particular focus is given to optimizing the neural network architecture and the learning strategy which are particularly critical to develop the capabilities required for tracking of target maneuvers. Towards these goals, a network growing scheme and a simplex algorithm that seeks the global minimum of the training error are presented. To provide validation of these methods, results of several tracking experiments involving targets executing complex maneuvers in noisy and clutter environments are presented.

TA2 Robust Systems I

TA2-1

The Finite Inclusions Theorem: A Tool for Robust Design

Theodore E. Djaferis

Abstract

Methods for robust controller design, are an invaluable tool in the hands of the control engineer. Several methodologies have been developed over the years and have been applied for the solution of specific robust design problems. One of these methods, is based on the Finite Inclusions Theorem (FIT) and exploits properties of polynomials. This has led to the development of FIT-based algorithms for robust stabilization, robust asymptotic tracking and robust noise attenuation design. In this paper, we consider SISO systems with parameter uncertainty and show how FIT can be used to develop algorithms for robust phase margin design.

TA2 Robust Systems

TA2-2

Every Mode Robust Stabilization of Jump Linear Systems via LMIs

M. Ait Rami

Abstract

This paper considers the mode-dependent state-feedback control problem of linear systems subject to random Markovian jumps in parameter values. For this kind of systems, the mean-square stability does not ensure the stability of every mode in the deterministic sense. We provide stabilizing solution in both senses. The proposed approach differs from the modified jump regulator approach and has several advantages. The proposed conditions are only sufficient, but less conservative. We can treat uncertainties that can affect modes or the transition probability matrix. The problem is formulated as a convex constraint (LMIs) one.

TA2 Robust Systems

TA2-3

Robust Diagonal Stabilization and Finite Precision Problem: An LMI Approach

Stephane Dussy

Abstract

Realization of digital filters or implementation of controllers in a digital computer may lead to unexpected instabilities resulting from the finite precision effects. Stability is usually ensured for an idealized discrete-time realization of the system. Nevertheless, as soon as A/D and D/A conversions get involved, the quantization of the state of the system, due to adder overflow, magnitude truncation, finite wordlength format, may introduce severe nonlinearities responsible for overflow oscillations, limit cycles or even chaotic behavior, even under zero input. This paper considers a parameter-dependent, discrete-time system in the companion form. We derive LMI conditions ensuring stability for the uncertain system in spite of the finite precision effect. We also seek an LMI formulation for the synthesis of a static output-feedback controller that guarantees robust stability for the finite precision problem.

TA2 Robust Systems

TA2-4

Robust Quasi NID Aircraft 3D Flight Control Under Sensor Noise

Marian J. Blachuta , Valery D. Yurkevich, Konrad Wojciechowski

Abstract

In the paper the design of an aircraft motion controller based on the Dynamic Contraction Method is presented. The control task is formulated as a tracking problem for Euler angles, where the desired decoupled output transients are accomplished under assumption of high-level, high-frequency sensor noise and incomplete information about varying parameters of the system and external disturbances. The resulting controller has a simple form of a combination of a low-order linear dynamical system and a matrix whose entries depend nonlinearly on certain measurable flight variables.

TA2 Robust Systems

TA2-5

Modeling and mu-Synthesis Robust Control of Two-Link Flexible Manipulators

Mansour Karkoub, *Kumar Tamma*

Abstract

Two-link robot manipulators are commonly used in industrial sectors such as manufacturing. Some manipulators are often bulky and their power consumption is relatively high. Others, such as the arm on the space shuttle, are driven slow to prevent the onset of flexible oscillations. The efficiency of these manipulators can be improved by reducing the weight of some of these arms and/or increasing the speed of others. These modifications complicate the dynamic behavior of the system due to the possible onset of low frequency oscillations. This paper addresses the issue of modeling and end-point robust control of two-link flexible manipulators using the mu-synthesis technique. The Timoshenko beam theory along with the assumed modes method are used to derive reference equations of motion for the flexible manipulator. Discrepancies between the control design model and the actual dynamics of the manipulator are attributed to neglect non-linearities such as cross-coupling which should be included in the controller design. A linear estimation of these errors will be identified and used in the control design to compensate for the unmodelled dynamics of the flexible arm and parameter uncertainties. The mu-synthesis control design techniques are then employed to synthesize controllers for the two-link flexible robot manipulator.

TA2 Robust Systems

TA2-6

Exponentially-Weighted Iterative Solutions for Worst-Case Parameter Estimation

Ali H. Sayed, Andrea Garulli, V. Nascimento, S. Chandrasekaran

Abstract

This paper proposes an iterative scheme for worst-case parameter estimation in the presence of bounded model uncertainties. The algorithm distinguishes itself from other estimation schemes, such as errors-in-variables and other Hinf methods, in that it leads to less conservative designs since it explicitly incorporates an a-priori bound on the size of the uncertainties. It also employs an exponential weighting scheme where data in the remote past are given less weight than the most recent measurements. This feature is especially useful in tracking problems where recent observations carry more information about the current value of the unknown parameter. Simulation results are included to demonstrate the performance of the recursive scheme.

TA2 Robust Systems

TA2-7

Some Issues on Robust Control for Nonlinear Systems

Michael Athans, Alan Chao

TA3-1

Optimal Location of Actuators for an Active Noise Control Problem

Fariba Fahroo

Abstract

In this paper, we investigate the problem of finding the optimal location of controllers to achieve reduction of the noise field in an acoustic cavity. We first formulate a linear quadratic tracking problem in a Hilbert space, and then consider the problem of optimization of an appropriate performance criterion with respect to the location of the controls. Numerical examples will be presented to illustrate our theoretical results.

TA3 Modeling Estimation and Control of Infinite Dimensional Systems III

TA3-2

Minimax Hinf Control of Stable Distributed Systems

Olof J. Staffans

Abstract

We study the distributed suboptimal full information Hinf problem for a stable well-posed linear system with control u, disturbance w, state x and output y. In our setting the transfer functions need not be rational or meromorphic; they are just plain Hinf without extra smoothness. The problem is to find all suboptimal compensators, i.e. compensators that make the norm of the closed loop input/output map from w to y less than a prescribed constant. We use a game theory approach to this problem and regard it as a two player non-zero sum game.

TA3-3

Conditional Moment Generating Functions for Integrals and Stochastic Integrals: Maximum-Likelihood Estimation

Charalambos D. Charalambous

Abstract

In this paper we present two methods for computing filtered estimates for moments of integrals and stochastic integrals of continuous-time nonlinear systems. The first method utilizes recursive stochastic partial differential equations. The second method utilizes conditional moment generating functions. For the case of Gaussian systems the recursive computations involve integrations with respect to Gaussian densities, while the moment generating functions involve differentiations of parameter dependent ordinary stochastic differential equations. The second method is applied in the expectation optimization algorithm.

