SOCIETY FOR INDUSTRIAL AND APPLIED MATHEMATICS

Preliminary Program

SIAM Conference on Control in the 90's: Achievements, Opportunities, and Challenges

MAY 17–19, 1989

Cathedral Hill Hotel, San Francisco, CA

Sponsored by the SIAM Activity Group on Control and Systems Theory

CONFERENCE THEMES

- Linear Systems
- Discrete Event Dynamical Systems
- Nonlinear Systems
- Stochastic Systems
- Identification and Control of Fluids
- Adaptive Control
- Computation and Control
- Optimal Control
- Estimation
- Identification
- Robust Control
- Control of Queues and Networks
- Distributed Parameter Systems
- Decentralized Control
- Robotics
- H-Infinity Control

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PROGRAM COMMITTEE

ORGANIZING COMMITTEE

INVITED PRESENTATIONS

Wednesday, May 17, 8:00 AM
Invited Presentation 1
Trends and Opportunities in Control Theory

During the last two decades, there has been an increasing diversity of mathematical tools used in control theory. In parallel, there has been an increasing number of opportunities for applications of control theoretic concepts.

On the one hand, the increased diversity of mathematical tools and approaches has enriched the body of knowledge represented by control theory. On the other, lateral communication between researchers in the various branches of control theory has become more difficult than ever before, and therefore also the training of new scientists in these areas.

The application of control theoretic concepts is being driven by rapid progress in computer technology. New applications often require mathematical models different from those traditionally used in control theory.

The speaker will address these and other broad questions in context with the present status of control theory.

Andrzej Z. Manitius
School of Information Technology and Engineering
George Mason University

Wednesday, May 17, 8:45 AM
Invited Presentation 2
State Space Computing: Past, Present, and Future

The speaker will survey numerical computing in control and system theory with particular emphasis on algorithms, numerical analysis, and mathematical software used for state space models. Some brief historical remarks will be followed by an assessment of the development and state-of-the-art in several key areas. One of these areas, which illustrates especially well the synergy that has existed between control and numerical linear algebra, will be the numerical solution of Riccati equations. Estimates of future trends in numerical computing for control will be presented, including remarks on parallel algorithms and algorithmically dedicated architectures.

Alan J. Laub
Department of Electrical and Computer Engineering
University of California, Santa Barbara

Wednesday, May 17, 1:15 PM
Invited Presentation 3
Adaptive Control

The goal of adaptation is to utilize the information contained in the output of a system while it is still evolving, in order to tune the controller itself in real-time so as to attain various objectives such as stabilizing the system at hand, ensuring that the output follows a given target trajectory, or even optimizing some measure of performance.

Over the last two decades this field of adaptive control has undergone considerable development in respect to theoretical understanding and practical implementation. Numerous successful practical applications have been reported, especially in the field of process control; and commercial adaptive controllers are now available.

The dynamic behavior of the overall adaptively controlled system, which includes both the dynamics of the system under control as well as the dynamics of the adaptation mechanism itself, is characterized by a set of nonlinear difference or differential equations. In addition, frequently there is "noise" entering the system, whose characteristics, such as spectral density, are unknown.

The speaker will survey the advances that have been made in designing adaptive controllers and in analyzing the complex nonlinear, possibly stochastic, dynamics involved. The key ideas behind the demonstrations of stability of the overall system and the self-tuning property of the adaptive controller will be explained.

Panganamala R. Kumar
Department of Electrical Engineering
University of Illinois, Urbana

Thursday, May 18, 8:00 AM
Invited Presentation 4
The Exemplary Behavior of Linear Controllers

There has always been a natural symbiosis between the mathematical framework used for describing dynamical systems and the principles being used in control theory. In this development, linear systems theory — from frequency domain descriptions to the state space methodology to polynomial matrix descriptions to co-prime factorizations — has played the pioneering role. In this talk, we will first review how dynamical systems can be formalized with variables as important supporting characters. This framework encompasses input/output and state space descriptions as special cases and, as a vantage point, has the benefit of being independent of the particular structure of the behavioral equations. We will subsequently cast interconnection and (feedback) control in this setting, with the latter viewed as a special type of interconnection. We will finally use this framework to find algorithms for computing the optimal least squares controller for linear systems described by an equation of the type $R(\sigma)\omega = 0$ with $R(s)$ a polynomial matrix and σ differentiation or the shift. The crucial role in these algorithms is played by a quadratic polynomial matrix equation.

Jan C. Willems
Mathematics Institute
University of Groningen, The Netherlands

Thursday, May 18, 8:45 AM
Invited Presentation 5
Trends and Recent Developments in Stochastic Control Theory

Broadly speaking, stochastic control theory is concerned with recursive estimation and control for systems with uncertainties modelled as random variables or random processes. The theory is motivated by application in such diverse areas as aerospace guidance and control, signal processing and communications, manufacturing processes and financial economics. Mathematical theories of optimal stochastic control, for models based on stochastic differential equations and Markov diffusion processes, are well developed. They have close connections with the theory of viscosity solutions of nonlinear partial differential equations. In addition, ideas from control and calculus of variations enter in the theory of large deviations, which is concerned with asymptotic estimates for probabilities of rare events associated with stochastic processes.

Another direction is the control of discrete event dynamical systems, such as those arising in computer/communication networks and production or assembly lines. Typical kinds of control actions involve scheduling of tasks, routing of messages, and dynamic resource allocation.

PROGRAM DESIGN: TOM JACKSON

INVITED PRESENTATIONS

A long standing problem has been to find computationally implementable algorithms for stochastic control and nonlinear estimation. Notwithstanding the difficulties, recent progress has been encouraging.

Wendell H. Fleming
Division of Applied Mathematics
Brown University

Thursday, May 18, 1:15 PM
Invited Presentation 6
Modeling and Control of Discrete Event Dynamical Systems

A discrete event dynamical system (DEDS) is a dynamical system whose behavior is governed by a sequence of discrete events, which occur at asynchronous and possibly unknown time intervals. For example, an event may represent the arrival of a vehicle in the traffic system, the arrival of a message in the communication system or the completion of a task, the breakdown or repair of a machine, or a reconfiguration of the system in a flexible manufacturing system. Such systems arise in a wide variety of applications, most of which are complex man-made systems, such as flexible manufacturing systems, data communications and computer networks, multi-mode control systems for reconfigurable aircraft and for computer-controlled subsystems of automobiles, data base management, and computer operating systems.

The speaker will examine a number of models and techniques that have been proposed for DEDS, with an emphasis on possible control applications. Such models and techniques include models based on traces or formal languages, petri nets, communicating sequential processes, models based on temporal or modal logic, queueing models, generalized semi-Markov processes, and perturbation analysis. The basic message will be that DEDS represents a new and challenging research area for control theorists and applied mathematicians, and that a combination of techniques from formal logic and languages, computer science, control theory, queueing theory, and random processes will be required.

Steven I. Marcus
Department of Electrical Engineering
University of Texas, Austin

Friday, May 19, 8:00 AM
Invited Presentation 7
Controllability, Stabilization, and Identification of Distributed Systems

The speaker will review some of the ideas and techniques of controllability and, in particular, provide an updating of the main trends in connection with the Hilbert Uniqueness Method introduced in his John von Neumann lecture at the SIAM annual meeting in 1986.

Applications leading to new problems will be indicated, with examples taken from (1) the stabilization of structures, including numerical methods and multi-bodies, and (2) the identification of systems and validation of models.

Jacques-Louis Lions
College de France and Centre National d' Etudes Spatiales, Paris

Friday, May 19, 8:45 AM
Invited Presentation 8
Feedback Control of Nonlinear Systems

In the last two decades, there has been an ever-increasing interest in the control of systems modeled by nonlinear ordinary differential equations. After an earlier phase of research addressed to the understanding of certain fundamental issues like controllability and observability, most of the attention was focused on the analysis and design of feedback structures, in which a control law based on information about the internal state of the system is implemented in order to achieve prescribed performances.

The contribution of some relevant differential-geometric concepts was instrumental in successfully solving problems such as transformation (via feedback and the changing of coordinates) into a linear controllable system, disturbance rejection, noninteracting control with internal stability, and matching of prescribed reference trajectories.

More recently, important progress is being made in developing systematic methods for asymptotic stabilization and output regulation. In addition, the problem of rendering a nonlinear control strategy adaptive with respect to plant parameter variations is being addressed. The first practical implementations of these newly developed design procedures, which include, for example, the control of high performance aircraft, elastic robots, and distillation plants, show definite improvement versus the results obtained by standard design techniques based on linear approximation around operating points.

The speaker will review the recent developments in nonlinear feedback design, and provide a perspective of open problems and trends that are driving the field.

Alberto Isidori
Dipartimento di Informatica e Sistemistica
Universita degli Studi di Roma, Italy

Friday, May 19, 1:15 PM
Invited Presentation 9
Identification and Control of Fluid Flow Systems

During the past ten years, several events have combined to produce an unusual opportunity for research in the areas of identification and control of fluid flow systems. In addition to the breakthroughs in computer technology, there have been remarkable developments in both theoretical and computational aspects of control theory. These technological advances have already had considerable impact on many areas of science, such as computational fluid dynamics, combustion, structural analysis and computational physics. Moreover, the ability to perform fast large scale computations provides the possibility of developing practical control and estimation algorithms for a variety of complex fluid-structural interaction problems. These developments along with the emergence of several new applications, provided a unique opportunity for modeling, active control and estimation of fluid dynamic systems.

The speaker will discuss potential applications of fluid flow control to active flutter suppression, acoustics, supermaneuverable aircraft and turbomachinery, and review some preliminary experimental and computational work. He will consider several problems unique to development of mathematical models for control design.

John A. Burns
Interdisciplinary Center for Applied Mathematics
Department of Applied Mathematics
Virginia Polytechnic Institute and State University

MINISYMPOSIA

1. **Stabilization of Distributed Parameter Systems**
   John E. Lagnese
   Georgetown University
2. **Symbolic Algebra, The Lie Theory of Differential Equations and Control**
   John Baras
   University of Maryland, College Park
3. **Optimization and Design 1**
   Elijah Polak
   University of California, Berkeley; and
   Roger J-B Wets
   University of California, Davis
4. **Complicated Dynamics and Control: Fluids, Circuits, and Feedback Systems**
   Anthony M. Bloch and David F. Delchamps
   Cornell University
5. **Singular Systems**
   Angelika Bunse-Gerstner
   Universitat Bielefeld, West Germany
6. **Adaptive Control: A Panel Discussion**
   Panganamala R. Kumar
   University of Illinois, Urbana
7. **Geometric Methods in Linear Control Theory 1**
   Joyce O'Halloran
   Portland State University
8. **Optimization and Design 2**
   Elijah Polak
   University of California, Berkeley; and
   Roger J-B Wets
   University of California, Davis
9. **Feedback Control of Distributed Parameter Systems**
   K. Ito and H. Thomas Banks
   Brown University
10. **Geometric Methods in Linear Control Theory 2**
    Joyce O'Halloran
    Portland State University
11. **Robustness of Nonlinear and Adaptive Control**
    Petar V. Kokotovic
    University of California, Santa Barbara
12. **Applications of Set Valued Calculus to Problems of Control**
    M. I. Krasovski
    Institute of Automatic Control, Sverdloski, U.S.S.R.; and
    A. Kurzhanski
    Arizona State University
13. **Structured Matrix Eigenproblems in Signal Processing and Control**
    Gregory S. Ammar
    Northern Illinois University
14. **Singular Stochastic Control**
    Wendell H. Fleming,
    Brown University; and
    Steve Shreve,
    Carnegie-Mellon University
15. **Robust Stability of Parametrized Linear Systems**
    L. Saydy,
    University of Maryland, College Park; and
    B.R. Barmish,
    University of Wisconsin, Madison
16. **Numerical Methods for Optimal Control Problems**
    Ekkehard W. Sachs
    University of Trier, West Germany (now visiting at North Carolina State University and Rice University)
17. **Equivalence, Control, and the Calculus of Variations**
    Robert B. Gardner
    University of North Carolina, Chapel Hill

MINISYMPOSIA

18. **Current Research in Discrete Event Dynamical Systems**
Steven I. Marcus,
University of Texas, Austin; and
Peter J. Ramadge,
Princeton University

19. **Stochastic Dynamic Optimization 1**
Pravin Varaiya,
University of California, Berkeley; and
Roger J-B Wets,
University of California, Davis

20. **Numerical Optimization Over Stable Systems 1**
William Helton
University of California, San Diego

21. **Nonsmooth Analysis Approach to Control Problems**
H. Frankowska
Universite Paris-Dauphine, France

22. **Adaptive Control: Recent Results**
Kostas S. Tsakalis
Arizona State University

23. **Challenges and Future Directions in Discrete Event Dynamical Systems**
Steven I. Marcus
University of Texas, Austin; and
Peter J. Ramadge
Princeton University

24. **Stochastic Dynamic Optimization 2**
Pravin Varaiya
University of California, Berkeley; and
Roger J-B Wets
University of California, Davis

25. **Numerical Optimization Over Stable Systems 2**
William Helton
University of California, San Diego

26. **Numerical and Experimental Aspects of Distributed Parameter Control**
Goong Chen
Texas A&M University

27. **Robustness of Adaptive Controllers**
Kostas S. Tsakalis
Arizona State University

28. **Global Methods in Control**
Efim A. Galperin
Universite du Quebec a Montreal, Canada

29. **Stabilization of Nonlinear Systems**
W. P. Dayawansa
Texas Tech University

30. **Sequential and Parallel Matrix Computations in Control**
Biswa N. Datta
Northern Illinois University

31. **Observability: Theory and Numerical Practice**
Clyde F. Martin
Texas Tech University

32. **Combinatorial Aspects of Control Algorithms**
Robert Grossman
University of Illinois, Chicago

33. **Problems in Flow Control and Related Areas 1**
Max D. Gunzburger
Los Alamos National Laboratory; and
Thomas P. Svobodny
Virginia Polytechnic Institute and State University

34. **Dynamics and Stability of Deformable Bodies**
John Baillieul and John H. Maddocks
University of Maryland, College Park

35. **New Algebraic Trends in Nonlinear Control Theories**
Michel Fliess
Laboratoire des Signaux et Systems
C.N.R.S.-ESE, France

36. **Optimization-Based Design of Control Systems**
Andre Tits and Michael Fan
University of Maryland, College Park

37. **Challenges in Time Varying System Theory**
Bijoy K. Ghosh
Washington University, St. Louis, MO

38. **Problems in Flow Control and Related Areas 2**
Max D. Gunzburger
Los Alamos National Laboratory; and
Thomas P. Svobody
Virginia Polytechnic Institute and State University

39. **Robot Control as a System Control Problem**
Tzyh-Jong Tarn
Washington University, St. Louis, MO

40. **Advances in Lie Theoretic Methods**
Matthias Kawski
Arizona State University

41. **Nonlinear Differential Algebraic Equations and Control Theory**
Stephen L. Campbell
North Carolina State University

42. **Reciprocal and Noncausal Processes**
Arthur J. Krener
University of California, Davis; and
M. Clark
Imperial College of Science and Technology, U.K.

