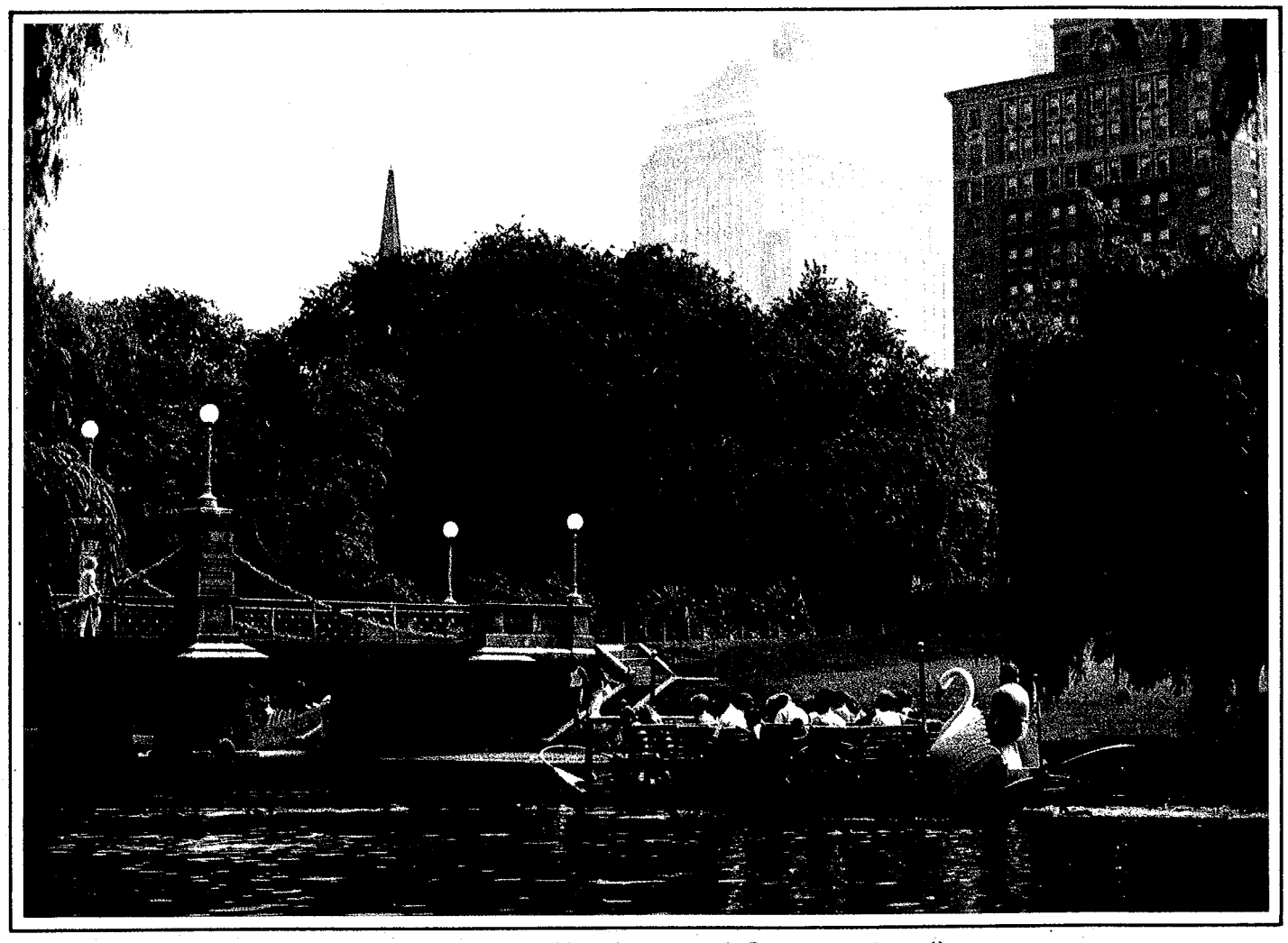
Society for Industrial and Applied Mathematics

Preliminary Program

and Short Course on Theoretical and Computational Aspects of Computer Vision

August 11, 1986

57 Park Plaza Hotel • Boston, Massachusetts



Linear Algebra (Analytic and Computational) and Its Applications in:

- ☐ Signal Processing
- ☐ Large-scale Systems
- ☐ Robust, Adaptive, and Stochastic Control
- ☐ Geometric Theory of Multivariable Control
- ☐ Estimation, Filtering, and Prediction
- ☐ Mathematical Systems Theory

Sponsored by the SIAM Activity Group on Linear Algebra

TABLE OF CONTENTS

ORGANIZING COMMITTEE

ADVISORY COMMITTEE

Photographs graciously provided by the Greater Boston Convention and Visitors Bureau.