TA3 Modeling Estimation and Control of Infinite Dimensional Systems III

TA3-4

Ergodic Boundary Control of Semilinear Systems

T. E. Duncan

TA4 Mobile Robots

TA4-1

A Robust-Adaptive Locomotion Controller For 9-Link Bipeds with Rapidly Varying Unknown Parameters

S. G. Tzefestas, A. E. Krikochoritis, C. S. Tzefestas

Abstract

The control and the study of motion of a biped robot has always been a challenging problem. The mechanical complexity of biped robots, the existence of an unpowered degree of freedom and the peculiarity of their motion due to the repeatability of movements and a permanent change of situations during one step, synthesize a complex problem. At the same time, undesired collisions with its environment, transport of unknown loads, or simplification of some dynamic characteristics, cause uncertainty (structured or not) which makes worse the control problem since an accurate model of the biped robot is not available. In this paper a nine link planar biped model is studied. It is a biped robot that includes not only the main links: legs, thighs and trunk, but also a two segments foot. For this biped robot, the kinematics and dynamic equations which describe completely the locomotion of the robot during the different phases of walking, are defined. Furthermore, a continuous walking pattern on a flat terrain is designed and the corresponding desired trajectories of the robot joints are calculated. Then, a nonlinear robust control technique is adopted, based on the fact that the control which has to ensure the stability of the biped robot must take into account the nonlinear dynamics of the system. This requires the knowledge of an accurate model of the biped robot, a condition that is never fulfilled because of the existence of disturbances and modelling inaccuracies such as parametric uncertainty and unmodeled dynamics. Thus, for the case there is not available a priori information about the unknown parameters, the parametric uncertainty has to be gradually reduced on-line by an adaptation or estimation mechanism. Here, rapidly time-varying unknown parameters are assumed, and a kind of robust-adaptive controller is designed which achieves robustness, while at the same time ensures that all signals in the closed-loop robot system are bounded the tracking error is of the order of parameter variations. Extensive simulation experiments showed the effectiveness of the proposed robust-adaptive control scheme.

TA4 Mobile Robots

TA4-2

An Assessment of Fuzzy Logic for Collision Avoidance in a Multiple Autonomous Mobile Robot System

Chris G. Dodds, Albert Zomaya

Abstract

A fuzzy logic approach for collision avoidance in a multiple autonomous mobile robot environment is proposed. Up to four robots are given starting points and destinations they must reach within a hypothetical indoor environment. The fuzzy logic method enables the robots to reach their intended destinations while avoiding stationary and mobile obstacles alike.

TA4-3

Steering a Robotic Snake

K. Sarrigeorgides, K. J. Kyriakopoulos

Abstract

In this paper we develop a methodology for steering on the plane the wheeled "snake" robot designed by Migadis and Kyriakopoulos. This mechanical system is subject to nonholonomic constraints. The kinematic model of the mobile robot is derived taking into consideration these constraints. The nonholonomic motion planning is solved by converting the multiple input system to a multiple-chain, single generator chained form via state feedback and a coordinate transformation. Simulation results are provided for a test case.

TA4-4

Motion Planning for Drift-Free Nonholonomic Systems Under a Discrete Levels Control Constraint

Photis G. Skiadas, Nick T. Koussoulas

Abstract

The motion planning problem for nonholonomic systems without drift is solved under the constraint that the control inputs can take values in a set that contains a finite number of allowable levels. If the system to be steered is also nilpotent or nilpotentizable, the steering can be exact. The results are applied in the steering of a simple system.

TA4 Mobile Robots

TA4-5

Dynamic Modelling of a Tricycle Mobile Robot

Andre Kamga

Abstract

A control law is derived for path tracking of a tricycle mobile robot after its dynamics modelling. The vehicle has a front steering and driving wheel and two free rear wheels with a common rotation axis. Thanks to poles placement, a controller in the form of a linear feedback of the errors (position, orientation, lateral speed, and angular speed) formally proves why such a system can be stabilized about a trajectory by using these above errors feedback to determine the command to the steering angle. Several simulation's results of the controller are presented.

TA4 Mobile Robots

TA4-6

A Navigation System With Self-Localization Capabilities for an Autonomous Mobile Robot

Alain Betourne, Alessandro Fefe, Salvatore Nicosia, Paolo Valigi

Abstract

In this paper a navigation system for an autonomous mobile robot is presented. The system is based on the joint use of an odometry, encoder based sensory system, of a vision system, and of an ultrasonic captor sensory system. A flexible hierarchical data structure is used to model complex, partially known, indoor environments, thus allowing the navigation system to drive the robot in these environments, and to perform periodic corrections of the robot position, by means of the vision system. The proposed approach for image processing is based on the use of the Hough transform. The paper describes the overall navigation system, giving details on the environment modeling approach, and on the image processing scheme. Experimental tests have been performed, showing the good accuracy achieved by the proposed position estimation scheme.

TA4 Mobile Robots

TA4-7

Path following with security margin: A new control algorithm for wheeled Robots

T. Hamel, P. Soueres, D. Meizel

Abstract

This paper addresses the problem of determining a feedback control law, robust with respect to localization errors, allowing a mobile robot to follow a prescribed path. The model we consider is a dynamic extension of the usual kinematic model of a car, in the sense that we defined the path curvature as a new state variable. The control variables are respectively the linear velocity and the derivative of the curvature. By defining a sliding manifold we determine a stabilizing controller for the nominal system i.e. when the exact configuration is supposed to be known. Then, using Lyapunov analysis, we prove that the system remains stable when the estimated values are used for feedback instead of the exact ones, and we characterize the robustness with respect to localization and curvature estimation errors. The result is expressed by determining a bounded attractive domain where the vehicle's configuration could possibly lie when the closed-loop control is performed with the estimated state values. This domain allows to compute easily a security margin for obstacle avoidance during the path-following phase. Experimental results are presented at the end of the paper.

TP1 Max-Algebra

TP1-1

Linear Projectors in the Max-Plus Algebra

G. Cohen, S. Gaubert, J.-P. Quadrat

Abstract

For operators between finite-dimensional free moduloids, images are defined in the standard way whereas the notion of kernel is replaced by the equivalence relation between elements with the same image. Given a moduloid X, any x in X, and two operators B ranging in X, and C with domain X, one raises the question of existence and uniqueness of an element in the equivalence class of x modulo the kernel of C and which in addition belongs to the image of B. Such an element is then called the projection of x onto the image of B parallel to the kernel of C. In a previous paper, this question has been solved for residuated (possibly nonlinear) operators. When a pair (B, C) satisfies the existence and uniqueness conditions, the image of B and the kernel of C are in direct sum or are transverse. In the present paper, we revisit this problem in the case of linear operators. We give a simpler characterization of transversality and an explicit formula for the projector. Unlike in vector spaces, for a given B, a transverse C need not exist, or, otherwise stated, the image of B is not always that of a linear projector. Indeed, the operators B for which this holds true are exactly those for which a generalized inverse exists. A computational algebraic test is given in order to check this property.

TP1 Max-Algebra

TP1-2

Equivalence Classes of Rank-3 Matrices in the Max-Algebra

Jean-Michel Prou, Edouard Wagneur

TP1 Max-Algebra

TP1-3

Control Synthesis Approaches Using the State Equations and the ARMA Model in Timed Event Graphs

Philippe Declerck

Abstract

An important aim is to make control synthesis of processes modelled by timed event graphs. Using the state equations, we solve the optimal tracking problem for any past evolution of the system. However, the model is only a picture of the reality and modelling errors and faults generate misestimation of the state vector. In the case of an unknown state vector, we propose to compensate this information loss by the use of "ARMA" model in control field.