43. **Computational Methods in Parameter Identification**
John Lund
Montana State University

SPECIAL EVENTS

Welcoming Reception
Tuesday, May 16, 1989
7:00 PM - 9:00 PM
Mezzanine
Cash Bar

Beer Party
Wednesday, May 17, 1989
6:45 PM - 8:30 PM
Mezzanine
The beer party will consist of beer, assorted sodas, make your own tacos, and mini burritos.
Cost: $15.00

PROGRAM-AT-A-GLANCE

Tuesday, May 16/PM

6:00 PM/Mezzanine
Registration Opens

7:00 PM/Mezzanine
Welcoming Reception

9:00 PM/Mezzanine
Registration Closes

Wednesday, May 17/AM

6:45 AM/Mezzanine
Registration Opens

7:45 AM/Ballroom
Opening Remarks

8:00 AM/Ballroom
Invited Presentations 1 and 2
Chair: Arthur J. Krener
University of California, Davis

8:00 AM
Trends and Opportunities in Control Theory
Andrzej Z. Manitius
George Mason University

8:45 AM
State Space Computing: Past, Present, and Future
Alan J. Laub
University of California, Santa Barbara

9:30 AM/ Mezzanine
Coffee

*10:00 AM/*CONCURRENT SESSIONS

Minisymposium 1/Ballroom
Stabilization of Distributed Parameter Systems
Chair: John E. Lagnese
Georgetown University

Minisymposium 2/Cathedral Hill A
Symbolic Algebra, The Lie Theory of Differential Equations and Control
Chair: John Baras
University of Maryland, College Park

Minisymposium 3/Cathedral Hill B
Optimization and Design 1
Chairs: Elijah Polak, University of California, Berkeley and Roger J-B Wets, University of California, Davis

Minsymposium 4/El Dorado
Complicated Dynamics and Control: Fluids, Circuits, and Feedback Systems
Chairs: Anthony M. Bloch and David F. Delchamps
Cornell University

Minisymposium 5/Pacific Heights
Singular Systems
Chair: Angelika Bunse-Gerstner
Universitat Bielefeld, West Germany

Contributed Presentations 1/Sea Cliff
Applications
Chair: Manfred Morari
California Institute of Technology

Contributed Presentations 2/Japanese Tea Room
H-Infinity Control
Chair: Dennis S. Bernstein
Harris Corporation, Melbourne, FL

Contributed Presentations 3/Room 378
Robust and Adaptive Control
Chair: A. Stephen Morse
Yale University

Wednesday, May 17/PM

12:00 Lunch

1:15 PM/Ballroom
Invited Presentation 3
Chair: Christopher I. Byrnes
Arizona State University

Adaptive Control
Panganamala R. Kumar
University of Illinois, Urbana

2:00 PM/
Break (no coffee)

*2:15 PM/*CONCURRENT SESSIONS

Minisymposium 6/Ballroom
Adaptive Control: A Panel Discussion
Chair: Panganamala R. Kumar
University of Illinois, Urbana

Minisymposium 7/Cathedral Hill A
Geometric Methods in Linear Control Theory I
Chair: Joyce O'Halloran
Portland State University

Minsymposium 8/Cathedral Hill B
Optimization and Design 2
Chairs: Elijah Polak, University of California, Berkeley; and Roger J-B Wets, University of California, Davis

Contributed Presentations 4/El Dorado
Beams
Chair: Mladen Luksic
Digital Equipment Corporation, Colorado Springs, CO

Contributed Presentations 5/Pacific Heights
Digital Filters in One or More Dimensions
Chair: David F. Delchamps
Cornell University

Contributed Presentations 6/Sea Cliff
Stochastic Systems
Chair: G. Yin
Wayne State University

Contributed Presentations 7/Japanese Tea Room
Networks and Communication Systems
Chair: Geert Jan Olsder
Delft University of Technology, The Netherlands

Contributed Presentations 8/Room 378
Singular and Periodic Systems
Chair: Stephen L. Campbell
North Carolina State University

4:15 PM/Mezzanine
Coffee

*4:30 PM/*CONCURRENT SESSIONS

Minisymposium 9/Ballroom
Feedback Control of Distributed Parameter Systems
Chairs: K. Ito and H. Thomas Banks
Brown University

Minisymposium 10/Cathedral Hill A
Geometric Methods in Linear Control Theory 2
Chair: Joyce O'Halloran
Portland State University

Minisymposium 11/Cathedral Hill B
Robustness of Nonlinear and Adaptive Control
Chair: Petar V. Kokotovic
University of California, Santa Barbara

Minisymposium 12/El Dorado
Applications of Set Valued Calculus to Problems of Control
Chairs: M. I. Krasovski, Institute of Automatic Control, Sverdloski, U.S.S.R.; and A. Kurzhanski, Arizona State University

Minisymposium 13/Pacific Heights
Structured Matrix Eigenproblems in Signal Processing and Control
Chair: Gregory S. Ammar
Northern Illinois University

Contributed Presentations 9/Sea Cliff
Stability of Families of Systems
Chair: Dragoslav D. Siljak
Santa Clara University

Contributed Presentations 10/Room 378
Identifications
Chair: Peter E. Caines
McGill University, Montreal

PROGRAM-AT-A-GLANCE

Thursday, May 18/AM

8:00 AM/Ballroom
Invited Presentations 4 and 5
Chair: Jane K. Cullum
IBM T. J. Watson Research Center

8:00 AM
The Exemplary Behavior of Linear Controllers
Jan C. Willems
University of Groningen, The Netherlands

8:45 AM
Trends and Recent Developments in Stochastic Control Theory
Wendell H. Fleming
Brown University

9:30 AM/Mezzanine
Coffee

*10:00 AM/*CONCURRENT SESSIONS

Minisymposium 14/Ballroom
Singular Stochastic Control
Chairs: Wendell H. Fleming, Brown University; and Steve Shreve, Carnegie-Mellon University

Minisymposium 15/Cathedral Hill A
Robust Stability of Parametrized Linear Systems
Chairs: L. Saydy, University of Maryland, College Park; and B.R. Barmish, University of Wisconsin, Madison

Minisymposium 16/Cathedral Hill B
Numerical Methods for Optimal Control Problems
Chair: Ekkehard W. Sachs
University of Trier, West Germany (now visiting at North Carolina State University and Rice University)

Minsymposium 17/Sea Cliff
Equivalence, Control, and the Calculus of Variations
Chair: Robert B. Gardner
University of North Carolina, Chapel Hill

Contributed Presentations 11/El Dorado
Nonlinear Systems 1
Chair: Alberto Isidori
Universita degli Studi di Roma, Italy

Contributed Presentations 12/Pacific Heights
Systems with Delays
Chair: David Gilliam
Texas Tech University

Contributed Presentations 13/Japanese Tea Room
Flexible Structures
Chair: Raymond C. Montgomery
NASA Langley Research Center

Contributed Presentations 14/Room 378
Decentralized Control and Estimation
Chair: Tamer Basar
University of Illinois, Urbana

Thursday, May 18/PM

12:00 PM/Lunch

1:15 PM/Ballroom
Invited Presentation 6
Chair: Biswa N. Datta
Northern Illinois University

Modeling and Control of Discrete Event Dynamical Systems
Steven I. Marcus
University of Texas, Austin

2:00 PM/
Break (no coffee)

*2:15 PM/*CONCURRENT SESSIONS

Minisymposium 18/Ballroom
Current Research in Discrete Event Dynamical Systems
Chairs: Steven I. Marcus, University of Texas, Austin; and Peter J. Ramadge, Princeton University

Minisymposium 19/Cathedral Hill A
Stochastic Dynamic Optimization I
Chairs: Pravin Varaiya, University of California, Berkeley; and Roger J-B Wets, University of California, Davis

Minisymposium 20/Cathedral Hill B
Numerical Optimization Over Stable Systems 1
Chair: William Helton
University of California, San Diego

Minisymposium 21/Pacific Heights
Nonsmooth Analysis Approach to Control Problems
Chair: H. Frankowska
Universite Paris-Dauphine, France

Minisymposium 22/Sea Cliff
Adaptive Control: Recent Results
Chair: Kostas S. Tsakalis
Arizona State University

Contributed Presentations 15/El Dorado
Nonlinear Systems 2
Chair: William M. Boothby
Washington University, St. Louis, MO

Contributed Presentations 16/Room 378
Optimal Control of Distributed Parameter Systems
Chair: John Burns
Virginia Polytechnic Institute and State University

Poster Session/Mezzanine
(Set up 12:00 PM-1:15 PM)

4:15 PM/Mezzanine
Coffee

*4:30 PM/*CONCURRENT SESSIONS

Minisymposium 23/Ballroom
Challenges and Future Directions in Discrete Event Dynamical Systems
Chairs: Steven I. Marcus, University of Texas, Austin and Peter J. Ramadge, Princeton University

Minisymposium 24/Cathedral Hill A
Stochastic Dynamic Optimization 2
Chairs: Pravin Varaiya, University of California, Berkeley and Roger J-B Wets, University of California, Davis

Minisymposium 25/Cathedral Hill B
Numerical Optimization Over Stable Systems 2
Chair: William Helton
University of California, San Diego

Minisymposium 26/Pacific Heights
Numerical and Experimental Aspects of Distributed Parameter Control
Chair: Goong Chen
Texas A&M University

Minisymposium 27/Sea Cliff
Robustness of Adaptive Controllers
Chair: Kostas S. Tsakalis
Arizona State University

Minsymposium 28/Room 378
Global Methods in Control
Chair: Efim A. Galperin
Universite du Quebec a Montreal, Canada

Contributed Presentations 17/El Dorado
Nonlinear Dynamics
Chair: Wolfgang Kliemann
Iowa State University

6:45 PM/Mezzanine
Beer and Taco Party

PROGRAM-AT-A-GLANCE

Friday, May 19/AM

8:00 AM/Ballroom
Invited Presentations 7 and 8
Chair: H. Thomas Banks
Brown University

8:00 AM
Controllability, Stabilization, and Identification of Distributed Systems
Jacques-Louis Lions
College de France and Centre National d' Etudes Spatiales, Paris

8:45 AM
Feedback Control of Nonlinear Systems
Alberto Isidori
Universita degli Studi di Roma, Italy

9:30 AM/Mezzanine
Coffee

*10:00 AM/*CONCURRENT SESSIONS

Minisymposium 29/Ballroom
Stabilization of Nonlinear Systems
Chair: W. P. Dayawansa
Texas Tech University

Minisymposium 30/Cathedral Hill A
Sequential and Parallel Matrix Computations in Control
Chair: Biswa N. Datta
Northern Illinois University

Minisymposium 31/Sea Cliff
Observability: Theory and Numerical Practice
Chair: Clyde F. Martin
Texas Tech University

Minisymposium 32/Room 378
Combinatorial Aspects of Control Algorithms
Chair: Robert Grossman
University of Illinois, Chicago

Contributed Presentations 18/Cathedral Hill B
Algebraic and Topological Methods
Chair: Robert L. Foote
Texas Tech University

Contributed Presentations 19/El Dorado
Numerical Methods
Chair: Alan J. Laub
University of California, Santa Barbara

Contributed Presentations 20/Pacific Heights
Queues
Chair: Richard E. Mortensen
University of California, Los Angeles

Contributed Presentations 21/Twin Peaks
Nonsmooth and Convex Approaches
Chair: J.P. Aubin
University of Paris, France

Contributed Presentations 22/Telegraph A
Robotics
Chair: Tzyh-Jong Tarn
Washington University, St. Louis, MO

Contributed Presentations 23/Telegraph B
Distributed Parameter Systems
Chair: R.E. Fennell
Clemson University

Friday, May 19/PM

12:00 PM/Lunch

1:15 PM/Ballroom
Invited Presentation 9
Chair: Alan Willsky
Massachusetts Institute of Technology

Identification and Control of Fluid Flow Systems
John A. Burns
Virginia Polytechnic Institute and State University

2:00 PM/
Break (no coffee)

*2:15 PM/*CONCURRENT SESSIONS

Minisymposium 33/Ballroom
Problems in Flow Control and Related Areas I
Chairs: Max D. Gunzburger, Los Alamos National Laboratory; and **Thomas P. Svobodny,** Virginia Polytechnic Institute and State University

Minisymposium 34/Cathedral Hill A
Dynamics and Stability of Deformable Bodies
Chairs: John Baillieul and John H. Maddocks, University of Maryland, College Park

Minisymposium 35/Cathedral Hill B
New Algebraic Trends in Nonlinear Control Theories
Chair: Michel Fliess
Laboratoire des Signaux et Systems, C.N.R.S.-ESE, France

Minisymposium 36/El Dorado
Optimization-Based Design of Control Systems
Chairs: Andre Tits and Michael Fan, University of Maryland, College Park

Minisympoisum 37/Pacific Heights
Challenges in Time Varying System Theory
Chair: Bijoy K. Ghosh
Washington University, St. Louis, MO

Contributed Presentations 24/Sea Cliff
Qualitative and Stochastic Decision Theory
Chair: M. Clark
Imperial College of Science and Technology, U.K.

Contributed Presentations 25/Twin Peaks
Discrete Event Systems
Chair: Alan Willsky
Massachusetts Institute of Technology

Contributed Presentations 26/Room 378
Algorithms
Chair: Roberto Horowitz
University of California, Berkeley

4:15 PM/Mezzanine
Coffee

*4:30 PM/*CONCURRENT SESSIONS

Minisymposium 38/Ballroom
Problems in Flow Control and Related Areas 2
Chairs: Max D. Gunzburger, Los Alamos National Laboratory and **Thomas P. Svobodny,** Virginia Polytechnic Institute and State University

Minisymposium 39/Cathedral Hill A
Robot Control as a System Control Problem
Chair: Tzyh-Jong Tarn
Washington University, St. Louis, MO

Minisymposium 40/Cathedral Hill B
Advances in Lie Theoretic Methods
Chair: Matthias Kawski
Arizona State University

Minisymposium 41/Pacific Heights
Nonlinear Differential Algebraic Equations and Control Theory
Chair: Stephen L. Campbell
North Carolina State University

Minisymposium 42/Sea Cliff
Reciprocal and Noncausal Processes
Chairs: Arthur J. Krener, University of California, Davis and **M. Clark,** Imperial College of Science and Technology, U.K.