SHORT COURSE

Short Course on Theoretical and Computational Aspects of Computer Vision

Monday, August 11

Harvard University, Pierce Hall, Room 209

The field of computer vision is rapidly developing into a standard tool for solving engineering problems. At the same time, faster computers and cheaper memory have made it possible to consider the implementation of whole new classes of algorithms involving computationally intensive procedures designed for stereo and motion analysis. In this course we want to introduce the audience to some of the more mathematical aspects of this subject, paying particular attention to the formulation of problems and the performance limitations associated with the techniques available today. Topics to be covered include edge-detection based on linear filtering followed by zero-crossing analysis stereo, morphological analysis, and three-dimensional motion analysis based on two-dimensional optical flow. Demonstrations using equipment in the Harvard Robotics Laboratory will be included. The speakers will emphasize mathematical ideas when appropriate and will not assume prior experience in the field of computer vision.

Due to the "hands-on" nature of the short course, attendance will be limited to 80 and registration will be accepted on a first come, first served basis. We urge you to preregister, as on-site registration will depend on availability.

PROGRAM

All speakers are from the Division of Applied Sciences, Harvard University, Cambridge, MA.

8:30 AM	Overview Roger W. Brockett
9:00 AM	Edges and Shapes Roger W. Brockett
10:00 AM	Coffee
10:30 AM	Scale Space Analysis James J. Clark
12:00 PM	Lunch
1:30 PM	Morphological Image Analysis Petros Maragos
3:00 PM	Coffee
3:30 PM	Motion Analysis K. Wohn
5:00 PM	Discussion

Preprints of the lecture materials will be distributed upon check-in at the short course registration desk.

All attendees must assemble at the registration desk, located in Convention Hall B at the 57 Park Plaza Hotel, between 7:30 AM and 8:00 AM to register and board buses for Harvard University.

REGISTRATION FEES

	SIAM Member	Non-Member	Student Member	Student Non-Member
Advance	$75	$ 90	$25	$35
On-site	$90	$105	$35	$45

Registration fees include preprints, lunch and transportation.

Invited Presentations

Tuesday, August 12, 8:30 AM
Invited Presentation 1
RECENT RESULTS IN ADAPTIVE CONTROL: OPPORTUNITIES FOR INTELLIGENT AND ARTIFICIALLY-INTELLIGENT CONTROL

Parameter adaptive control is a potentially important extension of classical control necessitated in practice because certain of the standard assumptions in classical control (e.g., systems parameters are or can be known precisely) may be violated. The speaker will report on new results in the adaptive stabilization and control of multivariable linear systems, highlighting recent derivations of necessary and sufficient conditions for adaptive stabilization.

Christopher Byrnes
Arizona State University
Tempe, AZ

Tuesday, August 12, 9:15 AM
Invited Presentation 2
GENERALIZATIONS AND APPLICATIONS OF BEZOUTIAN MATRICES

The classical Bezoutian matrix of two scalar polynomials has a great deal of applications in a wide variety of fields such as system theory, Lyapunov equations and stability, inversion of Toeplitz and Hankel matrices, etc. The demands of these fields (e.g., of multivariate system theory), as well as some recent developments in linear algebra, have inspired in the last decade many attempts to find successful generalizations of the Bezoutian to the case of two matrix polynomials. Some of such generalizations and their usage will be reviewed in our presentation. Also, a new concept of a Bezoutian associated with a family of matrix polynomials will be introduced and its applications to several apparently different problems will be discussed. In particular, a "Toeplitz" classification of matrices and some inversion algorithms will be suggested.