TP1 Max-Algebra

TP1-4

Dynamic Control of Kanban System Over Dioid Algebra

B. Cottenceau, L. Hardouin, J.-L. Boimond

Abstract

An objective of the just in time (JIT) manufacturing is to reduce work in process (WIP) inventory and to satisfy the customers demand. The most celebrated component is the so called Kanban method that we study in the dioid algebra setting. By considering the model of a Kanban cell we purpose dynamic controls of such systems. The first proposed control law allows to both decrease the WIP of a classical Kanban cell and to keep its output behavior. The obtained result is based on the residuation theory. The analytical expression of this control law shows that the customers demand will be known over a temporal horizon. The second approach yields the greater control law in order to reduce the WIP and to keep the same stock evolution in the output buffer of a classical Kanban cell. It is shown that the optimal control obtained does not need to have the future behavior of the customers demand. Finally the proposed control laws are extended to manufacturing systems with multiple Kanban cells.

TP1 Max-Algebra

TP1-5

Reachability and Observability of Linear Systems Over Max-Plus

M. J. Gazarik, E. W. Kamen

Abstract

This paper discusses the properties of reachability and observability for linear systems over the max-plus algebra. Working in the event-domain, the concept of asticity is used to develop conditions for weak reachability and weak observability. In the reachability problem, residuation is used to determine if a state is reachable and to generate the required control sequence to reach it. In the observability problem, residuation is used to estimate the state. As in the continuous-variable case, a duality also exists between the properties. Finally, an adjoint system is generated from the residual calculation in the reachability case and utilized to generate a solution to the just-in-time (JIT) scheduling problem.

TP1 Max-Algebra

TP1-6

Controllability in the Max-Algebra

Jean-Michel Prou, Edouard Wagneur

Abstract

We are interested here in the reachability problem for DEDS in the max-algebra. We show that this problem leads to an eigenvector problem in the min algebra. More precisely, we show that given a max-linear system, then, for every natural number $k \geq 1$ there is a matrix Σ_k, whose eigenspace associated with the eigenvalue 1 (the multiplicative identity, which coincides here with the real number 0 in the min algebra contains all the states which are reachable in k steps. Although not dealt with in this paper, a similar result also holds by duality on the observability side.

TP1 Max-Algebra

TP1-7

Nonexpansive Maps and Option Pricing Theory

V. Kolokoltsov

Abstract

The famous Black-Sholes (BS) and Cox-Ross-Rubinstein (CRR) formulas are basic results in the modern theory of option pricing in financial mathematics. They are usually deduced by means of stochastic analysis; various generalizations of those formulas were proposed using more sophisticated stochastic models for common stocks pricing evolution. In this report, we argue that classical BS and CRR formulas can be actually obtained as a part of the theory of nonexpansive maps, which contribute now one of the popular object of investigation in (max, +) algebra and its applications to Discrete Event Systems. This framework leads to another type of generalizations of BS and CRR formulas characterized generally by more rough assumptions on common stocks. evolution, which are therefore easier to verify. On the other hand, this approach is more elementary: it leads to BS and CRR formulas without the use of either martingales or stochastic equations.

TP2 Robust Systems II

TP2-1

Robust Stability Analysis of GPC: An Application to Dead-Beat and Mean-Level Predictive Controllers

Roberto Hernandez-Berlinches

Most stability results in model predictive control are based on the assumption that the model describes the real plant perfectly. In real systems the model is always different to the process and a robust stability analysis is needed. In this paper it is shown how the Extreme Point Results theory can be used to analyze the robust stability of predictive controllers in a natural way with low computational cost.

TP2 Robust Systems II

TP2-2

Robust Stability of Non-Linear Time-Varying Systems

Ezra Zeheb

Abstract

Systems with time-varying non-linearity confined to a given sector (Lure type) and a linear part with uncertainty formulated by an interval transfer function, are considered. Sufficient conditions satisfying the Popov criterion for stability, which are computationally tractable, are derived. The problem of checking the Popov criterion for an infinite set of systems, is reduced to that of checking the Popov criterion for a finite number of fixed coefficient systems, each in a prescribed frequency interval.

TP2-3

Constrained Stabilization of a Dynamic System: A Case Study

F. Blanchini, S. Cotterli, G. Koruza , S. Miani, R. Siagri, L. Tubaro

Abstract

In this work we consider the problem of determining and implementing a state-feedback stabilizing controller law for a laboratory two-tank dynamic system in the presence of state and control constraints. We do this by exploiting the properties of the polyhedral Lyapunov functions, i.e. Lyapunov functions whose level surfaces are polyhedra, in view of their capability of providing an arbitrarily good approximation of the maximal set of attraction, which is the largest set of initial states which can be brought to the origin with a guaranteed convergence speed. We will first recall the basic theoretical background needed for the scope and then we will report and analyze the results of the practical implementation on a two-tank laboratory system of a linear variable-structure and a quantized control law proposed in literature. Finally an heuristic procedure for the determination of a static linear gain will be presented.

TP2 Robust Systems II

TP2-4

Robust and Reliable Hinf Output Feedback Control for Linear Systems With Parameter Uncertainty and Actuator Failure

Chang-Jun Seo, Byung Kook Kim

Abstract

The robust and reliable Hinf output feedback controller design problem is investigated for uncertain linear systems with actuator failures within a prespecified subset of actuators. The uncertainty considered here is time-varying norm-bounded parameter uncertainty in the state matrix. The output of a faulty actuator is assumed to be any arbitrary energy-bounded signal. An observer-based output feedback controller design is presented which stabilizes the plant and guarantees an Hinf-norm bound on attenuation of augmented disturbances, for all admissible uncertainties as well as actuator failures. The construction of the observer-based output feedback control law requires the positive-definite solutions of two algebraic Riccati equations. The result can be regarded as an extension of existing results on robust Hinf control and reliable Hinf control of uncertain linear systems.

TP2 Robust Systems II

TP2-5

Quadratic Stabilizability of Uncertain Continuous-Time Systems Under State and Control Constraints in the Presence of Disturbances

H. X. de Araujo, I. Queinnec, S. Tarbouriech

Abstract

The problem of finding a linear stabilizing state-feedback control for uncertain continuos-time linear systems with state and control constraints is addressed. Both convex-bounded parametric uncertainties and adaptive bounded disturbances are considered. Based on the theory of ellipsoidal positively invariant sets, a programming approach is proposed to solve the control design problem.

TP2 Robust Systems II

TP2-6

Delay-dependent Robust Stability Tests and Decay Estimates for Systems With Input Delays

Kostas Hrissagis, Olga I. Kosmidou

Abstract

The robust asymptotic stabilization of uncertain systems with delays in the manipulated variables is considered in this paper. Sufficient conditions are derived that guarantee closed-loop stability under state-feedback control in the presence of nonlinear and/or time-varying perturbations. The stability conditions are given in terms of scalar inequalities and do not require the solution of Lyapunov equations. The approach makes use of the matrix measure to yield robust-stability conditions. The problem of constrained control is also discussed, and alternative stability conditions for some case of saturation nonlinearities are presented. Estimates of the stability degree and the rate of decay of the solutions are also obtained. Finally, an example illustrates the results.

TP3 Linear Systems I

TP3-1

Transfer Function Equivalence of Feedback/Feedforward Compensators

Vladimir Kucera

Abstract

Equivalence of several feedback and/or feedforward compensation schemes in linear systems is investigated. The classes of compensators that are realizable using static or dynamic state feedback are characterized. Stability of the compensated system is studied. Applications to model matching are included.