Minisymposium 43/Room 378
Computational Methods in Parameter Identification
Chair: John Lund
Montana State University

Contributed Presentations 27/El Dorado
New Frequency Domain Methods
Chair: Clyde Martin
Texas Tech University

Contributed Presentations 28/Twin Peaks
Optimal Control
Chair: Pierluigi Zezza
Universita de Firenze, Italy

6:30 PM
Conference Adjourns

MINISYMPOSIA

Wednesday, May 17, 10:00 AM
Minisymposium 1/Ballroom
STABILIZATION OF DISTRIBUTED PARAMETER SYSTEMS

This minisymposium will focus on the design and analysis of feedback controls which stabilize systems modelled by partial differential equations, and the construction of open-loop controls to exactly control such systems. The presentation will address the following topics: (a) design of ad hoc stabilization feedbacks, both linear and nonlinear, and a detailed analysis of the asymptotic behavior of the closed-loop system (Lasiecka and Triggiani); (b) design of optimal feedback stabilizing operators and the analysis of the associated Riccati equation (Da Prato); and (c) geometrical optics methods and the use of microlocal analysis in stabilization and exact control problems (Littman). Strengths and limitations of each approach will be discussed.

Organizer: **John E. Lagnese**
Georgetown University

Stabilization and Controllability of Waves and Plates with Semilinear Boundary Conditions
Irena Lasiecka, University of Virginia, Charlottesville

The Role of Geometric Optics in Exact Controllability
Walter Littman, University of Minnesota, Minneapolis

Periodic Distributed and Boundary Control Problems for Parabolic Equations
G. Da Prato, Scuola Normale Superiore, Pisa, Italy

Uniform Stabilization of Waves and Plates by Dissipative and Non-Dissipative Feedback Operators
Roberto Triggiani, University of Virginia, Charlottesville

Wednesday, May 17, 10:00 AM
*Minisymposium 2/*Cathedral Hill A
SYMBOLIC ALGEBRA, THE LIE THEORY OF DIFFERENTIAL EQUATIONS AND CONTROL

Organizer: **John Baras**
University of Maryland, College Park
(Speakers and titles of presentations will be listed in the Final Program)

Wednesday, May 17, 10:00 AM
Minisymposium 3/Cathedral Hill B
OPTIMIZATION AND DESIGN 1

This series of lectures is intended to illustrate the use of optimization techniques in engineering design. We touch on a variety of issues that arise in applications (production engineering, circuitry design, structural optimization, control of chemical processes), in software development and related algorithmic procedures.

Organizers: **Elijah Polak,** University of California, Berkeley; and **Roger J-B Wets,** University of California, Davis

(Title to be announced)
R. Brayton, University of California, Berkeley

Problem Formulation Techniques for Structural Optimization
G. Vanderplaats, Engineering Design Optimization, Inc.

Optimal Transistor Sizing in VLSI Circuits as a Non-Differentiable Optimization Problem
Alberto Sangiovanni-Vincentelli, University of California, Berkeley

Exact Tradeoffs in LTI Controller Design: An Example
Craig Barratt and **Stephen Boyd,** Stanford University

Wednesday, May 17, 10:00 AM
Minisymposium 4/El Dorado
COMPLICATED DYNAMICS AND CONTROL: FLUIDS, CIRCUITS, AND FEEDBACK SYSTEMS

During the last fifteen years, interest has been increasing rapidly among engineers and applied scientists in complicated dynamical behavior that can occur in nonlinear systems arising in applications. It is important that control engineers understand not only how such behavior arises, but also how to develop techniques that facilitate the effective implementation of feedback controllers in its presence. This minisymposium includes presentations on a number of practical systems in which complicated dynamical phenomena appear, along with discussions of how and to what extent the behavior of these systems can be controlled. Two presentations address problems in turbulence and fluid dynamics, while the other two consider chaotic behavior in nonlinear electrical and mechanical systems.

Organizers: **Anthony M. Bloch** and **David F. Delchamps,** Cornell University

The Sights and Sounds of Chaos
Leon O. Chua, University of California, Berkeley

The Turbulent Boundary Layer: Modeling the Wall Region and Control
N. Aubry, CCNY and Cornell University; **P.J. Holmes, J.L. Lumley,** and **E. F. Stone,** Cornell University

Dynamic Instabilities and Chaos in the Flyball Governor
Steven Shaw, Michigan State University

Transport and Mixing Due to Chaotic Advection: Parameter Dependence and Control
Stephen Wiggins and **Anthony Leonard,** California Institute of Technology

Wednesday, May 17, 10:00 AM
Minisymposium 5/Pacific Heights
SINGULAR SYSTEMS

Time invariant linear continuous or discrete time systems of the form $E\dot{x} = Ax + Bu$, $y = Cx$ or $Ex_{k+1} = Ax_k + Bu_k$, $y_k = Cx_k$, where E can be singular, are called singular systems or semistate systems or descriptor systems. In applications, the traditional approach to such systems is to apply a transformation which separates the dynamic state equations from the algebraic equations. Such methods usually destroy sparsity or other structures which the original system may exhibit. Moreover, the transformation can be highly sensitive to numerical error. In the past few years there has been an increasing interest in developing reliable techniques for treating singular systems. Some concepts and methods for the standard systems have already been carried over or have been modified to apply to descriptor systems. It has been shown, however, that some properties of the singular systems are not shared by the well-known state systems. This minisymposium presents some recent results in this area.

Organizer: **Angelika Bunse-Gerstner**
Universitat Bielefeld, West Germany

On Stability of Descriptor Systems
Ralph Byers, University of Kansas; and **Nancy Nichols,** University of Reading, UK

Selective Modal Analysis of Large Singular Systems
George Verghese, Massachusetts Institute of Technology; **Ignacio Perez-Arriaga, Luis Rouco,** and **Luis Pagola,** Universidad Pontificia Comillas, Madrid, Spain

Improving the Structure of Descriptor Systems by Derivative Feedback
Angelika Bunse-Gertsner, **Volker Mehrmann,** Universitat Bielefeld, W. Germany; and **Nancy Nichols,** University of Reading, UK

Applications of Derivative Feedback for Descriptor Systems
Angelika Bunse-Gertsner, Volker Mehrmann, Universitat Bielefeld, W. Germany; and Nancy Nichols, University of Reading, UK

Wednesday, May 17, 2:15 PM
Minisymposium 6/Ballroom
ADAPTIVE CONTROL: A PANEL DISCUSSION

This minisymposium will deal with adaptive control in areas of its problems and prospects. There will be a brief discussion by each of the panelists, followed by a seventy-five minute panel discussion with audience participation. The agenda will be as follows with each speaker giving a 10–15 minute opening statement:

Moderator: **Panganamala R. Kumar,** University of Illinois, Urbana

Adaptive Control: Problems and Prospects
Peter S. Caines, McGill University, Montreal

Adaptive Control: Why, When and How
Petar Kokotovic, University of California, Santa Barbara

Adapting to the Continuously Evolving Methodologies of Parameter Adaptive Control
A. Stephen Morse, Yale University

Interaction with audience

Wednesday, May 17, 2:15 PM
Minisymposium 7/Cathedral Hill A
GEOMETRIC METHODS IN LINEAR CONTROL THEORY 1

Geometric methods have proved invaluable in approaching problems about canonical forms, equivalences, and feedback, among others. A linear invariant control system $E\dot{x} = Ax + Bu$, $y = Cx$ is given by the 4-tuple of matrices (E,A,B,C) and so the set of all such systems of a given dimension may be identified with the manifold $K^{n\times(2n+m+p)}$ where K is either $\mathbb{R}$ or $\mathbb{C}$. Taking this global viewpoint, we can realize perturbations, feedback, and equivalences in terms of subsets of this manifold. In many cases, such considerations involve Lie group or algebraic group actions on $K^{n\times(2n+m+p)}$ and properties of the resulting orbit spaces.

Organizer: **Joyce O'Halloran,**
Portland State University

Orbit Spaces of Generalized State Space Systems
(To be presented by the Organizer)

Hessenberg Varieties on Semisimple Lie Groups
Filippo De Mari, Universitat Bremen, W. Germany

(Title to be announced)
Clyde Martin, Texas Tech University

Generic Multivariable Zeros and Geometric Control Theory
Bostwick F. Wyman, Ohio State University

Wednesday, May 17, 2:15 PM
Minisymposium 8/Cathedral Hill B
OPTIMIZATION AND DESIGN 2

This series of lectures is intended to illustrate the use of optimization techniques in engineering design. We touch on a variety of issues that arise in applications (production engineering, circuitry design, structural optimization, control of chemical processes), in software development and related algorithmic procedures.

Organizer: **Elijah Polak,** University of California, Berkeley; and **Roger J-B Wets,** University of California, Davis

Problems and Challenges in Chemical Process Control
Brad Holt, University of Washington, Seattle

Scheduling Turbofan Engine Control Set Points by Semi-Infinite Optimization
Daniel Stimler, Philips Laboratorties, Briarcliff Manor, NY

Ban Optimal Control Algorithm for Slewing Flexible Structures Subject to Control and State Space Constraints
Theodore Baker and **Elijah Polak,** University of California, Berkeley

Extended Linear-Quadratic Optimal Control
R. T. Rockafellar, University of Washington, Seattle

Wednesday, May 17, 4:30 PM
Minisymposium 9/Ballroom
FEEDBACK CONTROL OF DISTRIBUTED PARAMETER SYSTEMS

In this minisymposium we address the topics of stabilization of distributed parameter systems through feedback. Both direct stabilization through dissipative mechanisms and LQR stabilization will be discussed. The relationship between stabilization and exact controllability through boundary forces and moments for elastic systems will be explored. For LQR problems, approximations leading to computational techniques for the operator Riccati equations for feedback gains are discussed for both continuous time and discrete time systems.

Organizers: **K. Ito,** and **H.T. Banks,** Brown University

On the Convergence of Sampled-time Approximations for Infinite Dimensional LQG Control and Estimation Problems
I. G. Rosen and C. Wang, University of Southern California, Los Angeles

Approximation of the LQR-problem in Hilbert Space
F. Kappel, University of Graz, Austria

Approximation Techniques for Parabolic Control Systems: A Variational Approach
H. T. Banks and **K. Ito,** Brown University

Uniform Stabilization/Exact Controllability from the Boundary of Thermoelastic Plates
John E. **Lagnese,** Georgetown University

Wednesday, May 17, 4:30 PM
Minisymposium 10/Cathedral Hill A
GEOMETRIC METHODS IN LINEAR CONTROL THEORY 2

Geometric methods have proved invaluable in approaching problems about canonical forms, equivalences, and feedback, among others. A linear time invariant control system $E\dot{x} = Ax + Bu$, $y = Cx$ is given by the 4-tuple of matrices (E,A,B,C) and so the set of all such systems of a given dimension may be identified with the manifold $K^{n\times(2n+m+p)}$ where K is either $\mathbb{R}$ or $\mathbb{C}$. Taking this global viewpoint, we can realize perturbations, feedback, and equivalences in terms of subsets of this manifold. In many cases, such considerations involve Lie group or algebraic group actions on $K^{n\times(2n+m+p)}$ and properties of the resulting orbit spaces.

Organizer: **Joyce O'Halloran**
Portland State University

(Title to be announced)
Mark Shayman, University of Maryland, College Park

(Title to be announced)
Daniel Cobb,
University of Wisconsin, Madison

The Relationship Between Invariants of Pfaffian Systems and Feedback Equivalence
Robert B. Gardner,
University of North Carolina, Chapel Hill

Sufficient Conditions for Strong D-Stability
E. H. Abed, and **C-F. Kuen,** University of Maryland, College Park

Wednesday, May 17, 4:30 PM
Minisymposium 11/Cathedral Hill B
ROBUSTNESS OF NONLINEAR AND ADAPTIVE CONTROL

Analysis of the effects of parametric and dynamic uncertainties on nonlinear dynamic systems is needed to reveal whether nonadaptive feedback linearization design will guarantee robustness, and when an adaptive feedback linearization approach is more appropriate. In nonadaptive high-gain designs the phenomenon of controller and/or observer peaking may interfere with uncertain nonlinearities and result in a drastic decrease of the stability region. Adaptive parameter updates reduce the effects of parametric uncertainties and avoid the need for high-gain loops.

New problem formulations in this area motivate the development of a geometric- asymptotic-adaptive methodology. Trade-offs between adaptive and nonadaptive designs are to be made vis-a-vis unmodeled dynamics, which are known to cause instabilities in some linear adaptive systems. Nonlinear adaptive designs may benefit from algorithm modifications based on current research in linear adaptive control.

Organizer: **Petar V. Kokotovic**
University of California, Santa Barbara

(Titles to be announced)
S. S. Sastry, University of California, Berkeley

P. Ioannou, University of Southern California

R. Marino, Second University of Rome, Italy

L. Praley, Ecole de Mines, Paris, France

Wednesday, May 17, 4:30 PM
Minisymposium 12/El Dorado
APPLICATIONS OF SET VALUED CALCULUS TO PROBLEMS OF CONTROL

Organizers: **M. I. Krasovski,** Institute of Automatic Control, Sverdloski, U.S.S.R.; and **A. Kurzhanski,** Arizona State University

Wednesday, May 17, 4:30 PM
Minisymposium 13/Pacific Heights
STRUCTURED MATRIX EIGENPROBLEMS IN SIGNAL PROCESSING AND CONTROL

A variety of problems in systems and control theory and signal processing involve the computation of the eigenvalues and possibly the invariant subspaces of matrices with certain special structures. It is therefore of interest to develop and analyze efficient algorithms that take advantgage of the particular structure of a given problem. This session will focus on numerical algorithms for the solutions of some of these structured eigenproblems. Specifically, eigenproblems for Hamiltonian matrices, and the related antiquaternion matrices, will be considered. We will also consider some recently developed algorithms for the eigenproblem for orthogonal matrices and its applications in signal processing.

Organizer: **Gregory S. Ammar**
Northern Illinois University

Hermitian Antiquaternion Jacobi Matrices
William B. Gragg, Naval Postgraduate School

A Jacobi-Like Method for the Solution of the Algebraic Riccati Equation
Angelika Bunse-Gerstner, and **Frank Klapper,** Universitat Bielefeld, W. Germany

Fast Approximation of Dominant Harmonics by Solving an Orthogonal Eigenproblem
Lothar Reichel, Bergen Scientific Centre, Norway and University of Kentucky, Lexington

An Algorithm for the Orthogonal Eigenproblem
(To be presented by the Organizer)

Thursday, May 18, 10:00 AM
Minisymposium 14/Ballroom
SINGULAR STOCHASTIC CONTROL

Singular stochastic control is concerned with problems of optimal control of Markov diffusion processes, in which no upper bound or control rates is imposed. The optimal accumulated control up to time t is generally a continuous, bounded variation function of t, but not absolutely continuous. Typically, there is an associated free boundary problem for a variational inequality, and the control actions occur to keep the system state at the free boundary. There are a variety of applications, including queueing systems under heavy traffic and financial economics. The theory gives rise to interesting problems about multidimensional reflected diffusions.