L. Lerer
Israel Institute of Technology
Israel

Tuesday, August 12, 2:00 PM
Invited Presentation 3
SYNERGISM IN NUMERICAL LINEAR ALGEBRA AND CONTROL

Numerical linear algebra has played a synergistic role in the algorithms underlying modern multivariable control and system theory. Such algorithms generally must be implemented in finite-precision computing environments which necessitates paying careful attention to their numerical stability and to the analysis of the condition of the particular problems being solved.

Increasing interest has been focused recently on control problems with very stringent numerical requirements such as the need to solve extremely large problems at very high speed and with very high accuracy. Such problems will require a variety of parallel algorithms implemented with algorithmically dedicated architectures for their solutions.

The speaker will discuss the general numerical considerations indicated above, illustrating them with specific applications in which linear algebra is prominently featured. He will also review recent progress in parallel algorithms implemented with special architectures.

Alan J. Laub
University of California, Santa Barbara
Santa Barbara, CA

Wednesday, August 13, 8:30 AM
Invited Presentation 4
FACTORIZATION OF RATIONAL MATRIX FUNCTIONS AND LINEAR SYSTEMS: RECENT RESULTS AND UNSOLVED PROBLEMS

Finding factorizations of matrix polynomials and the minimal factorization of rational matrix functions that are analytic at infinity are important linear algebraic problems. They arise in systems theory in conjunction with the problem of cascade decompositions of linear time-invariant systems. Similarly, linear functional decompositions of rational matrix functions considered as a generalization of the factorization problem have important applications to Wiener-Hopf equations and the stability problem.

The speaker will review recent results on these problems and related topics. In addition, he will describe a number of unsolved problems about factorization such as the problems of factoring a matrix function with a positive definite imaginary part and a matrix function that is not analytic at infinity.

Israel Gohberg
Tel Aviv University
Israel

Wednesday, August 13, 9:15 AM
Invited Presentation 5
OPTIMIZATION OVER SPACES OF MATRIX-VALUED ANALYTIC FUNCTIONS

Problems in control theory often involve common performance measures such as tracking error, restriction on bandwidth, and gain phase margin. These problems can be described in the following way:

Given a function $\Gamma(\omega,Z) \geq 0$ of a real variable ω and a matrix Z, find

$$\inf_{Z \in G} \sup_{\omega} \Gamma(\omega, Z(\omega)).$$

In applications such as those above, ω is frequency, $Z(\omega)$ is a matrix-valued analytic function of design choices, and Γ is the performance of the system to be designed.

The speaker will discuss some of the qualitative properties of solutions to the general problem, approaches to finding exact solutions when Γ is a 'simple' function, and iterative methods for solving general optimization problems.

J. William Helton
University of California, San Diego
La Jolla, CA

Wednesday, August 13, 2:00 PM
Invited Presentation 6
APPLICATIONS OF LINEAR ALGEBRA TECHNIQUES TO KALMAN FILTERING AND MODERN ESTIMATION

Much of what the electrical and control systems engineering community regards as techniques for modern estimation are simply applications of sound numerical linear algebra principles to problems involving stochastic models and noisy data. The speaker will focus on numerical solutions to the discrete time Kalman filter. Two solution methods will be presented. The first is the square-root information filter/smoother (SRIF/SRIS), which is an extension of the QR orthogonal transformation solution to the recursive least-squares parameter estimation problem. The second involves the reformulation of the Kalman filter estimate/covariance recursion in terms of square-root free Cholesky factors. Choosing an upper triangular factorization, UDU^T, expedites conversion to and comparison with the SRIF formulation. The presentation will include key linear algebra ideas that have contributed directly and indirectly to the increasing popularity of the SRIF and U-D estimation techniques.