TP3 Linear Systems I

TP3-2

Numerical Operations Among Rational Matrices: Standard Techniques and Interpolation

P. Husek, M. Sebek, J. Stecha

Abstract

Numerical operations on and among rational matrices are traditionally handled by direct manipulation with their scalar entries. A new and sometimes numerically attractive alternative is proposed here that is based on interpolation. The procedure begins with evaluation of the rational matrices in several complex points. Then all the required operations are performed consecutively on constant matrices corresponding to each particular point. Finally, the resulting rational matrix is recovered from the particular constant solutions via interpolation. It may be computed either in polynomial matrix of rational functions. The operations considered include addition, multiplication and computation of polynomial matrix fraction form. The standard and the two interpolation methods are compared by experiments.

TP3-3

Design Fault-Tolerant of LTI State-Space Systems

C. N. Hadjicostis, G. C. Verghese

Abstract

The design of linear time-invariant (LTI) systems in state form has traditionally focused on implementations that require the least number of state variables. Such minimal designs have attempted to limit the requires resources, such as hardware, computation time or power, by minimizing the system dimension. In recent years, however, the increasing necessity for the design and implementation of fault-tolerant systems has proved that "controlled redundancy" (that is, redundancy that has been intentionally introduced in some systematic way) can be extremely important: it can be used to detect and correct errors or to guarantee desirable performance despite hardware or computational failures. Modular redundancy, the traditional approach to fault tolerance, is prohibitively expensive because of overhead in replicating the hardware. This paper discusses alternative methods for systematically introducing redundancy in LTI systems in state form. Our approach consists of mapping the state space of the original system into a redundant space of higher dimension while preserving, within this larger space, the properties of the original system in some encoded form. We provide a complete characterization of the class of appropriate redundant LTI systems and illustrate through several examples ways in which our framework can be used for achieving fault tolerance.

TP3 Linear Systems I

TP3-4

An Integrated Framework for Input, Output and Control Structure Selection: Advanced Control Diagnostics

N. Karcanias, J. Leventides, E. Milonidis

Abstract

This paper aims at formulating an integrated approach to the overall problem of control structure selection and identifying open issues and problems. It is based on the assumption that there exists a progenitor model of the linear type for the process, which however may not be well defined. We then use structural analysis of the system theoretic framework, the interaction measures and the results for the evaluation of alternative decentralization schemes, to specify a step by step approach to the control structure selection. The problem of handling alternative criteria is also considered and basic elements of a system procedure are given. There are many open issues, which are identical and are still open and thus the proposed structural approach should be considered as the first step to the development of an integrated methodology that involves the following major steps: (a) Classification of system model variables and definition of well structured progenitor model. (b) Definition of effective input, output structure based on operability, controllability criteria.(c) Determining the structure of the control scheme by evaluation of alternative decentralized structures. Finally the basics of methodology for sorting out the alternative criteria which may be used in such problem are presented.

TP3-5

System Zeros Analysis via SVD of the First Nonzero Markov Parameter and the Kalman Decomposition Theorem

Jerzy Tokarzewski

Abstract

In this paper we present a complete characterization of system zeros of an arbitrary linear system described by a state-space model S(A, B, C, D). The presented approach is based on singular value decomposition of the first nonzero Markov parameter and the Kalman canonical decomposition theorem. Invariant zeros are treated as the triples: complex number, state-zero direction, input-zero direction. Several numerical examples are discussed.

TP3 Linear Systems I

TP3-6

Constrained Controllability of Dynamical Systems

Jerzy Klamka

Abstract

The present paper is devoted to a study of constrained controllability and controllability for linear dynamical systems if controls are taken to be nonnegative. In analogy to the usual definition of controllability it is possible to introduce the concept of positive controllability. We shall concentrate on approximate positive controllability for linear infinite-dimensional dynamical systems when the values of controls are taken from a positive closed convex cone and the operator of the system is normal and has pure discrete point spectrum. The special attention is paid for positive infinite-dimensional linear dynamical systems. General approximate constrained controllability results are then applied for distributed parameter dynamical systems described by linear partial differential equations of parabolic type different kinds of boundary conditions. Several remarks and comments on the relationships between different concepts of controllability are given. Finally, simple numerical illustrative example is also presented.

TP4 Robot Control

TP4-1

Global Asymptotic Stabilisation of an Active Mass Damper for a Flexible Beam

L. Menini, A. Tornambe, L. Zaccarian

Abstract

In this paper, a finite dimensional approximated model of a mechanical system constituted by a vertical heavy flexible beam with an active mobile mass located at the tip, is proposed; such a model is parametric in the approximation order, so that a prescribed accuracy in the representation of the actual system can be easily obtained with the proposed model. The system itself can be understood as a simple representation of a building subject to transverse vibration, whose vibrating modes are damped by a control action performed at the top by means of a moving mass. A simple PD control law, which requires only the measurement of the relative mass position and velocity with respect to the end-point of the beam, is shown to globally asymptotically stabilize all the flexible modes considered in the approximation model, regardless of the chosen approximation order. Simulation runs confirm the effectiveness of the proposed control law in achieving both position regulation of the mass and vibration control.

TP4 Robot Control

TP4-2

Variable Structure Control of a Robotic Assistance System

M. L. Corradini, T. Leo, G. Orlando

Abstract

The development of an autonomous robotic system for the assistance to disabled people (composed of a 'car-like' mobile base and a robot arm) is the primary aim of the MOVAID Project, supported by the CEC in the framework of the TIDE Programme. In the context of the MOVAID Project, an automatic navigation system is currently being developed at the Robotics Lab at the Dipartimento di Elettronica e Automatica. From the functional viewpoint, the navigation system can be decomposed into a motion planner and a collision avoidance module. Both blocks, however rely on a suitable low-level control procedure, which has to drive the wheel actuators in order to ensure the tracking of the planned trajectory with a sufficient degree of precision, opposing eventual parameter variations and external disturbances. In this paper, a recently developed discrete-time Variable Structure Control (VSC) technique is applied to the control of the steering-wheel robot of the MOVAID Project. The algorithm has been designed in the discrete-time domain, therefore allowing to avoid the well-known problems due to the discretization of continuous-time controllers. The simulation study reported in this note is preliminary to the experimental testing of the control algorithm, which is being carried out.

TP4 Robot Control

TP4-3

Control of Robot Manipulators Using CMAC Neural Networks

S. Commuri, S. Jagannathan, F. L. Lewis

Abstract

A comprehensive treatment of Cerebellar Model Articulation Controller (CMAC) Neural Network (NN) for the control of robot manipulators is presented. The structure and localized learning properties of CMAC NN is exploited to design efficient controllers for nonlinear systems belong to a given useful class. Continuous and discrete-time implementation of these controllers are symmetrically examined. Novel weight update schemes are derived and the closed-loop stability of the controller and the system is rigorously proved. These weight update schemes are shown to be nonstandard modifications of adaptive techniques prevalent in the literature. Finally the validity of these techniques are demonstrated through numerical studies.