Organizers: **Wendell H. Fleming,** Brown University (Chair); and **Steve Shreve,** Carnegie-Mellon University

Regulated Brownian Motion
J. Michael Harrison, Stanford University

Probabilistic Aspects of Singular Stochastic Control
I. Karatzas, Columbia University

Singular Control in Heavy Traffic Problems
Harold J. Kushner, Brown University

(Title to be announced)
H. M. Soner, Carnegie-Mellon University

MINISYMPOSIA

Thursday, May 18, 10:00 AM
Minisymposium 15/Cathedral Hill A
ROBUST STABILITY OF PARAMETRIZED LINEAR SYSTEMS

A fundamental problem which arises in the analysis and synthesis of control systems is the recognition that the mathematical model assumed for the system is always inexact, and that the parameters of the system may deviate away from their nominal values. The question of interest is then to determine to what extent a nominal system remains stable when subjected to a given class of perturbations. The goal of the minisymposium is to present some of the latest results on robust stability of parametrized linear systems.

Organizers: **L. Saydy,** University of Maryland, College Park; and **B. R. Barmish,** University of Wisconsin, Madison

Properties of Robust Stability Margin as a Function of Frequency
B. R. Barmish, Z. C. Shi, and R. Tesio, University of Wisconsin, Madison

Generic Property of Uncertain Polynomials Multilinear in the Parameters
A. Sideris, M. K. H. Fan, R. Sanchez Pena, and J. C. Doyle, University of Southern California

When is the Image of a Multilinear Mapping a Polytope?
C. V. Hollot, University of Massachusetts, Amherst

Guarding Maps and the Robust Generalized Stability Problem
L. Saydy, A. L. Tits, and E. H. Abed, University of Maryland, College Park

The Largest Stability Rectangle for Families of Polynomials with Linear Uncertainty
T. Djaferis, University of Massachusetts, Amherst

On the Robust Stabilization of Linear Uncertain Systems
R. K. Yedavalli, Ohio State University

Thursday, May 18, 10:00 AM
Minisymposium 16/Cathedral Hill B
NUMERICAL METHODS FOR OPTIMAL CONTROL PROBLEMS

The numerical solution of optimal control problems often involves the use of techniques from mathematical programming. This minisymposium focusses on applications of optimization algorithms in control theory. Some of the distinctive features of control problems in optimization are the infinite-dimensional nature of the variables and the infinitely many constraints. This leads to various effects for the formulation of the numerical methods and their convergence analysis.

Organizer: **Ekkehard W. Sachs**
University of Trier, W. Germany (now visiting at North Carolina State University, and Rice University)

(Title to be announced)
Eugene F. Cliff, Virginia Polytechnic Institute and State University

Formal Newtonian Projection Methods for Continuous-Time Input-Constrained Optimal Control Problems
Joseph C. Dunn, North Carolina State University

Multiplier Methods for Nonlinear Optimal Control
William W. Hager, University of Florida, Gainesville

Sequential Quadratic Programming Methods and Optimal Control Problems
(To be presented by the Organizer)

Thursday, May 18, 10:00 AM
Minisymposium 17/Sea Cliff
EQUIVALENCE, CONTROL, AND THE CALCULUS OF VARIATIONS

This minisymposium addresses equivalence, control and the calculus of variations, which have been found not only to interface, but to be intimately interrelated. This has resulted in a constructive technique for producing time critical closed loop controls in certain sufficiently nonlinear control systems.

The reports show some of the consequences of this approach, including the generalization of the classical Brunovsky normal forms to a completely nonlinear and surprisingly computable setting, the existence of invariantly attached metrics for which the geodesics are time-critical solutions, the detailed analysis of scalar controls in the case of three state variables, and a report on the relationships with symplectic geometry.

Organizer: **Robert B. Gardner**
University of North Carolina, Chapel Hill

Symmetry Groups and Normal Forms for Control Systems
William F. Shadwick, University of Waterloo, Canada

Metric Geometries in Feedback Control
George Rudolph Wilkens, Jr., University of Hawaii, Manoa

Equivalence of Scalar Control Systems
David Thompson, University of South Alabama

Symplectic Foliations and Control
Robert Hermann, Mathematical Science Press, Brookline, MA

Thursday, May 18, 2:15 PM
Minisymposium 18/Ballroom
CURRENT RESEARCH IN DISCRETE EVENT DYNAMICAL SYSTEMS

In the recent past, there have been exciting new research efforts into a number of different approaches to the modeling and control of discrete event dynamical systems (DEDS). These approaches bring to bear tools from queueing theory and various aspects of computer science, but in ways that have uniquely control-theoretic flavor. The talks in this minisymposium concentrate on selected aspects of the current research in this area, including the supervisory control of DEDS, real time discrete event processes, stability of stochastic DEDS models, and some aspects of perturbation analysis for DEDS.

Organizers: **Steven I. Marcus (Chair),** University of Texas, Austin; and **Peter J. Ramadge,** Princeton University

Multiobjective Control Tasks for Discrete-Event Systems
Peter J. Ramadge, Princeton University

An Algebra of Discrete Event Processes
Michael Heymann, NASA-Ames Research Center, and Technion-Israel Institute of Technology

Stability of Stochastic DEDS Models
Jean Walrand, University of California, Berkeley

On the Constructability of Parameterized Sample Path Families of Discrete Event Systems
Christos G. Cassandras, University of Massachusetts, Amherst; and **Stephen G. Strickland,** Harvard University

Thursday, May 18, 2:15 PM
Minisymposium 19/Cathedral Hill A
STOCHASTIC DYNAMIC OPTIMIZATION 1

This series of lectures is devoted to various approaches to numerical solution procedures for the optimization of stochastic dynamical systems. The techniques include stochastic optimal control, Markov decision processes, stochastic programming and simulation.

Organizers: **Pravin Varaiya,** University of California, Berkeley; and **Roger J-B Wets,** University of California, Davis

Multigrid Algorithms for Nonlinear Stochastic Control
John Baras, University of Maryland, College Park

Dynamic Scheduling of Manufacturing Systems
P. R. Kumar, University of Illinois, Urbana

Almost Sure Convergence of a Stochastic Approximation Algorithm with Application to Adaptive Control
Armand Makowski, University of Maryland, College Park; and **Adam Schwartz,** Technion, Israel Institute of Technology

Monte Carlo Methods for Optimization of Stochastic Systems
Peter W. Glynn, Stanford University

Thursday, May 18, 2:15 PM
Minisymposium 20/Cathedral Hill B
NUMERICAL OPTIMIZATION OVER STABLE SYSTEMS 1

Organizer: **William Helton**
University of California, San Diego

On the Direct Computation of the H_∞-Norm and the μ-Norm of a Transfer Matrix
Andre L. Tits and Michael K. H. Fan, University of Maryland, College Park, MD

Computing the Optimally Scaled Norm of a Transfer Matrix
Stephen P. Boyd, Stanford University

(Titles to be announced)
Boyd Pearson, Rice University; **William Helton,** University of California, San Diego; and **Elijah Polak,** University of California, Berkeley

Thursday, May 18, 2:15 PM
Minisymposium 21/Pacific Heights
NONSMOOTH ANALYSIS APPROACH TO CONTROL PROBLEMS

Nonsmooth analysis brought new tools to investigate different issues arising in control theory. In particular those allowing to study classical control problems, where nonregularities and set-valued character do arise in a natural way: as for instance in control systems with state dependent controls, state constraints, nonregularity or uncertainty of dynamics, in descriptor and implicit control systems. Beside such "nonregular" problems, nonsmooth issues may also occur in very regular problems: for example in construction of optimal feedback lows or investigation of the value function

or more generally, solutions of the Hamilton-Jacobi equations. Dealing with new settings, nonsmooth analysis develops new basic theorems and new techniques which, in several cases, simplify the earlier approaches to smooth problems.

The aim of this minisymposium is to present some applications of the results obtained so far to the issues of optimal control, controllability observability, the value function and construction of optimal feedback.

Organizer: **H. Frankowska**
Universite Paris-Dauphine, France

(Title to be announced)
J.P. Aubin, Universite Paris-Dauphine, France

Hamiltonian Trajectories and Duality in Optimal Control
R. T. Rockafellar, University of Washington, Seattle

(Title to be announced)
R. Vinter, Imperial College London, UK

(Title to be announced)
To be presented by the Organizer

Thursday, May 18, 2:15 PM
Minisymposium 22/Sea Cliff
ADAPTIVE CONTROL: RECENT RESULTS

This minisymposium emphasizes on recent results, approaches and techniques in the theory and application of adaptive control. The presentations will discuss present and future trends, implementation issues and theoretical advancements in the field of adaptive control, in an effort to improve the performance as well as enlarge the range of applications of adaptive controllers.

Organizer: **Kostas S. Tsakalis**
Arizona State University

Adaptive Control of A Chaotic System
R. Kosut, Integrated Systems, Inc., and Stanford University

Hierarchical Adaptive Control System and Its Robustness to Uncertainties
Z. J. Chen, Beijing University, China

Adaptive Control of Linear Systems with Rapidly Varying Parameters
E. W. Kamen, University of Pittsburgh; **T. E. Bullock,** and **C. H. Song,** University of Florida, Gainesville

Design of Estimators for Robust Adaptive Control
(To be presented by the organizer)

Thursday, May 18, 4:30 PM
Minisymposium 23/Ballroom
CHALLENGES AND FUTURE DIRECTIONS IN DISCRETE EVENT DYNAMICAL SYSTEMS

The area of discrete event dynamical systems represents a challenging new research area for applied mathematicians and control theorists. The speakers in this minisymposium will present viewpoints on the challenges and future research directions in this area. This will be a less formally structured minisymposium, in which there will also be time for audience participation.

Organizers: **Steven I. Marcus,** University of Texas, Austin; and **Peter J. Ramadge (Chair),** Princeton University

Architectural Issues in the Control of Discrete Event Systems
W. M. Wonham, University of Toronto

Logic Control Systems and AI
Peter E. Caines, McGill University, Canada

Real-Time Finitely Recursive Processes
Randall A. Cieslak, and **Pravin Varaiya,** University of California, Berkeley

Recent Results in Perturbation Analysis
Y. C. Ho, Harvard University

Thursday, May 18, 4:30 PM
Minisymposium 24/Cathedral Hill A
STOCHASTIC DYNAMIC OPTIMIZATION 2

This series of lectures is devoted to various approaches to numerical solution procedures for the optimization of stochastic dynamical systems. The techniques include stochastic optimal control, Markov decision processes, stochastic programming and simulation.

Organizers: **Pravin Varaiya,** University of California, Berkeley; and **Roger J-B Wets,** University of California, Davis

Numerical Methods for Stochastic Control Problems
Harold Kushner, Brown University

(Titles to be announced)
I. Karatzas, Columbia University

Jean Walrand, University of California, Berkeley

A Heuristic Scheduling Policy for Multi-Item Single Machine Production Systems with Time-Varying, Stochastic Demands
Robert C. Leachman, University of California, Berkeley

Thursday, May 18, 4:30 PM
Minisymposium 25/Cathedral Hill B
NUMERICAL OPTIMIZATION OVER STABLE SYSTEMS 2

Organizer: **William Helton**
University of California, San Diego

State Space Formulas for the Solution of the Standard H^∞-Problems
Joseph A. Ball, Virginia Polytechnic Institute and State University

4-Block Problem for Multivariable Distributed Systems
Allen Tannenbaum, University of Minnesota, Minneapolis

New Methods in Optimal Control
John C. Doyle, California Institute of Technology

(Titles and additional speakers to be announced)

Thursday, May 18, 4:30 PM
Minisymposium 26/Pacific Heights
NUMERICAL AND EXPERIMENTAL ASPECTS OF DISTRIBUTED PARAMETER CONTROL

In this minisymposium we will address the directions, methods, theory and results in the numerical and experimental study of distributed parameter control systems.

Due to the advent of high power computers and advanced experimental equipments, we now have an excellent opportunity to build, test and verify the models of various distributed parameter control systems and to compute their numerical solutions. Such results are interesting theoretically and useful in applications.

The speakers will present results on shape optimization algorithms, viscoelasticity, and the boundary element method. Also the comparison of laboratory experimental and numerical results will be discussed.

Organizer: **Goong Chen**
Texas A&M University

Numerical and Experimental Aspects of Distributed Parameter Control
David L. Russell, Virginia Polytechnic Institute and State University

Numerical Aspects in Shape Optimization and Control
Michel Delfour, Universite de Montreal, Canada

Feedback Stabilization in Systems with Viscoelastic Damping
Kenneth B. Hannsgen and **Robert L. Wheeler,** Virginia Polytechnic Institute and State University

Application of the Boundary Element Method to Boundary Control Problems
J. Zhou, L. Ji and **Goong Chen,** Texas A&M University

Thursday, May 18, 4:30 PM
Minisymposium 27/Sea Cliff
ROBUSTNESS OF ADAPTIVE CONTROLLERS

The emphasis of the minisymposium is on the robustness and performance properties of adaptive controllers. The recent results that will be presented, cover a wide range of topics on the robustness of adaptive controllers in an attempt to put into perspective the potential advantages as well as drawbacks of adaptive control. The discussions will stimulate new ideas and provide valuable insight for the successful development of adaptive control systems for practical use.

Organizer: **Kostas S. Tsakalis**
Arizona State University

Recent Results in Robust Adaptive Control
G. C. Goodwin, University of Newcastle, New South Wales

Adaptive Proportional Controller: Boundedness of Solutions
L. Praly, Ecole Nationale Superieure d'Ingenieurs Electriciens de Grenoble, France

Unacceptable Transients in Adaptive Controllers
C. E. Rohrs, and **R. Younce,** Tellabs Research Center; and **S. Harvey,** University of Notre Dame

Robust Design of an Implicit LQG Self Tuner
Q. Song and **M. J. Grimble,** University of Strathclyde, Glasgow

MINISYMPOSIA

Thursday, May 18, 4:30 PM
Minisymposium 28/Room 378
GLOBAL METHODS IN CONTROL

Global solutions of nonconvex optimal control problems are the matter of principal interest and importance in aerospace sciences, in economics and in engineering applications. Classical variation-based methods (the maximum principle, the Hamilton-Jacobi-Bellman equation, etc.) cannot deliver global solutions of nonconvex problems because of essentially local considerations used to establish one or another variational optimality condition. Hence, to develop a global method, one has to abandon local considerations, that is, to abandon the use of the calculus of variations and related techniques. Certain new ideas and approaches will be presented at the minisymposium. The subsequent panel discussion is aimed at the exchange of opinions about these entirely new ideas.