TP4-4

On the Development of a Quick Connect Disconnect Coupler for Rapidly Configured Modular Robots

P. S. Shiakolas, T. W. Sharpe, T. J. Lawley

Abstract

In this paper, we present a novel modular robot connection that provides for the rapid deployment of automation through the quick and rapid configuration of robotic devices based on modules. Modular robots have certain advantages over conventional robots. A modular robot, can be defined as one for which the interchange of link and joint modules quickly occurs with minimal basic adaptations to the base robotic hardware, eliminates many of the flexibility constraints of current robots and re-uses the modules for future configurations. One important component of a modular robot is a Quick Connect/Disconnect (QCD) joint coupler which provides for connection and separation as well as orientation of the individual link-joint-actuator modules. QCD based robots find applications in pilot and prototyping environments, in manufacturing lines with low volume and multi-product production, and on mobile platforms for unstructured manufacturing scenarios such as hazardous material handling and other manufacturing environments.

TP4 Robot Control

TP4-5

Robot Control Using a Sliding Mode

M. Belhocine, M. Hamerlain, K. Bouyoucef

Abstract

The dynamical model of manipulator robot is represented by an equation system which are nonlinear and strongly coupled. Furthermore, the initial parameters of the manipulator depend on the payload which is often unknown and variable. So, to avoid these problems we studied variable structure system which is well suited for robotic arms. To this end, an application of the sliding mode control based on variable structure systems for a four degrees of freedom robot is described in this paper. This technique is applied to the regulation (point to point) control of SCARA robot. So the aim of this work is to show the practical realization and to demonstrate the robustness and the validity of this control law on the robot manipulator via experimental results obtained and discussed in the end.

WA1 Nonlinear Systems

WA1-1

Set-Valued State Observers for Nonlinear Systems

Jeff S. Shamma, Kuang-Yang Tu

Abstract

A set-valued observer (SVO) produces a set of possible states based on output measurements and a priori measurements of exogenous disturbances and noises. Previous work considered linear time-varying systems and unknown-but-bounded exogenous signals. In this case, the sets of possible state vectors take the form of polytopes whose centers are optimal state estimates. These polytopic sets can be computed by solving several small linear programs. A SVO can be constructed conceptually for nonlinear systems, however the set of possible state vectors no longer takes the form of polytopes which in turn inhibits their explicit computation. This paper considers an "extended SVO". As in the extended Kalman filter, the state equations are linearized about the state estimate, and a linear SVO is designed along the linearization trajectory. Under appropriate observability assumptions, it is shown that the extended SVO provides an exponentially convergent state estimate in the case of sufficiently small initial condition uncertainty, and provides a non-divergent state estimate in the case of sufficiently small exogenous signals.

WA1 Nonlinear Systems

WA1-2

State Observers for Linear Systems With Smooth/Bounded Input

A. Germani, C. Manes

Abstract

It is known that for nonlinear systems the drift-observability property (i.e. observability for zero input) is not sufficient to guarantee the existence of an asymptotic observer for any input. Many authors studied conditions on systems structure that ensure uniform observability (i.e. observability for any input). Conditions are available that define restrict classes of uniformly observable systems. This work considers the problem of state observation with exponential error rate for smooth nonlinear systems that do not meet conditions of uniform observability: conditions are given on the input, instead of on the system structure. It is shown that drift-observability, together with a smoothness/boundedness condition on the input, is sufficient to ensure the existence of an exponential observer. Three types of observers are presented, that can be constructed under drift-observability assumption. One works well for systems with maximal relative degree or in the case of input sufficiently small. A second type of observer succeeds for systems with any relative degree in the case of input sufficiently smooth. The input derivatives up to a certain order are required for its implementation. Both observers ensure exponential convergence of exponential error to zero. A third observer suitable in the case of smooth input does not require input derivatives, and ensures exponential decay of the observation error below a prescribed level. Computer simulations close the paper.

WA1 Nonlinear Systems

WA1-3

Parameter Identification of Nonlinear Systems With Known Structure

A. Astolfi, J. J. Milek, F. J. Kraus

Abstract

This paper addresses the problem of on-line parameter estimation for non-linear continuous time dynamical systems of known structure. Two parameter estimation problems are formulated and explicitly solved. The resulting parameter estimation algorithms incorporate an observer; the adjustment of the observer parameters is considered as a stabilization problem for an uncertain system and is solved using sliding mode method. In the full information parameter estimation problem it is assumed that all the system states and their derivatives are known. In the output measurement parameter estimation problem we assume that only one state is known, the other states are reconstructed using an adaptive observer. The proposed algorithm is applied for parameter estimation of a Van der Pol oscillator.

WA1 Nonlinear Systems

WA1-4

Design and Analysis of Incipient Fault Diagnosis Schemes Using On-Line Approximators

Marios M. Polycarpou, Michael A. Demetriou

Abstract

Detection of incipient (slowly developing) faults is crucial in automated maintenance problems where early detection of worn equipment is required. In this note, a general framework for model-based fault detection and diagnosis of a class of incipient faults is developed. The changes in the system dynamics due the fault are modeled as nonlinear functions of the state and input variables, while the time profile of the failure is assumed to be exponentially developing. An automated fault diagnosis architecture using nonlinear on-line approximations with an adaptation scheme is designed and analyzed. A simulation example of a simple nonlinear mass-spring system is used to illustrate the results.

WA1 Nonlinear Systems

WA1-5

On Feedback Linearization Solution

M. Hou, A. C. Pugh

Abstract

Based upon a condensed Brunovsky form, feedback linearization for both single-input and multi-input nonlinear systems is derived in a unified manner. The derivation appears considerably simpler than the known derivations for the multi-input case. A straightforward characterization of the coordinate transformation required in the feedback linearization is provided.

WA1 Nonlinear Systems

WA1-6

On Singular Phenomena in Certain Time-Optimal Feedback System Operating by Discontinuous Resistance

Wladyslaw Hejmo

Abstract

The purpose of this paper is to present the solution of selected time-optimal problems of the controlled object the dynamics of which is given by: $dx/dt = y$, $dy/dt = f(x) + u$, where $|u| \leq 1$ and motion resistance function $f(x) = 0$ if $x < 0$, and $f(x) = -A$ if $x \geq 0$ where $0 \leq A < 1$. That model describes dynamics of a very important class of industrial installations.

WA1 Nonlinear Systems

WA1-7

Emergency Control of Unstable Behavior of Nonlinear Systems Induced by Fault

Mark A. Pinsky, Michael V. Basin

Abstract

This paper presents the emergency control approach intended to urgently return to the stability basin the system states affect by abrupt changes in certain system coefficient on a short time interval. Because of its short duration, the modeling of both the fault and controller involves delta- functions significantly simplifying analysis and control of fault phenomena. The design of an emergency controller is based on the technique for computing fault-induced jumps of the system states, which is described in the paper. A sample emergency controller instantaneously returning states of a Van-der-Pol system to the stability basin is designed.

WA2 Applications

WA2-1

A Symbolic Sensor for an Antilock Brake System of a Commercial Aircraft

B. Ewers, J. Bordeneuve-Guibe, Corrine Langlois

Abstract

The design of a *symbolic sensor* that identifies the condition of the runway surface (dry, wet, icy, etc.) during the braking of a commercial aircraft is discussed. The purpose of such a sensor is to generate a qualitative, real-time information about the runway surface to be integrated into the future aircraft Antilock Breaking System (ABS). It can be expected that this information can significantly improve the performance of ABS. For the design of the symbolic sensor different classification techniques based upon fuzzy set theory and neural networks are proposed. To develop and to verify these classification algorithms data recorded from recent breaking tests have been used. The results show that the symbolic sensor is able to correctly identify the surface condition. Overall, the application example considered in this paper demonstrates that symbolic information processing using fuzzy logic and neural networks has the potential to provide new functions in control system design. The paper is part of a common research project between E.N.S.I.C.A. and Aerospatiale in France to study the role of the fuzzy set theory for potential applications in future aircraft control systems.

WA2 Applications

WA2-2

Multivariable Predictive Controller for a Test Stand of Air Conditioning

Cyril Vaucoret, Joel Bordeneuve-Guibe

Abstract

In this paper, a Multivariable Predictive Control (MPC) algorithm is developed and applied to an industrial test stand for aircraft air conditioning systems. This process has to satisfy a very strict specifications sheet over a large operating range in order to simulate the working conditions of the aircraft equipment. Multivariable identification tests have been carried out to model the system and are reported here. Finally, comparisons through simulation studies between the existing PID regulation and the proposed MPC point out a great improvement of performance.

WA2-3

Hinf Control Design for an Adaptive Optics System

Nikolaos Denis, Douglas Looze, Jim Huang, David Castanon

Abstract

In this paper we first present a full order Hinf controller for a multi-input, multi-output (MIMO) adaptive optics system. We apply model reduction techniques to the full order Hinf controller and demonstrate that the closed loop system with the reduced order Hinf controller achieves the same high level of performance. Upon closer examination of the structure of the reduced order Hinf controller it is found that the dynamical behavior of the reduced order Hinf controller can be accurately approximated by a single-input, single-output (SISO) transfer function multiplied by the inverse of the adaptive optics plant dc gain. This observation then leads to a general design methodology which only requires the synthesis of a SISO Hinf controller and multiplication by constant matrices.

WA2 Applications

WA2-4

Optimal Fixture Design for Drilling in Elastically Deforming Plates

K. Wardak, U. Tasch, P. G. Charalambides

WA2 Applications

WA2-5

Development of Mold Level Controller Using Sliding Mode Control in Continuous Casting Processing

Seung Ryeol Yoo, Young Seub Kueon

Abstract

A sliding mode control was applied to mold level control in the continuous casting process. The parameters of the mathematical model are obtained by simulation with the data measured in POSCO's no.2 caster and adjusted though on-line test. The new controller based on VME bus system has parallel interface with a conventional controller. The sliding gate can be controlled by the controller selected between the developed and the conventional controller. Developed controller takes account of casting speed, tundish weight, mold width and etc. the deviation magnitude of the mold level was reduced by the developed controller.

WA2 Applications

WA2-6

Modeling and Simulation of Blood Pump for Controller Development

Yih-Choung Yu, James F. Antaki, J. Robert Boston, Marwan Simaan, Phil J. Miller

Abstract

A mathematical model describing pressure-volume relationship of the Novacor left ventricular assist system (LVAS) was developed. The model consisted of lumped resistance, capacitance, and inductance elements with one time-varying capacitor to simulate the cyclical pressure generation of the system. The ejection and filling portions of the pump cycle was modeled with two separate functions. The corresponding model parameters were estimated by least squares fit to experimental data obtained in the laboratory. The model performed well at simulating pump pressure of operation throughout the full cycle. Computer simulation of the pump with a cardiovascular model demonstrated the interaction between the LVAS with the cardiovascular system. This model can be used to incorporate on-line cardio-vascular parameter estimation and to design a new controller for the LVAS.

WA2 Applications

WA2-7

The Control and Structures Research Laboratory (CSRL): A Control-Oriented Test-Bed for Large Segmented Reflectors

Majdedin Mirmirani, Helen R. Boussalis, Khosrow Rad, Mohluddin Ahmed, Anastasios Chassiakos, Petros Ioannou, Elias Kosmatopoulos

Abstract

Because of the weight and volume constraints of space-borne instruments segmented reflectors have become only the practical choice for future astrophysical missions. While a monolithic reflector depends on the mechanical properties of its material to provide the dimensional stability required for good optical performance, a segmented reflector requires an active segment-alignment control system in order to make the reflecting surface have the optical performance of a monolithic unit. This paper describes an experimental test-bed that is being developed at the Control and Structures Research Laboratory (CSRL) at California State University, Los Angeles (CSULA). The CSRL test-bed is a 2.4m focal length Cassegrain optical configuration consisting of a 2.66m actively controlled segmented primary and an active secondary. The primary consists of six hexagonal panels surrounding a fixed central panel and supported by a light-weight flexible truss structure. The project has been founded by NASA to study the complex dynamic behavior of large segmented optical systems.

WA3-1

I1-Optimal Control for Multirate Systems Under Full State Feedback

Johannes Aubrecht, Petros G. Voulgaris

Abstract

This paper considers the minimization of the Iinf-induced norm of the closed loop in linear multirate systems when full state information is available for feedback. A state-space approach is taken and concepts of viability theory and controlled invariance are utilized. The essential idea is to construct a set such that the state may be confined to that set and that such a confinement guarantees that the output satisfies the desired output norm conditions. Once such a set is computed, it is shown that a memoryless nonlinear controller results, which achieves near-optimal performance. The construction involves the solution of several finite linear programs and generalizes to the multirate case earlier work on linear time-invariant systems (LTI).

WA3 Linear Systems II

WA3-2

Ellipsoidal Bounding in Stable Predictive Control

M. Cannon, B. Kouvaritakis

Abstract

Efficient algorithms for approximate minimization of constrained infinite horizon predictive control costs are presented. The resulting control laws have guaranteed stability and asymptotic tracking, and comparable performance with existing QP-based control laws.

WA3 Linear Systems II

WA3-3

Constrained Stable Predictive Control: An I2-optimal Approach

B. Kouvaritakis, J. A. Rossiter, M. Cannon

Abstract

Perturbations on l2-optimal solutions are used for the derivation of efficient/feasible predictive algorithms.

WA3 Linear Systems II

WA3-4

The Performance of Generalized Minimum Variance System Identification

Odell R. Reynolds, Meir Pachter

Abstract

In this paper, a comparison is made between the novel Generalized Minimum Variance and established generalized Least Squares estimation algorithms. The emphasis of the Generalized Minimum Variance algorithm is on the proper treatment of measurement noise for dynamical system identification. The algorithms are compared in a carefully performed, reproducible experiments which include measurement noise. Differences are apparent under small measurement samples, but the two appear to produce statistically similar results asymptotically.

WA3-5

Weighted Hinf Mixed-Sensitivity Minimization for Stable Distributed Parameter Plants Under Sampled-Data Control

Delano R. Carter, Armando A. Rodriguez

Abstract

This paper considers the problem of designing near-optimal finite-dimensional controllers for stable multiple-input multiple-output (MIMO) distributed parameter plants under sampled-data control. A weighted Hinf-style mixed-sensitivity measure which penalizes the control is used to define the notion of optimality. Controllers are generated by solving a "natural" finite-dimensional sampled-data optimization. A priori computable conditions are given on the approximations such that the resulting finite-dimensional controllers stabilize the sampled-data controlled distributed parameter plant and are near-optimal. The proof relies on the fact that the control input is appropriately penalized in the optimization. This technique also assumes and exploits the fact that the plant can be approximated uniformly by finite-dimensional systems. Moreover, it is shown how the optimal performance may be estimated to any desired degree of accuracy by solving a single finite-dimensional problem using a suitable finite-dimensional approximant. The proofs and constructions given are simple. Finally, it should be noted that no infinite-dimensional spectral factorizations are required. In short, the paper provides a straight forward control design approach for a large class of MIMO distributed parameter systems under sampled-data control.