Organizer: **Efim A. Galperin**
Universite du Quebec a Montreal, Canada

Stabilizing Management of Fluctuating Resources
Veijo Kaitala and George Leitmann, University of California, Berkeley

Global Solution of Nonconvex Differential Games
Efim A. Galperin, Universite du Quebec a Montreal and Quan Zheng, Shanghai University of Science and Technology, China

The Delta Algorithm for Global Optimal Control
(To be presented by the Organizer)

Foundations of Fuzzy Logic Control
Lotfi A. Zadeh, University of California, Berkeley

Nonconvex Global Optimal Control: Methods and Perspectives (Panel Discussion)
Panelists: **E. Galperin, G. Leitmann, Q. Zheng, L. Zadeh,** and the audience

Friday, May 19, 10:00 AM
Minisymposium 29/Ballroom
STABILIZATION OF NONLINEAR SYSTEMS

We plan to bring together the authors of some significant contributions on stabilization of nonlinear systems in the recent past. The work of C. I. Byrnes alongside with A. Isidori has set the standard in this direction. The works of M. Kawski and of C. Martin and W. Dayawansa have been directed towards obtaining necessary and sufficient conditions for asymptotic stability in low dimensional situations. The work of B. K. Ghosh is directed towards the stabilization of a class of nonlinear systems using techniques from time-varying linear systems theory.

Organizer: **W. P. Dayawansa**
Texas Tech University

Stabilization of Singular Systems
M. Kawski, Arizona State University

Bounded Input-Bounded Output Stabilization of Nonlinear Systems
Christopher Byrnes, Arizona State University

Some New Methods in the Problem of Compensating a Discrete Time-Varying and Nonlinear Systems
Bijoy K. Ghosh, Washington University, St. Louis

C^0- and C^1- Stabilization of Two-Dimensional Systems
Clyde F. Martin and **W. P. Dayawansa,** Texas Tech University

Friday, May 19, 10:00 AM
*Minisymposium 30/*Cathedral Hill A
SEQUENTIAL AND PARALLEL MATRIX COMPUTATIONS IN CONTROL

The design and analysis of linear time-invariant control systems give rise to a variety of interesting linear algebraic problems such as; eigenvalue and eigenstructure assignment, matrix equation (Sylvester, Lyapunov, Riccati, etc.), frequency response, stability and inertia, etc. In last few years, numerically reliable techniques have been developed for several of these problems. However, most of these techniques do not apply to large scale sequential computations and furthermore, parallel algorithms for even small and dense problems virtually do not exist presently.

The speakers of this session will discuss how some of the existing sophisticated computational techniques for large scale and parallel matrix computations can be gainfully employed to design algorithms for parallel and large scale computations of several of the above-mentioned problems.

Organizer: **Biswa N. Datta**
Northern Illinois University

Solving Algebraic and Discrete Riccati Equations by Nonsymmetric Jacobi Iteration
Ralph Byers, University of Kansas

Parallel Algorithms for Single-Input and Multi-input Eigenvalue Assignment Problems
(To be presented by the Organizer)

A Survey of Methods for Computing Decentralized Fixed Modes
R. V. Patel, Concordia University; and **P. Misra,** Wright State University

Parallel Algorithms for Riccati Equations Using Matrix Sign Functions
Judy Gardiner, Ohio State University

Friday, May 19, 10:00 AM
Minisymposium 31/Sea Cliff
OBSERVABILITY; THEORY AND NUMERICAL PRACTICE

The session will contain two talks concerning the pathology of observability, and two devoted to the numerical implementation of algorithms developed over the last two years. The numerical experience indicates that real-world problems can be solved using the theory of observability.

Organizer: **Clyde F. Martin**
Texas Tech University

(Titles to be announced)
Clyde Martin and **W. Dayawansa,** Texas Tech University

David Gilliam and **Bernard Mair,** Texas Tech University

D. I. Wallace, Dartmouth College

Parameter Identification in Parabolic Systems Via Sinc Method
John Lund and **Curt Vogel,** Montana State University

Friday, May 19, 10:00 AM
Minisymposium 32/Room 378
COMBINATORIAL ASPECTS OF CONTROL ALGORITHMS

This session brings together researchers who work on the combinatorial aspects of control theory. This area is important in designing algorithms in nonlinear control theory and in the symbolic computation of control trajectories. Techniques such as the use of shuffle products, coproducts, Chen series, generating functions, and trees have been found useful in this work. There are several means of packaging the combinatorial computations that arise in nonlinear control theory, and it is an open problem to relate them. In this session, these computations are attacked through shuffle products, through coalgebra coproducts, and through free Lie algebras.

Organizer: **Robert Grossman**
University of Illinois, Chicago

The Shuffle Product and Some Differential Identities in Systems Theory
P. E. Crouch, Arizona State University; and F. Lamnabhi-Lagarrigue, C.N.R.S.-E.S.E., France

Vector Fields Which Generate Free, Nilpotent Lie Algebras
Matthew A. Grayson, University of California at San Diego, La Jolla

Higher Order Derivations and Trees
(To be presented by the Organizer)

Friday, May 19, 2:15 PM
Minisymposium 33/Ballroom
PROBLEMS IN FLOW CONTROL AND RELATED AREAS 1

The control of flow fields plays an important role in many areas of applications and such problems come in many guises. Here, we bring together scientists working on various aspects of flow control problems or on problems which have a direct bearing on their solution. For example, some of the speakers will address issues in shape optimization, while others will look at value optimization. Quantities such as the viscous drag and the deviation from desired flow fields are optimized. Incompressible, compressible, inviscid and viscous flow problems will be discussed in deterministic and stochastic settings. The speakers will address questions of existence, uniqueness and regularity of solutions, and also of obtaining approximate numerical solutions.

Organizers: **Max D. Gunzburger (Chair),** Los Alamos National Laboratory; and **Thomas P. Svobodny,** Virginia Polytechnic Institute and State University

Effect of Domain Shape on the Spectrum of the Biharmonic Operator
Robert Acar, and **Luther W. White,** University of Oklahoma, Norman

Control Problem for the Burger's Equation
Sungkwon Kang, Virginia Polytechnic Institute and State University

Shape Estimation and Control in Aeroelastic Systems
Patricia Lamm, Michigan State University

Viscous Drag Reduction by Suction and Blowing Through the Boundary: Formulation, Analysis and Approximation of a Mathematical Model
Max D. Gunzburger, Los Alamos National Laboratory; **Lisheng Hou,** Carnegie-Mellon University; and Thomas Svobodny, Virginia Polytechnic Institute and State University

Friday, May 19, 2:15 PM
Minisymposium 34/Cathedral Hill A
DYNAMICS AND STABILITY OF DEFORMABLE BODIES

This session does not explicitly concern control. Rather the lectures will address problems from mechanics of a type that give rise to questions in control. The formulation of complicated dynamical problems, such as coupled rigid and flexible bodies will be discussed. Particular emphasis will be given to stability properties.

Organizers: **John Baillieul** and **John H. Maddocks** (Chair), University of Maryland, College Park

Nonlinear Stability of Relative Equilibria by the Energy-Momentum Method
Juan C. Simo, Stanford University

Bifurcation Behavior in Rotating Beams
Anthony M. Bloch, Cornell University, and Ohio State University

Nonlinear Stability of Relative Equilibria by Lyapunov-Type Methods
John H. Maddocks, University of Maryland, College Park

(Title and speaker to be announced)

Friday, May 19, 2:15 PM
Minisymposium 35/Cathedral Hill B
NEW ALGEBRAIC TRENDS IN NONLINEAR CONTROL THEORIES

Since the works of R. E. Kalman and many others, algebraic methods are certainly the main mathematical tools for understanding linear systems. For nonlinear systems the situation looked quite different until recently. The aim of this minisymposium is to show that algebra is beginning to gain more popularity in nonlinear control, since it is now offering an alternative approach which often greatly enlighten various problems.

Organizer: **M. Fliess**
Laboratoire des Signaux et Systemes, C.N.R.S.-ESE, France

Controllability is Harder to Decide Than Accessibility
Eduardo D. Sontag, Rutgers University

(Titles to be announced)
J. W. Grizzle, University of Michigan, Ann Arbor

C. H. Moog, Laboratoire d'Automatique, ENS 17, France

(To be presented by the Organizer)

Panel Discussion: The Future of Algebraic Methods
Panelists: M. Fliese, E. D. Sontag, J. W. Grizzle, C. H. Moog, and the audience

Friday, May 19, 2:15 PM
Minisymposium 36/El Dorado
OPTIMIZATION-BASED DESIGN OF CONTROL SYSTEMS

With the recent dramatic increase in available computing power, numerical optimization has become an attractive tool for the design of complex engineering systems. Yet, generalized use of numerical optimization techniques in design has been hindered by (i) the difficulty to translate in a faithful manner the actual design problem into any kind of rigid mathematical optimization problem, (ii) the inability of classical optimization tools to efficiently take into account the many distinctive features of optimization problems arising in a design context, and (iii) the unavailability of software tools offering to the designer a powerful as well as congenial environment supporting such capabilities. The minisymposium will focus on some aspects of these questions.

Organizers: **Andre Tits** and **Michael Fan,** University of Maryland, College Park

A Barrier Function Method for Minimax Problems
E. Polak, J. E. Higgins, University of California, Berkeley; and D. Q. Mayne, Imperial College, UK

Design of Linear Controller via Nondifferential Optimization
Stephen Boyd, Stanford University

Highlights of CONSOLE, an Optimization-Based Design System
Michael Fan, and Andre Tits, University of Maryland, College Park

Friday, May 19, 2:15 PM
Minisymposium 37/Pacific Heights
CHALLENGES IN TIME VARYING SYSTEM THEORY

This minisymposium addresses an important problem area in system theory — that of studying the effect of time variation on the parameters of a dynamical system described by ordinary differential equations in the continuous time and difference equations in the discrete time. Time varying systems arise as a result of uncertain parameter variation or as a result of modelling a control system for which the performance specification varies in real time. The control system therefore adaptively changes in real time to match the desired performance.

Presently, our understanding of a time varying system is restricted to parameters that are slowly varying in time. The main approach in the past had been to generalize the "time invariant" thinking. This obviously is restrictive.

This minisymposium focuses attention on four pioneers in this field. They have analyzed time varying systems from apparently distinct viewpoints, yet their overall objectives are related. We hope that their techniques would come under a much broader general framework which in my view is also a challenge in the 90's.

Organizer: **Bijoy K. Ghosh**
Washington University, St. Louis, MO

Stability and Modes of a Linear Time Varying System
E. W. Kamen, University of Pittsburgh

Robust Performance in Sampled Data Control System
P. Kabamba, University of Michigan, Ann Arbor

A Theory of Fractional Representation for Time Varying and Nonlinear Systems
M. Verma, University of Texas, Austin

Simultaneous Stabilization of Discrete-Time Multi-Input Multi-Output Linear Time Varying Systems by Time Varying Dynamic Compensation
Paul R. Bouthellier, Washington University, St. Louis, MO

Friday, May 19, 4:30 PM
Minisymposium 38/Ballroom
PROBLEMS IN FLOW CONTROL AND RELATED AREAS 2

The control of flow fields plays an important role in many areas of applications and such problems come in many guises. Here, we bring together scientists working on various aspects of flow control problems or on problems which have a direct bearing on their solution. For example, some of the speakers will address issues in shape optimization, while others will look at value optimization. Quantities such as the viscous drag and the deviation from desired flow fields are optimized. Incompressible, compressible, inviscid and viscous flow problems will be discussed in deterministic and stochastic settings. The speakers will address questions of existence, uniqueness and regularity of solutions, and also of obtaining approximate numerical solutions.

Organizers: **Max D. Gunzburger,** Los Alamos National Laboratory; and **Thomas P. Svobodny (Chair),** Virginia Polytechnic Institute and State University

Optimal Design for the Drag of a Body in a Viscous Fluid
Jacques Simon, Universite Pierre et Marie Curie et CNRS, France

Singular Perturbation for Stochastic Control Problems Involving Semilinear Parabolic Equations
Panagiotis E. Souganidis, Brown University

(Title to be announced)
J. Zolesio, C.N.R.S., France

Finite Element Approximations of Optimization Problems for the Navier-Stokes Equations with Distributed or Boundary Controls
Max D. Gunzburger, Los Alamos National Laboratory; Lisheng Hou, Carnegie-Mellon University; and Thomas Svobodny, Virginia Polytechnic Institute and State University

Friday, May 19, 4:30 PM
Minisymposium 39/Cathedral Hill A
ROBOT CONTROL AS A SYSTEM CONTROL PROBLEM

This session is expected to show applications of modern nonlinear control theory to the control of robot arms from system point of view. The list of speakers are top researchers in the robotics and control theory areas who are now exploring the application of systems theory to the control of robot arms.

Organizer: **Tzyh-Jong Tarn**
Washington University, St. Louis, MO

Task Space Control of Robot Arms
A. K. Bejcyz, Jet Propulsion Laboratory

The Nonlinear Control Theory of Linearly Uncontrollable Mechanical Systems
John Baillieul, Boston University

Adaptive Control of Flexible Joint Robots
Mark W. Spong, University of Illinois, Urbana

The Role of Zero Dynamics in Robotic Systems
Alessandro De Luca, Universita di Roma "La Sapienza", Italy

Friday, May 19, 4:30 PM
Minisymposium 40/Cathedral Hill B
ADVANCES IN LIE THEORETIC METHODS

Starting in the early 70's, roughly speaking, with an extension of Nagano's theorem on transitive Lie algebras, the use of Lie theoretic methods for the description of properties of smooth nonlinear control systems on a manifold has been overly successful, and evolved into several different directions. E.g., it is known that the relations satisfied by the iterated Lie brackets determine as important properties as accessibility, (small-time) local controllability, the structure of time-optimal trajectories, etc. and very likely also the maximal smoothness of asymptotically stabilizing feedback laws. A major ongoing research object is to decipher the code in which these properties are encoded in the Lie brackets—a problem which so far has been solved completely only for accessibility, and partially solved for the other properties.

This minisymposium is intended to give a survey of some of the latest achievements and challenges for future work regarding the richness of the information that can explicitly be extracted from the iterated Lie brackets,

Organizer: **Matthias Kawski**
Arizona State University

(Title to be announced)
Klaus Wagner, Mathematisches Institut der Universitat, W. Germany

Stabilizing Feedback Controls
Henry G. Hermes, University of Colorado, Boulder

(Title to be announced)
Gianna Stefani, Universita Degli Studi, Firenze, Italy

The Structure of Small-Time Reachable Sets and Time Optimal Feedback Control Laws
Heinz Schattler, Washington University, St. Louis

Friday, May 19, 4:30 PM
Minisymposium 41/Pacific Heights
NONLINEAR DIFFERENTIAL ALGEBRAIC EQUATIONS AND CONTROL THEORY

Many control systems are first modeled as differential algebraic equations. Traditionally, it has been necessary to rewrite the equations in an explicit form before analyzing the system. In the last decade there has been an increasing interest in working with the original implicit models if possible. The motivations for doing this have included: easier variation of models in simulation studies; obtaining numerical results directly from computer generated models; preservation of useful properties such as sparsity, system structure, and physically meaningful variables; solution of problems not easily put in explicit form; solution of wider classes of models; and shortening the time it takes the scientist and engineer to go from initial model formulation to numerical results. This minisymposium will present both recent results and future directions of research. Talks will cover numerical methods, applications to control and mechanical systems, and the theory of nonlinear differential algebraic control systems.

Organizer: **Stephen L. Campbell**
North Carolina State University

The Numerical Solution of Initial Value Problems in Trajectory Control
Kathryn E. Brenan, The Aerospace Corporation, Los Angeles

(Titles to be announced)
Kenneth D. Clark, Bell Northern Research, RTP, North Carolina
N. Harris McClamroch, University of Michigan, Ann Arbor

Parameter Estimation of Mechanical Systems with Constraints
Peter C. Muller, University of Wuppertal, W. Germany

Friday, May 19, 4:30 PM
Minisymposium 42/Sea Cliff
RECIPROCAL AND NONCAUSAL PROCESSES

Organizers: **M. Clark,** Imperial College of Science and Technology, U.K.; and **Arthur J. Krener,** University of California, Davis

Estimation of Noncausal Processes
Bernard Levy, University of California, Davis

The Self-Adjoints of Gaussian Reciprocal Processes
Ruggero Frezza, University of California, Davis

(Title to be announced)
M. Clark, Imperial College of Science and Technology, U.K.

Reciprocal Diffusions, the Non-Gaussian Case
Arthur J. Krener, University of California, Davis

Friday, May 19, 4:30 PM
Minisymposium 43/Room 378
COMPUTATIONAL METHODS IN PARAMETER IDENTIFICATION

This minisymposium addresses computational methods for identification in time-dependent distributed parameter systems. The focus is on fully Galerkin approaches. This is in contrast to more standard time stepping schemes. Various choices of basic functions are addressed for both spatial and temporal expansions. An overview of sinc methods of approximation and new analytic expressions for these approximations will be presented, including treatment of both second and fourth order spatial operators. In particular, efficient fully Galerkin procedures to recover the diffusion coefficient in parabolic problems will be discussed with accompanying numerical results.

Organizer: **John Lund**
Montana State University

New Analytic Expressions for Approximations in the Frequency and Time Domains
Frank Stenger, University of Utah

A Sinc-Galerkin Method for Flexible Structures
Ralph Smith, Montana State University

Fully Galerkin Methods for Parabolic Problems: Computational Techniques for Parameter Identification
Curtis R. Vogel, Montana State University, and Iowa State University

Fully Galerkin Methods in Parabolic Problems: Sinc Discretization and Solution of Nonlinear Problems
Ken Bowers, Montana State University

CONTRIBUTED PRESENTATIONS

Wednesday, May 17/10:00 AM
Contributed Presentations 1/Sea Cliff
APPLICATIONS

Robust Controller Design for a Nonlinear CSTR
Francis J. Doyle, Andrew K. Packard and Manfred Morari, California Institute of Technology

Optimal Production of Secreted Protein in Fed-Batch Reactors
W. Fred Ramirez and Seujeung Park, University of Colorado, Boulder

Optimal Control and Identification for Optical Lithography
W. Fred Ramirez and Tom A. Carroll, University of Colorado, Boulder

Periodic Output Controllers for Tubular Packed-Bed Reactors
Scott Kendra and Ali Cinar, Illinois Institute of Technology

Mathematical Modeling and Perfusion Assessment During Local Hyperthermia
Miriam Siegler, Villanova University

Realizations and Identifications of Multimodels Application to the Control of a Heat Exchanger
Guy Bornard and Li Ping Hu, Ecole Nationale Superieure d'Ingenieurs Electriciens de Grenoble, France

Wednesday, May 17/10:00 AM
Contributed Presentations 2/Japanese Tea Room
H-INFINITY CONTROL

Computation of the Minimal Order H_∞ Optimal Compensator
Douglas P. Looze, University of Massachusetts, Amherst

Generalized Riccati Equations for Robust H_∞ Control Design
Dennis S. Bernstein, Harris Corporation, Melbourne, FL

Optimal Diagonal Scalings for State Feedback Problems
Andy Packard, University of California, Santa Barbara; and Kemin Zhou, California Institute of Technology

A Simple Derivation of All Optimal Solutions to the Four-Block General Distance Problem
Athanasios Sideris and Davut Kavranoglu, California Institute of Technology, Pasadena

H^∞ In The Time Domain: The Standard Four Blocks Problem
Gilead Tadmor, University of Texas at Dallas, Richardson

Convergence Inequalities for Four-Block γ-Iteration in H^∞ Optimization Problems
Y.K. Foo, Nanyang Technological Institute, Singapore

Wednesday, May 17/10:00 AM
Contributed Presentations 3/Room 378
ROBUST AND ADAPTIVE CONTROL

Stochastic Robustness
Robert F. Stengel and Laura E. Ryan, Princeton University

Perfect Robust Recovery via Proportional Integral Observer
Bahram Shafai and Stuart R. Beale, Northeastern University

Convergence Analysis of a Class of Self-Tuning Predictors and Controllers
Rahbar Maghsoodi, St. Mary's University

Adaptive Control with Input Constraints
Jean-Claude Hennet, Centre National de Recherche Scientifique, France

Robust Stabilization of Systems with Simultaneous Real Poles Uncertainties
J.M. Amillo and F.A. Mata, Universidad Politecnica de Madrid, Spain

Wednesday, May 17/2:15 PM
Contributed Presentations 4/El Dorado
BEAMS

On the Shape of the Strongest Beam
Steve Cox and Michael L. Overton, Courant Institute of Mathematical Sciences, New York University

Exact Boundary Controllability for a Hybrid System Involving an Euler-Bernoulli Beam with Variable Physical Characteristics
Steven Taylor, University of Minnesota, Minneapolis

Applications of Finite Element Analysis in the Control of Complex Mechanical Systems
Mladen Luksic, Digital Equipment Corporation, Colorado Springs, CO

Pointwise Stabilizability of Coupled Elastic Beam Systems
You Yuncheng, Purdue University

Exponential Stabilization of a Plate
Richard Rebarber, University of Nebraska, Lincoln

General Input Elements for Distributed Control Systems
Scott Hansen, Virginia Polytechnic Institute and State University

Wednesday, May 17/2:15 PM
Contributed Presentations 5/Pacific Heights
DIGITAL FILTERS IN ONE OR MORE DIMENSIONS

A Variational Method for Electric Impedance Tomography
Robert V. Kohn and Alan McKenney, Courant Institute of Mathematical Sciences, New York University

Recent Developments in Control of 2D Systems
M. Bisiacco, E. Fornasini, and G. Marchesini, University of Padova, Italy

Information and Uncertainty in Feedback Systems with Measurement Quantization
David F. Delchamps, Cornell University

Time and Lag Recursive Computation of Cumulants From a State Space Model
Ananthram Swami and Jerry M. Mendel, University of Southern California

On the Analysis of Jump Detection Filters
Chun Yang, P. Bertrand, and M. Mariton, Centre National de Recherche Scientifique, France

Wednesday, May 17/2:15 PM
Contributed Presentations 6/Sea Cliff
STOCHASTIC SYSTEMS

The Synthesis Problem in Optimal Control Existence of a Solution
U.G. Haussmann, University of British Columbia

Exact Solutions for Some Partially Observed Optimal Stochastic Control Problems
Kurt Helmes, University of Kentucky

Optimal Control of Systems Subject to Stochastic and Deterministic Disturbances
Altug Iftar, University of Toronto, Canada

Some Recent Developments on Parallel Stochastic Approximation Methods
G. Yin, Wayne State University

Finite Time Observers
Matthew R. James, Brown University

Sensitivity Analysis of Stochastic Systems Using Likelihood Ratio (LR) Method
Bin Zhang, Harvard University

Wednesday, May 17/2:15 PM
Contributed Presentations 7/Japanese Tea Room
NETWORKS AND COMMUNICATION SYSTEMS

Optimal Control of Hierarchical Inventory Systems
Fouzia Kabbaj and Edmundo Rofman, INRIA-Rocquencourt, France; Roberto Gonzalez, CONICET and U.N. Rosario, Argentina; and Claudia Sagastizabal, IMAF, National University, Cordoba, Argentina

Optimal Scheduling Control in a Multi-Class Fluid Network
Hong Chen, New Jersey Institute of Technology; and David D. Yao, Harvard University

Performance Analysis of Data-Driven Networks
Geert Jan Olsder, Delft University of Technology, The Netherlands

Optimal Control of a Telephone Network—Centralized and Decentralized Approach
Edward Chlebus, University of Mining and Metallurgy, Poland

Wednesday, May 17/2:15 PM
Contributed Presentations 8/Rm 378
SINGULAR AND PERIODIC SYSTEMS

On the Structure and Pole Placement of Discrete Linear Periodic Systems
Baeil P. Park and Erik I. Verriest, Georgia Institute of Technology

Study of Discrete Singularly Perturbed Linear Control Problems by a Bilinear Transformation
Xue-Min Shen and Zoran Gajic, Rutgers University

On Dead-beat Control of Linear Discrete-time Descriptor Systems
Essam Y. Ibrahim, Clarkson University

Controllability of Singular Decentralized Systems
Xu Kai Xie and Gue Shan Zhang, Northeast University of Technology, China

Structural Controllability of Parametrized Descriptor Systems
Qingling Zhang, Northeast University of Technology, People's Republic of China

Further Results on the Design of Multirate Control Systems
Patrizio Colaneri and Nicola Schiavoni, Politecnico di Milano; and Riccardo Scattolini, Universita di Pavia, Italy

CONTRIBUTED PRESENTATIONS

Wednesday, May 17/4:30 PM
Contributed Presentations 9/Sea Cliff
STABILITY OF FAMILIES OF SYSTEMS

Polytopes of Positive Polynomials
Dragoslav D. Siljak, Santa Clara University

Simultaneous Performance Satisfaction For Several Plants Via A Single Controller
W.E. Schmitendorf, University of California, Irvine

Strict Positive Realness Condition for Interval Plants with Applications
S.P. Bhattacharyya, Herve' Chapellat and M. Dahleh, Texas A&M University

Structured Eigenstructure Assignment
L. H. Keel, Tennessee State University; and S.P. Bhattacharyya, Texas A&M University, College Station

Computation of Maximal Stability Domains for Control Systems
Herve' Chapellat and S.P. Bhattacharyya, Texas A&M University

A Stability Test for Polynomials with Linear Dependence on Uncertain Parameters, Minimizing the Number of Corners and Edges to be Checked
Anders Rantzer, Royal Institute of Technology, Sweden

Wednesday, May 17/4:30 PM
Contributed Presentations 10/Room 378
IDENTIFICATIONS

An Optimal Parameter Discretization Scheme for Multiple Model Adaptive Estimators
Stuart N. Sheldon and Peter S. Maybeck, Air Force Institute of Technology

A Once-per-Transient Process and Disturbance Identification Method
Archibald G. Hill, and Worachat Raksakij, University of Southwestern Louisiana

Development and Application of Generalized Kalman and LMS Filters for Multi-Step Identification
Stephen A. Jacklin, NASA Ames Research Center

Determination of Maximum Parameter Uncertainty in Output Feedback-Stabilized Discrete-Time Dynamic Systems
John H. Mott and Mario E. Magana, University of Alabama, Tuscaloosa

A Stable Method to Compute the Elements of a Linear System
Daniel Chuo Chin, Johns Hopkins University

On the Use of Asymptotic Observers for the Parameter Estimation
Antonio Tornambe, Fondazione Ugo Bordoni, Roma, Italy

Thursday, May 18/10:00 AM
Contributed Presentations 11/El Dorado
NONLINEAR SYSTEMS 1

On the Estimation of Sliding Domains and Stability Regions of Variable Structure Control Systems with Bounded Controllers
S. Mehdi Madani-Esfahani and Stanislaw H. Zak, Purdue University; and Stefen Hui, San Diego State University

Feedback Compensation of Discontinuous Nonlinearities
Wenceslao Cebuhar, Virginia Polytechnic Institute and State University

Bound-Optimal Stabilization of Unknown Nonlinear Stochastic Systems
Engin Yaz, University of Arkansas, Fayetteville

Nonlinear PI Controller for Mimo Nonlinear Systems with Nonlinear Output
H. Chris Tseng, Santa Clara University

A Tracking Problem for Uncertain Vector Systems
J.W. Macki, University of Alberta, Canada; P. Nistri and P. Zecca, Universita di Firenze, Italy

Variable Structure Control System Design with Performance Enhancements
Stephen Gardner, Polytechnic of Wales, U.K.