WA3-6

On Sampled-Data Control Systems With Discontinuous Output

Marian J. Blachuta

Abstract

Discrete-time models of sampled-data control systems are addressed when both a continuous-time plant and a discrete-time controller have feedthrough. It is pointed out that in this case discrete-time models which can be found in most references should not be used in the closed-loop context. A new state-space model appropriate for the closed-loop modeling, and formulae for calculating the related discrete-time pulse transfer functions are derived. Intersample phenomena are studied and the feasibility of that model to describe systems with parasitic dynamics is emphasized. Examples from the literature illustrate the relevance of the issue.

WA4 Automotive Systems

WA4-1

Macroscopic Traffic Flow Modeling of Automated Highway Systems

H. Raza, P. Ioannou

Abstract

An accurate macroscopic traffic flow model of automated highways is necessary not only for analyzing the collective dynamical behavior of automated vehicles but also for designing control laws to improve system level performance. In this paper a macroscopic model for describing the traffic flow on automated highways is developed by using the microscopic control laws that govern the motion of individual vehicles. Some assumptions were used to derive the instantaneous speed and density profiles from the kinematics of individual vehicles. We have given enough structure to the modeling task, so that the model is independent of the implementation details, hence can be applied to a wide variety of automated highway concepts. The developed model can be used to analyze the steady state behavior of AHS traffic flow for different operating conditions and is currently under study. We plan to use the results of this analysis as guidelines for designing macroscopic as well as microscopic control laws.

WA4-2

Robust Prevention of Limit Cycles for Robustly Decoupled Car Steering Dynamics

Juergen Ackermann, Tilman Buente

Abstract

Considerable safety benefits are achieved by robustly decoupling the lateral and yaw motions of a car with active steering. Robust unilateral decoupling requires an actuator to generate an additional front wheel steering angle. However, introducing actuators to closed loop systems may cause undesired limit cycles due to actuator saturation and rate limits. By introducing a simple nonlinear modification of the control law, this paper proposes a remedy to prevent limit cycles for robustly decoupled car steering dynamics. The robustness of the resulting system w.r.t. the avoidance of limit cycles is investigated for varying operating conditions by combining the parameter space approach and the theory of describing functions.

WA4 Automotive Systems

WA4-3

Modular Design for the Computation of Vehicle Dynamic Behavior

R. Majjad, U. Kiencke

Abstract

In the last years many efforts have been done to develop simulation models. These models need a lot of computational time. This paper presents a new modular simulation to avoid these problems. This approach requires a good tire model to take the nonlinearities into account which have a significant influence on the dynamic behavior of the car. The process of composing the model is modular and consists of several sub-models (tires, chassis, suspension, steering, wind, road). Each of them can be developed independently. The advantage of the simulation is the reduction of time and costs for designing and engineering different controller concepts or vehicle safety systems. It will be proved with different examples that this simulation gives good results for the realistic behavior of the vehicle. The time of simulation is reduced by minimizing the coordinate transformations.

WA4 Automotive Systems

WA4-4

Identification of Parameters for Complex Vehicle Models

R. Majjad, M. Hafner

Abstract

In the last years many efforts have been done to develop simulation models. These models need a large amount of parameters. Many of these parameters are unknown and difficult to measure. A precise knowledge of interior parameters of the car is necessary to be able to make a model which delivers accurate and reliable results. This paper presents the identification of some important parameters concerning the dynamical behavior of the vehicle. These parameters are the load slope ε and the moments of inertia J_X, J_Y, J_Z for the x-, y- and z-axis and the mass of the chassis. To achieve this goal, a non-linear observer will be used to calculate and to validate the wheel forces which are needed as input values for an estimator. The five parameters are estimated using a RLS method. According to measurements in a test car our method delivers a very good estimation for the behavior of the vehicle.

WA4-5

Fuzzy Parking and Point Stabilization:Application Car Dynamics Model

S. Bentalba, A. El Hajjaji, A. Rachid

Abstract

The first specific problem in this paper is to park a car to a given goal x-position at right angle starting from a given configuration by controlling the acceleration or deceleration force and steering angle of wheels. After dealing with the parking problem, two fuzzy controllers are proposed, the first generates the steering angle from position and orientation errors of the car, while the second controller generates the acceleration or deceleration force from the generated steering angle and the speed of the car. From these controllers and with a geometric transformation, we design a new control method for the second purpose in this study which consists to stabilize the car to a given goal coordinates and an orientation starting from a given position. Simulation results using dynamics car are successfully performed.

WA4 Automotive Systems

WA4-6

Sliding Mode Control of a Turbocharged Diesel Engine

S. Ouenou-Gamo, A. Benchaib, A. Rachid, M. Ouladsine

Abstract

This study seeks to apply sliding mode control on a turbocharger Diesel engine. A complete physical model followed by a reduced form and taking into account thermodynamics of the different steps of the Diesel cycle has never been proposed in the literature. The study shows the role of the turbocompressor on the cylinder filling during the air intake and the exhaust phases on different engine states through thermodynamically laws. This is an attempt to describe the dynamics of the diesel engine by physical equations. The sliding mode control method is used and a solution to the multivariable system control problem is presented. A compressor power control approach is used and relationships between fluid states in the air intake and the exhaust manifold pressure are discussed.

WP1 Two-Dimensional Systems

WP1-1

A New Method for Computing the Stability Margin of Two-Dimensional Systems

Nikos E. Mastorakis

Abstract

The stability margin of 2-D (two-dimensional) Linear Shift Invariant causal single-input single-output discrete systems is investigated. A new method to compute the stability margin of 2-D continuous systems is considered. Illustrative examples are also included.

WP1 Two-Dimensional Systems

WP1-2

New Stability Test for 2-D Systems

Nikos E. Mastorakis

Abstract

In this paper, a new stability test for two-dimensional (2-D) discrete systems is presented. The proposed test is based on a simple 1-D test which is simpler but equivalent to that of Schur-Cohn. The test can be easily automated via a suitable computer code. Examples are given.

WP1 Two-Dimensional Systems

WP1-3

Reachability and Minimum Energy Control of Nonnegative 2D Roesser Type Models

Tadeusz Kaczorek

Abstract

A new class of nonnegative 2D Roesser type models is introduced. Necessary and sufficient conditions are established for the reachability of the nonnegative 2D Roesser type model for zero boundary conditions. It is shown that the nonnegative 2D Roesser type model having no nilpotent system matrix is unreachable for nonzero boundary conditions. The minimum energy control problem is formulated and solved for the nonnegative 2D Roesser type model with zero boundary conditions. The considerations are illustrated by means of a numerical example.

WP1 Two-Dimensional Systems

WP1-4

Some Results on the Dynamics of 2D Positive Systems

Ettore Fornasini, Maria Elena Valcher

WP2 Adaptive Control

WP2-1

Adaptive Control of Discrete-Time Output-Feedback Nonlinear Systems

Jiaxiang Zhao, Ioannis Kanellakopoulos

Abstract

In adaptive control design for discrete-time output-feedback nonlinear plants, the main obstacle is the lack of effective ways to design estimators for the unmeasured states and the unknown parameters. Since these quantities appear as arguments of arbitrary nonlinear functions, traditional estimation methods cannot be used. To resolve this problem, we propose a new systematic methodology by which one can recover all the necessary information about the unknown part of the system in finite time, so that a control schemes for global stabilization and tracking can be designed for such plants.