Thursday, May 18/10:00 AM
Contributed Presentations 12/Pacific Heights
SYSTEMS WITH DELAYS

Stabilization of Linear Control Systems with Infinite Delays
A.S.C. Sinha, Purdue University, Indianapolis

Optimal Feedback Control of Linear Delay Systems with Terminal Constraint: A Dynamic Programming Approach
Ali Hedayat, Solano College, Oakland, CA

Optimal and Suboptimal Control of Differential-Difference Systems
Rafael T. Yanushevsky, University of Maryland, and University of the District of Columbia

An Iterative Optimal Feedback Synthesis Algorithm for Plants with Transmission Delays
N. Eva Wu, State University of New York, Binghamton

Variational Approach for Linear-Quadratic Optimal Control Problem of Time-Varying System with Delay
Roberto M. Sales, Universidade de Sao Paulo, Brazil

Incomplete State Feedback Laws for Systems with Internal Time-Delays
Guy Bornard and Li Ping Hu, Ecole Nationale Superieure d'Ingenieurs Electriciens de Grenoble, France

Thursday, May 18/10:00 AM
Contributed Presentations 13/Japanese Tea Room
FLEXIBLE STRUCTURES

Optical Processing Techniques for the Estimation and Control of Flexible Structures
Michael F. Barsky and Douglas K. Lindner, Virginia Polytechnic Institute and State University; Ian T. Gallimore, North Carolina State University; and Douglas G. Thayer, NASA Langley Research Center

Application of a Distributed Optical Sensor and Processor to the Control of a Flexible Beam
Sharon S. Welch, NASA Langley Research Center

Control of Large Flexible Spacecraft Using Optical Distributed Sensing and Computation
Raymond C. Montgomery and Sharon S. Welch, NASA Langley Research Center

Stabilization and Energy Decay in Viscoelastic Structures
Kenneth B. Hannsgen and Robert L. Wheeler, Virginia Polytechnic Institute and State University

A Self-Tuning Regulator Approach to the Control of Large Space Structures
Donald A. Kelly and Gordon Lee, Colorado State University

IMSC Using Piezoelectric Transducers as Sensors and Actuators
Chin Chung Won and Sathya V. Hanagud, Georgia Institute of Technology

Thursday, May 18/10:00 AM
Contributed Presentations 14/Room 378
DECENTRALIZED CONTROL AND ESTIMATION

Optimum Design of Communication Channels and Control Strategies for Linear-Quadratic Stochastic Systems
Tamer Basar, University of Illinois, Urbana; and Rajesh Bansal, AT&T Bell Laboratories, Columbus, OH

On Decentralized Control System Design
Vasilios Manousiouthakis, University of California, Los Angeles

Finite-Dimensional Nonlinear Estimators for Distributed Estimation Systems
John A. Gubner, University of Wisconsin, Madison

On Algebraic Equivalences Between Decentralized and Centralized Linear Control
M. de la Sen, Universidad del Pais Vasco, Spain

Design of Robust Decentralized Controllers for Interconnected Systems
Christophe Pillou, Ecole Nationale Superieure d'Ingenieurs Electriciens de Grenoble, France

Thursday, May 18/2:15 PM
Contributed Presentations 15/El Dorado
NONLINEAR SYSTEMS 2

On Local and Global Controllability
Rosamaria Bianchini, Universita Degli Studi, Firenze, Italy; and Gianna Stefani, Universita Degli Studi, Napoli, Italy

A Solution of the Model Matching Problem and the Factorization Problem for Nonlinear Systems
G. Conte, University of Genova, Italy; A.M. Perdon, University of Padova, Italy; and C.H. Moog, Laboratory Automatique de Nantes, France

Dynamical Systems in the Plane: Classical Theorems and Smooth Stabilizability
Andrea Bacciotti, Polytechnico of Torino, Italy

Stability on Nonlinear Observers In Closed Loop Setting
Carl Hedrick, University of California, Berkeley

Global Observability of Systems with Complex Dynamics
Lance D. Drager and Robert L. Foote, Texas Tech University

Stability Aspects of Exact-linearization Methods: A Hybrid Approach
Michael Nikolaou and Vasilios Manousiouthakis, University of California, Los Angeles

Thursday, May 18/2:15 PM
Contributed Presentations 16/Room 378
OPTIMAL CONTROL OF DISTRIBUTED PARAMETER SYSTEMS

Approximation Techniques for Nonatomic Neutral Control Systems
Janos Turi, Worcester Polytechnic Institute

Optimal Nonlinear Control System Design in a Lipschitz-Normed Banach Space Setting
Rui J. P. de Figueiredo and Guanrong Chen, Rice University

CONTRIBUTED PRESENTATIONS

The Linear Quadratic Gaussian/Loop Transfer Recovery Technique for a Class of Distributed Parameter Systems
Randall N. Paschall, Air Force Institute of Technology

Optimal Feedback Control Theory of Linear Neutral Systems
Ethelbert N. Chukwu, North Carolina State University

Direct Methods for Nonlinear Problems in Optimal Control of Distributed Systems
Srdjan Stojanovic, University of Cincinnati

On the Optimality of Stabilization Feedbacks
Enrike Zuazua, Universidad Autonoma, Spain

Thursday, May 18/4:30 PM
Contributed Presentations 17/El Dorado
NONLINEAR DYNAMICS

The Spectrum of Nonlinear Control Systems
Fritz Colonius, University of Bremen, West Germany; and Wolfgang Kliemann, Iowa State University

Linear Feedback and Bifurcation Control
Jyun-Horng Fu, Wright State University; and Eyad H. Abed, University of Maryland, College Park

Determination of All the Zeros of a Vector Function via Dynamical System Theory
Pedro J. Zufiria and Ramesh S. Guttalu, University of Southern California

The Scanning Normal Form Method and Stability Problem in Nonlinear Control Systems
Mark A. Pinsky, Boston, MA

Topological Dynamics and Observability and Controllability of Systems
Mahesh Nerurkar, Rutgers University

Stability of Nonlinear Systems via Invariant Manifolds. Applications to Stabilizability Problems
Peter Seibert and Rodolfo Suarez, Universidad Autonoma Metropolitana-Iztapalapa, Mexico

Friday, May 19/10:00 AM
Contributed Presentations 18/Cathedral Hill B
ALGEBRAIC AND TOPOLOGICAL METHODS

The Global Topology of Observable, Controllable Linear Systems
Benjamin M. Mann and R. James Milgram, Stanford University

Controllability of Linear Systems, Differential Geometry of Curves in Grassmannians and Generalized Grassmannians, and Riccati Equations
Lance D. Drager, Robert L. Foote, and Clyde F. Martin, Texas Tech University; and James Wolper, Hamilton College

Riccati Equations, Algebras, Invariant Systems
Arthur A. Sagle, University of Hawaii, Hilo; and Hyo Chul Myung, University of Northern Iowa

Algebraic Geometry Design of Linear Multivariable Control Systems with Structural and Robustness Constraints
Joe H. Chow, Rensselaer Polytechnic Institute

Explicit Solutions of Two-point Boundary Value Problems for Second Order Difference Matrix Equations
Lucas Jodar, Universidad Politecnica de Valencia, Spain

Mathematical Morphology for Solving Difference Equations
Charles R. Giardina, City University of New York

Friday, May 19/10:00 AM
Contributed Presentations 19/El Dorado
NUMERICAL METHODS

Optimal Numerical Techniques Applied to a Soft Landing Re-entry Space Vehicle
David D. Stokebrand, Honeywell, Inc., Albuquerque; and A. John Boye, University of Nebraska, Lincoln

Survey of Practical Trajectory Optimization Techniques
Craig A. Phillips, Naval Surface Warfare Center

Numerical Solutions of Optimal Control Problems
John Gregory, Southern Illinois University, Carbondale

Optimal Controllers and Systolic Implementations
Jorge L. Aravena, Louisiana State University, Baton Rouge

Eigenstructure Assignment Using State Feedback
George Miminis, Memorial University of Newfoundland

SINAI—16 Numerical Software: An Example of a Methodology
Dalcidio Moraes Claudio and Tiaraju Asmuz Diverio, Universidad Federal do Rio Grande, Brazil

Friday, May 19/10:00 AM
Contributed Presentations 20/Pacific Heights
QUEUES

Stochastic Optimal Control of Production in a Two-Machine Flowshop
Sheldon Lou and Suresh Sethi, University of Toronto, Canada; and Michael Taksar, State University of New York, Stony Brook

Infinitesimal Perturbation Analysis for an Equivalent Representation of the M/M/m Queue
Jian-Qiang Hu, Harvard University

Resequencing in Parallel Queues with Bernoulli Loading
Levent Gun, University of Maryland, College Park; and Alain Jean-Marie, INRIA, France and University of Maryland, College Park

Pricing Control of Customer Usage Patterns as a Stochastic Control Problem
Richard E. Mortensen, University of California, Los Angeles

Effective Solution of the Constrained Markov Decision Problem in the Finite Case
Bach Ngoc Bui and Hayri Korezlioglu, Ecole Nationale Superieure des Telecommunications, France

Optimal Control of a Processor Sharing Queue
Peter de Waal, Center for Mathematics and Computer Science, Amsterdam, The Netherlands

Friday, May 19/10:00 AM
Contributed Presentations 21/Twin Peaks
NONSMOOTH AND CONVEX APPROACHES

The Adjoint Arc in Nonsmooth Optimization
Philip D. Loewen, University of British Columbia, Canada; and R.T. Rockafellar, University of Washington

Discrete Optimal Control Problems with State and Control Constraints
Alvaro Bolano de la Hoz, University of Puerto Rico

Pontryagin Maximum Principle Without Conjugate Equations
Barbara Kaskosz and S. Lojasiewicz, Jr., University of Rhode Island

An Optimal Control Problem L^∞
Paolo Nistri and Pietro Zecca, Universita de Firenze, Italy

How Difficult Constrained Control Problems Are?
J. Kogan, University of Maryland, Baltimore County

The Hyperplane Method for Reachable State Estimation
Timothy J. Graettinger, Carnegie Mellon University

Friday, May 19/10:00 AM
Contributed Presentations 22/Telegraph A
ROBOTICS

Optimal Control of Robotic Manipulators with Obstacles Avoidance
Jyhshing Jack Wang, M.W. Kellogg Company, Houston

Is it Time to Re-think Robot Control?
Vassilios D. Tourassis, University of Rochester

Task-Based Robot Control
Marcelo H. Ang, Jr., University of Rochester

Robust Adaptive Control of Flexible Robot Manipulators
K. Khorasani, Concordia University, Canada

Control Strategies for Flexible Link Robots
Bruno Siciliano, Universita di Napoli, Italy

An Optimization Approach to the Resolution of the Inverse Kinematic Problem of Redundant and Nonredundant Manipulators
Yasmina Bestaoui, Universite de Tlemcen, Algeria

Friday, May 19/10:00 AM
Contributed Presentations 23/Telegraph B
DISTRIBUTED PARAMETER SYSTEMS

Simulation of Stochastic Linear Hereditary Systems
R.E. Fennell, R.E. Haymond, and J.A. Reneke, Clemson University

Solution of a Generalized Stefan Problem by Reduction to a Parabolic Inverse Problem
Barbara Bekins, University of California, Santa Cruz; Igor Malyshev, Hedley Morris, and Vladimir Naroditsky, San Jose State University

Linear System Identification as an Inverse Heat Flow Problem
Alfred S. Carasso, National Institute of Standards and Technology

Vibrational Control of Infinite Dimensional Systems
Joseph Bentsman, University of Illinois, Urbana

Langrange Multipliers in Dual Pairs of Banach Spaces
Rudolf Schmid, Emory University, Atlanta

Gap Metic Applications in Systems and Control Theory
Siquan Zhu, Eindhoven University of Technology, The Netherlands

CONTRIBUTED PRESENTATIONS

Friday, May 19/2:15 PM
Contributed Presentations 24/Sea Cliff
QUALITATIVE AND STOCHASTIC DECISION THEORY

Information Structures and Causality
Mark S. Andersland, University of Iowa; and Demosthenis Teneketzis, University of Michigan, Ann Arbor

Statistical Independence in Stochastic Decision Theory
Jalel Zrida and J. Douglas Birdwell, University of Tennessee, Knoxville

Qualitative Reasoning in Fault-Tolerant Control of Large-Scale Systems
George Vachtsevanos, Georgia Institute of Technology

Qualitative Control Theory: Qualitative Transformation and Semiotics Approach to Control
Behrouz Homayoun Far, Matsuroh Nakamichi, and Mitsuji Sampei, Chiba University, Japan

An Interpretation of Stochastic Discrete-Event Systems As Chaotic Deterministic Systems
Stephen G. Strickland, Harvard University

Iconics: The Use of New Morphisms to Give an Exact Definition to a Network of Icons
John Brode, SimuLogics, Cambridge, MA

Friday, May 19/2:15 PM
Contributed Presentations 25/Twin Peaks
DISCRETE EVENT SYSTEMS

Input-Output Structure of Discrete Event Systems
Kemal Inan, University of California, Berkeley

Analysis and Control of Discrete Event Dynamic Systems: A State Space Approach
Cuneyt M. Ozveren and Alan S. Willsky, Massachusetts Institute of Technology

Supervisory Control of Discrete Event Systems with Blocking
Stephane Lafortune and Enke Chen, University of Michigan, Ann Arbor

Supervisory Control of Stochastic Discrete Event Systems
Feng Lin, Wayne State University

Condition/Event Nets for Timed Discrete Event Systems
Bruce H. Krogh, Carnegie Mellon University

A Stochastic Approximation Algorithm for Optimization of Discrete Event Dynamical Systems
Yorai Wardi, Georgia Institute of Technology

Friday, May 19/2:15 PM
Contributed Presentations 26/Room 378
ALGORITHMS

New Adaptive Learning Rules
Roberto Horowitz, William Messner, and Wei-Wen Cao, University of California, Berkeley

Suboptimal Control of Constrained Discrete Time Linear Systems
Mario Sznaier and Mark J. Damborg, University of Washington, Seattle

Adaptive Nonlinear Scalings in Optimization
Richard G. Carter, NASA Langley Research Center

Trajectory Thinning for Low Observables via Multicriteria Dynamic Programming
Eric De Jong and Lawrence H. Frank, Pacific Missile Test Center, Point Mugu, CA; Harriet H. Kagiwada and Robert E. Kalaba, Infotec Development, Inc., Camarillo, CA

Advanced Computational Stochastic Dynamic Programming for Continuous Time Problems
Floyd B. Hanson, University of Illinois, Chicago

Conical Hull and Numerical Range Techniques for Some Symmetric Matrix Problems from Control
John C. Allwright, Imperial College, London, U.K.

Friday, May 19/4:30 PM
Contributed Presentations 27/El Dorado
NEW FREQUENCY DOMAIN METHODS

Linear Control Systems Redesign—a Generalized Fourier Series Approach
Dieter Franke, Universitat der Bundeswehr Hamburg, West Germany

Recent Development on Pole-Zero Synthesis
Chia-Chi Tsui, CUNY Staten Island College

Friday, May 19/4:30 PM
Contributed Presentations 28/Twin Peaks
OPTIMAL CONTROL

Optimal Control and Differential Games with Maximum Cost
Emmanuel N. Barron, Loyola University of Chicago

An Optimal Technique for Estimating the Reachable Set of a Controlled n-Dimensional Linear System
Danny Summers and Gary C.W. Sabin, Memorial University of Newfoundland, Canada

On Optimal Control of Linear State-space Systems Containing Input Derivatives
S. Harris, E.Y. Ibrahim, V. Lovass-Nagy and R.J. Schilling, Clarkson University

Solution of a Singular Time Invariant Stochastic Linear Optimal Regulator Problem
Pinhas Barak, GMI Engineering & Management Institute, Flint, MI

Sufficient Conditions for Calculus of Variations Problems With Variable Endpoints
Vera M. Zeidan, University of Waterloo, Canada

The Jacobi Necessary Condition in the Calculus of Variations and in Optimal Control
PierLuigi Zezza, Universita de Firenze, Italy; and Vera Zeidan, University of Waterloo, Canada

Special Notice to Contributed Presentation Authors and Chairs of Contributed Presentation Sessions:

Twenty minutes are allowed for each contributed presentation. Presenters are requested to spend a maximum of seventeen minutes for their presentation, and three minutes for questions and answers.

Please note:

For presentations with more than one author, an underlineation is used to denote the author who will present the paper.

POSTER SESSION

Thursday, May 18/2:15 PM
Poster Session/Mezzanine

Digital Filtering of Noise from an Aperiodic Pulse Function
B.S. Tan and P.R. Krishnaswamy, National University of Singapore

Robust Decentralized Control Using the Quasi-Block Diagonal Dominance Concept
Huang Shu and Chang-ji Huang, Southwestern Jiaotong University, People's Republic of China

General Theorems on the Stability of Large Scale Systems
Zhongzhou Shu, Southwestern Jiaotong University, People's Republic of China

Towards a Systems Theory for Repetitive Processes
E. Rogers, D.H. Owens and K.J. Smyth, University of Strathclyde, Scotland

On the Stabilization of Nonlinear Systems by State Feedback
William M. Boothby, Washington University, St. Louis; and Riccardo Marino, Seconda Universita di Roma "Tor Vergata", Italy

Identification and Control Using Discrete Decision Theory
J. Douglas Birdwell, University of Tennessee, Knoxville

Predictive Transform Control
Erlan H. Feria, College of Staten Island of City University of New York

Delta Traffic Problem
Lere Shakunle, Matran Software International, West Germany

The Underlying Semiring Module Structure of Discrete Event Dynamical Systems
Edouard Wagneur, Ecole des Hautes Etudes Commerciales, Canada

On a Frequency Domain, Quadratic, Optimal Control Problem with Tracking/Disturbance Rejection Constraints
Gilberto O. Correa, Laboratorio National de Computacao Cientifica, Rio die Janeiro, Brasil; and Marcos A. Silveira, Department of Electrical Engineering, Pontificia Universidade Catolica do Rio de Janeiro, Rio de Janeiro, Brasil

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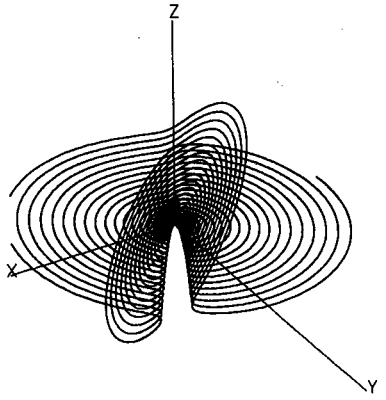
Dynamical Systems Approaches to Nonlinear Problems in Systems and Circuits

Edited by Fathi M.A. Salam and Mark L. Levi

The proceedings of the Second Engineering Conference on Qualitative Methods for the Analysis of Nonlinear Dynamics focuses on sample works and approaches of dynamical systems useful in treating nonlinear circuits and systems in engineering and the physical sciences.

Contents. **General Analytical Methods:** Reversibility, Homoclinic Points, and the Henon Map; The Applicability of Mel'kinov's Method to (Highly) Dissipative Systems; Transversal Heteroclinic Intersections in Slowly Varying Systems; Stochastically Perturbed Hopf Bifurcation; The LaSalle Invariance Principle in Infinite Dimensional Hilbert Space; Damping in Nonlinear Solid Mechanics: **General Simulation Methods:** Three-Dimensional Rotation Instrument for Displaying Strange Attractors; A Double Strange Attractor; Forced Two-Well Potential Duffing's Oscillator; A Chaotic Saddle Catastrophe in Force Oscillators; On the Simulation of a Paradigm of Nonlinear Dynamics; **Electrical Engineering:** Nonlinear Circuits and Systems: An Experimental Investigation of Chaos in an RF Driven Josephson Junction; Soliton Experiments in Annular Josephson Junctions; Control Systems: Smoothing and Linearization of Discontinuous Control Systems; Some Qualitative Aspects of Power Systems Dynamics; Applications of Nonlinear Theory to Control Design; Local Bifurcation Control; Stabilization of Nonlinear Systems with Uncontrollable Linearization; Stability



Analysis of Hybrid Composite Dynamical Systems; **Mechanical Engineering:** Solids and Vibrations: Chaotic Dynamics in Solid Mechanics; Rolling of Ships in Large-Amplitude Waves; Chaotic Motions in Parametrically Excited Systems with Quadratic Nonlinearities; On the Effects of Asymmetries on a System Near a Codimension Two Point; Bifurcations in Flow-Induced Oscillations in Tubes Carrying a Fluid; Periodic and Chaotic Motions of a Buckled Beam Experiencing Parametric and External Excitation; Mechanical Systems: The Dynamics of Two Coupled Rigid Bodies; Control of Constrained Hamiltonian Systems and Applications to Control of Constrained Robots; Robust Nonlinear Computed Torque Control for Robot Manipulators.

January 1988
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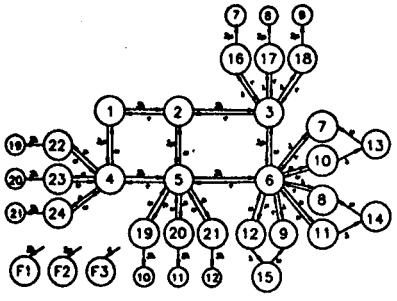

Linear Algebra in Signals, Systems, and Control

Edited by Biswa Nath Datta, Charles R. Johnson, Marinus A. Kaashoek, Robert J. Plemmons, and Eduardo O. Sontag

The design of signal processing and control systems has long served as a prime example of a fruitful synergism between engineering problems, mathematical analysis, and computational methods. Advances in control and systems theory, in parallel with advances in computational methods, have brought linear algebra to the leading edge of this synergism, as illustrated by these Proceedings. Forty-six papers present results on analytical and computational linear algebra and its application to mathematical systems theory; geometric theory of multivariable control; signal processing; estimation, filtering and prediction; and robust, adaptive and stochastic control.

Contents. Topics discussed include: algorithms for spectral estimation, digital filtering, discrete-time periodic Riccati equations, interpolation, system realization, parallel processing in adaptive control, and a discussion of integrating different symbolic and numeric tools for linear system analysis. Discusses numerical methods for Toeplitz matrices, ill-posed control problems, singular value decompositions, preconditioned conjugate-gradient methods, subspace computation applied to signal processing, and least-square methods. Theoretical topics in control and systems theory include bilinear descriptor control systems, noninteracting decomposition, absolute tracking of Lurie systems, robust stabilization, reachability with constraints, high-gain stabilization and adaptive control. Papers on linear algebra discuss inertia theorems for Lyapunov and Riccati equations, root-clustering criteria, algebraic curves, centrosymmetric matrices, l_p norms of matrices, and matrix continued fractions.

May 1988
xiv + 667 pages, Hardcover
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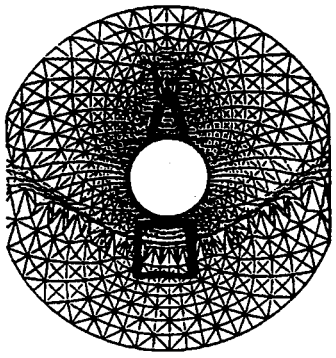
ICIAM '87: Proceedings of the First International Conference on Industrial and Applied Mathematics

Editors: James McKenna and Roger Temam

Eighteen hundred applied mathematicians, computer and computational scientists, statisticians, and users of mathematics in engineering and the bio- and physical sciences from 51 countries gathered in Paris in June 1987. The conference demonstrated the cohesiveness of the applied mathematics community in the western world and conclusive evidence that this community works across international boundaries. Most impressive was the high quality of the work being done by this very large international community.

ICIAM '87 includes presentations of the 16 internationally known applied mathematicians, who were the invited speakers of the conference; summaries of the 69 minisymposia; and the titles and speakers of those minisymposia and the approximately 1,000 contributed papers; the opening presentations by Paul Germain, Secretary of the French Academy of Sciences, the welcoming addresses by the sponsoring



societies—GAMM, IMA, SIAM, and SMAI—and a multi-page collection of pictures taken at the conference. This collection of material provides a broad view of applied and computational mathematics around the world.

October 1988
xx + 376 pages, Hardcover
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Handbook for Matrix Computations

Thomas F. Coleman and Charles Van Loan

Frontiers in Applied Mathematics 4

Handbook for Matrix Computations is the first volume that provides the user with a step-by-step introduction to FORTRAN 77, BLAS, LINPACK, and MATLAB. The authors have written a reference that spans several levels of practical matrix computations with a strong emphasis on examples and "hands on" experience.

This volume can be used as a second text for scientific computing courses that involve a significant amount of algebraic computation. It is ideal for a one-semester introductory numerical methods course or a graduate-level numerical analysis course. The only prerequisites are a one-semester course in matrix algebra and some experience with a high-level programming language such as Pascal.

September 1988
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TRANSPORTATION INFORMATION

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American Airlines has been chosen as the official carrier for this conference. You can fly to San Francisco and save on travel from May 14–22, 1989 inclusive.

In a special arrangement with SIAM, American Airlines is offering you the services of their toll free convention reservation desk, along with a complement of discounts.

- 5% off any fare for which you qualify, including First Class and Ultra Saver fares. ***THE DISCOUNTS CAN RANGE FROM 40%–70% OFF NORMAL COACH FARES!***

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To make reservations for one of the above discounted fares:

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- For those of you having to use a corporate or university travel agent, you may still purchase your ticket through the local agents, just be sure to mention to the agent the above discounts. Your local agent can call the American Airlines Convention Desk to make your reservation. *Make sure that the agent uses the SIAM account number: S16090.*

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Take 101 North until the freeway splits. Go left towards the Golden Gate Bridge. Follow the Golden Gate Bridge signs to the end of the freeway until it becomes Franklin Street. Proceed five blocks to Post Street and turn right. Continue to the intersection of Van Ness Avenue and turn right. The Cathedral Hill Hotel garage entrance is in the middle of the block on Van Ness.

From Los Angeles
Take highway 5 North to 580 West to the Bay Bridge. Take the Main Street exit on the right. Proceed to Market Street and turn left, and then take the first right onto South Van Ness to Van Ness Street. Follow Van Ness to Geary Street. The Cathedral Hill Hotel is on Van Ness at Geary Street.

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A number of airport shuttle vans stop at the island on the arrival level of the airport. Lorries Airport Service and Super Shuttle depart every twenty minutes and cost approximately $10.00. A local taxi will cost $25.00.

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DOLLAR RENT-A-CAR has been selected as the official car rental agency for this conference. The following rates will apply:

Type of Car	Daily Rate		Weekly Rate
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- We encourage you to make an advance reservation as on-site availability cannot be guaranteed. Make reservations by calling: 1-800-421-6878. *When making your reservations, be sure to give the SIAM account number CCSIA3. You should also mention that you are attending the SIAM Conference on Control in the 90's:, May 17–19, 1989 in San Francisco, in order to receive the discounted rates.*
- Cars may be picked up at the San Francisco Airport at the Dollar Car Rental Desk located in the baggage claim area of the airport. You may also use some Downtown locations, as well as San Jose and Oakland Airport locations.
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- The prices quoted do not include refueling services, tax optional collision damage waiver, and personal accident insurance.

HOTEL INFORMATION

Cathedral Hill Hotel
Van Ness at Geary Street
San Francisco, CA 94109
(415) 776-8200

SIAM is holding a block of rooms at the Cathedral Hill Hotel. These rooms are being held on a first come, first served basis at $76/Single and $89/Double. *These rooms will be held for our exclusive use only until April 20, after which date reservations will depend on availability.*

We urge you make your reservations as soon as possible. You may do so by telephoning (415) 776-8200, or by mailing in the Hotel Reservation Form located in the back of this program. *When making your reservation via phone, please be certain to identify yourself as an attendee at the SIAM Conference on Control in the 90's to receive the discounted rate.*

Late Arrival Policy: If you plan to check-in after 6:00 PM, you must guarantee your room for late arrival by making payment in advance for one night. Payment can be made by either AMEX, MC, Visa, Diner's Club or check.

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Weather: San Francisco is blessed with a temperate marine climate and enjoys mild weather year-round. Temperatures seldom rise above 70 or fall below 40 . Morning and evening fogs roll in during the summer months, but rarely persist. Women are most comfortable with a light jacket or coat, or in a suit. Men's attire requires only light-to-medium-weight suits or sports clothes. An all-weather coat will take the chill off cool evenings. Lightweight summer clothes are seldom practical in San Francisco. Bring comfortable walking shoes.

About the Hotel: There is one restaurant in the hotel which specializes in fine dining and continental cuisine. The restaurant is called the Hilltop Room and is open Tuesday thru Saturday from 5:30 PM–10:30 PM. The prices range between $14 and $17. There is also a coffee shop which is open 7 days a week from 6:00 AM until 11:00 PM. They serve breakfast, lunch and dinner. The prices range between $3.50 for breakfast to $15.00 for dinner. There are many restaurants which offer a variety of cuisines within walking distance of the hotel. The hotel is also equipped with an outdoor pool.

Parking: The Cathedral Hill Hotel offers complimentary parking for those attendees who will be staying at the hotel. However, those attendees not staying in the hotel can expect to pay an average of $15 per day for parking.

REGISTRATION INFORMATION

Please complete the Advance Registration Form found on the back page of this brochure and return it in the envelope provided in the middle section of this program. We urge attendees to register in advance, as the registration fee is lower for advance registrants. The advance registration deadline is May 9, 1989. The registration desk will be located in the Mezzanine and will be open at the following times:

Tuesday, May 16	6:00 PM–9:00 PM
Wednesday, May 17	7:00 AM–6:30 PM
Thursday, May 18	7:30 AM–6:30 PM
Friday, May 19	7:30 AM–2:30 PM

SPECIAL EVENTS

Welcoming Reception
Tuesday, May 16, 7:00 PM–9:00 PM
Mezzanine
Cash Bar

Beer Party
Wednesday, May 17, 6:45 PM–8:30 PM
Mezzanine
Cost: $15 consists of beer, assorted sodas, make your own tacos and mini burritos

REGISTRATION FEES:

Advance registration deadline: May 9, 1989

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** This represents a $5.00 discount for members of the SIAM Activity Group on Control and Systems Theory*

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The telephone number at the Cathedral Hill Hotel is 1-415-776-8200. The Cathedral Hill will either connect you with the SIAM registration desk or forward a message.

Credit Cards
SIAM is now accepting VISA, Master Card and AMEX for payment of registration fees and special functions. When you complete the Advance Registration Form, please be certain to indicate the type of credit card, the number and the expiration date.

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July 17–21, 1989
SIAM Annual Meeting
Sheraton Hotel
San Diego, CA

September 25–28, 1989
SIAM Conference on Mathematical and Computational Issues in Geophysical Fluid and Solid Mechanics
Stouffer Greenway Plaza Hotel
Houston, TX

November 6–10, 1989
SIAM Conference on Geometric Design
Sheraton Mission Palms Hotel
Tempe, AZ

December 11–13, 1989
Fourth SIAM Conference on Parallel Processing for Scientific Computing
Hyatt Regency Hotel
Chicago, IL

March 5–7, 1990
SIAM Conference on Applied Probability in Science and Engineering
Clarion Hotel
New Orleans, LA

May 7–10, 1990
SIAM Conference on Applications of Dynamical Systems
Marriott Hotel
Orlando, FL

July 16–20, 1990
SIAM Annual Meeting
Hyatt Regency Hotel
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SIAM Conference on Control in the 90's: Achievements, Opportunities and Challenges

May 17–19, 1989
Cathedral Hill Hotel
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