WP2 Adaptive Control

WP2-2

An Uncertainty Model Validation Approach to Adaptive Robust Linear Control

Robert E. Kosut

Abstract

It is shown that validation (unfalsification) of the standard robust control design uncertainty model is the natural replacement for system identification when the intended use of the model is robust control. The result is an "uncertainty" tradeoff curve between model uncertainty and disturbance uncertainty. Hence, a family of uncertainty models are unfalsified (validated) from the data record. The family of unfalsified models can be used in an iterative approach to system identification and robust control design. The idea can be applied iteratively to both the plant model and the resulting candidate robust control.

WP2 Adaptive Control

WP2-3

Application of a Multivariable Adaptive Controller with PID Structure to a Wastewater Treatment Plant with D-N Configuration

A. M. Macarulla, J. Florez, J. X. Ostolaza, E. Ayesa

Abstract

In this paper a multivariable adaptive controller with PID structure based on the algorithm developed by Yusof and Omatu (1993) using the Minimum Variance strategy, has been applied to a model of a municipal Wastewater Treatment Plant (WWTP) with nitrification and dinitrification processes (D-N configuration). This plant is a non-linear process with low controllability. The aim of the controller is to improve the overall performance of the system. The process must satisfy the quality requirements of the effluent water in terms of its concentrations of nitrates and ammonia. The manipulable variables are the Dissolved Oxygen level in the oxic reactor and the Internal Recycle flow rate. The results presented show the response of the plant and the controller under a seasonal variation of temperature. They prove that the operation of the plant is improved, and running costs are lower.

WP2 Adaptive Control

WP2-4

Adaptive Variable Structure Control of Robot Manipulators With Exponentially Stable Trajectories

H. Yu

Abstract

An adaptive variable structure control approach for the robot manipulators is proposed in this paper. The proposed approach avoids requirement of the uncertain parameter bounds which is adopted in the most robust control methods, and makes the tracking error converge to zero exponentially without requiring any persistent excitation. In addition, the fast parameter variations (e.g. payload variation) are allowed, unlike the conventional adaptive control method which assumed that the parameter variations are slower than the adaptive mechanism.

WP3 Linear Systems III

WP3-1

Normalized Coprime Factorizations for Discrete-Time Periodic Systems

Baohui Xie, Vassilis l. Syrmos

Abstract

In this paper the notation of Normalized Coprime Factorization (NCF) for linear discrete-time periodic systems is studied. These systems arise in the study of linear time-varying systems with periodic coefficients. The problem is approached by the study of the original linear periodic state space representation of the system instead of its linear time-invariant representation using lifting technique. It is shown that the NCF can be obtained through the solution to Discrete Periodic Riccati Equations (DPRE). The properties of the DPRE are used to study the NCF for the linear periodic systems.

WP3 Linear Systems III

WP3-2

The Tracking and Regulation Problem for a Class of Generalized Systems

Antonio Tornambe

Abstract

The tracking and regulation problem is considered for a class of generalized systems, in case of exponential reference signals and of disturbance functions. First, the notions of steady-state response and of blocking zero, which are classical for linear time-invariant systems, are given for generalized systems. Then, the tracking and regulation problem is stated and solved for the class of generalized systems under consideration, giving a general design procedure. As a corollary of the effectiveness proof of the design procedure, an algebraic version of the internal model principle is stated for generalized systems.

WP3 Linear Systems III

WP3-3

Dynamic Output Feedback Stabilization for a Class of Saturated Linear Systems

M. Klai, Y. Ait-Amirat

Abstract

This paper addresses the problem of the global stabilization of a linear system with saturating controls by means of a dynamic output feedback using a saturated linear controller built from an observer. It is shown that a simple linear control law of an optimal-like type always globally stabilizes the closed-loop system when the linear system to be controlled is asymptotically or critically stable.

WP3 Linear Systems III

WP3-4

Stabilization Independent of Delay for Saturated Linear Systems

M. Klai, Y. Ait-Amirat

Abstract

This paper deals with the problem of global stabilization independent of delay for a class of delayed linear systems subject to bounded controls. A new sufficient condition addressing the global asymptotic stabilization (G.A.S.), via saturated (static or dynamic) feedback, of such class of systems is proposed. It concerns the class of systems for which the open-loop system without time-delay term is Hurwitz.

WP3 Linear Systems III

WP3-5

Design of L.Q.G. Dissipative Controllers Using Linear Matrix Inequalities

R. Drai

Abstract

We present an application of the Linear Matrix Inequality approach to robust control to the design of multivariable L.Q.G. controllers verifying various sector conditions that generalize existing results concerning positive real systems. The main result is illustrated by considering robust attitude control of a telecommunication satellite in an acceleration maneuver.

WP4 Digital Signal Processing II

WP4-1

An Application of the EM Algorithm to Sequence Estimation in the Presence of Tone Interference

Quan G. Zhang, Costas N. Georghiades

Abstract

For a direct-sequence spread-spectrum (DS-SS) system we pose and solve the problem of maximum-likelihood (ML) sequence estimation in the presence of narrowband interference, using the expectation-maximization (EM) algorithm. It is seen that the iterative EM algorithm obtains at each iteration an estimate of the interference which is then subtracted from the data before a new sequence estimate is produced. Both uncoded and trellis coded systems are studied, and the EM-based algorithm is seen to perform well, outperforming a receiver that uses an optimized notch filter to remove the interference, especially for large interference levels.

WP4 Digital Signal Processing II

WP4-2

A Nonlinear Filtering Algorithm for the Measurement of Rainfall Drop Size Distribution

Takis Kasparis, John Lane

Abstract

Using an impulse suppression algorithm, environmental noise such as thunder and wind can be filtered from the sound of raindrops impacting an acoustic rain gauge sensor. A non-linear filter algorithm, based on a gated median filter, was previously used to suppress scratch noise from damaged phonograph records. The goal of this work is to adapt this impulse suppression algorithm and evaluate its performance in detecting and filtering the impulse signal from a sensor element of the Acoustic Rain Gauge Array at the University of Central Florida. In this case, the amplitude of each impulse is a measurement of the raindrop size impacting sensor. By subtracting the filtered signal from a delayed version of the original, the output signal contains only the drop impulses from which the raindrop size impacting the

WP4 Digital Signal Processing II

WP4-3

Invariant Line Matching Theory of Consecutive Images

Djemma Kachi, Xiao-Wei Tu

Abstract

This paper presents a general line matching method based on geometrical invariants. A line segment is characterized locally by invariant parameters under the group of displacements within an image and the scale changes. Matching is achieved through two steps, features clustering and hypothesis verification. In order to be matched, a pair of lines represented by neighboring features must satisfy geometrical constraints (relative angle and distance) in the image plane. Experiments have shown an high rate matching of different types of images. this is due to the stability of the used line invariants which lead to few hypotheses of matching, as well as the verification using geometrical constraints. Tests conducted on different images sequences have shown efficient matching of images and parts of scenes.