Gerald J. Bierman
Factorized Estimation Applications, Inc.
Sherman Oaks, CA

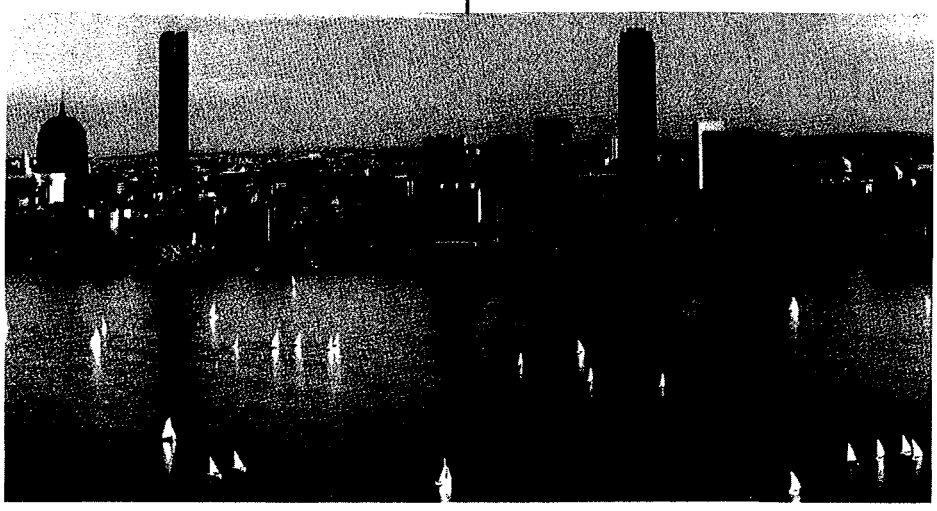
Wednesday, August 13, 8:15 PM
Special Lecture
SMOOTH SHAPES AND THEIR CHARACTERIZATIONS IN TERMS OF ANALYSIS AND GEOMETRY

Roger W. Brockett
Harvard University
Cambridge, MA

Thursday, August 14, 8:30 AM
Invited Presentation 7
THE MINIMALITY AND IRREDUCIBILITY OF BOUNDARY VALUE SYSTEMS

Various problems in linear estimation theory, in transport theory and in the study of integral equations of convolution type lead in a natural way to non-causal systems of the following type:

$$\begin{cases} \dot{x}(t) = Ax(t) + Bu(t), & 0 \leq t \leq \tau, \\ y(t) = Cx(t), & 0 \leq t \leq \tau, \\ N_1x(0) + N_2x(\tau) = 0. \end{cases}$$



Here the boundary conditions are well-posed, which implies that (as in the causal case) the input/output behavior is well-defined. For these so-called boundary value systems the canonical structure theory has been developed recently, and it has become clear that in their system theoretical properties boundary value systems differ considerably from causal systems. In this lecture these developments will be reviewed and illustrated by various examples. Classical notions as controllability, observability, minimality and irreducibility will be analyzed in this context. It turns out that there are unexpected connections with the minimality problem for causal N-D systems.

M. A. Kaashoek
Vrije Universiteit
The Netherlands

Thursday, August 14, 9:15 AM
Invited Presentation 8
LINEAR ALGEBRA AND VLSI ARRAY PROCESSORS

Due to the fast growing VLSI (Very Large Scale Integration) technology, special-purpose array processors have become increasingly appealing, especially for real-time signal processing systems. In designing such processors, it is important to exploit the underlying properties of the algorithms involved. Most signal processing algorithms have a matrix algebraic appearance, and share the critical attributes of regularity, recursiveness, and local communication that have been effectively exploited in the innovative systolic and wavefront array processors.

These array processors maximize the effectiveness of VLSI for intensive and pipelined computing and yet circumvent its main limitation on communication. The application domain of such array processors covers a very broad range, including digital filtering, spectrum estimation, adaptive array processing, image/vision processing, and seismic and tomographic signal processing.

The speaker will provide a general overview of VLSI array processors in a unified treatment from both the algorithm and the architecture perspectives.

S. Y. Kung
University of Southern California
Los Angeles, CA

Thursday, August 14, 2:00 PM
Invited Presentation 9
AGGREGATION AND TIME SCALE ANALYSIS OF PERTURBED LINEAR SYSTEMS AND FINITE-STATE MARKOV PROCESSES

Perturbed linear systems of the form $\dot{x} = A(\varepsilon)x$, where ε is a small parameter, are common in mathematical system theory and its applications. New procedures and insights concerned with the aggregation and time scale decomposition of such models will be described. In particular a general method, with graph-theoretic and probabilistic interpretations, will be described for the case when $A(\varepsilon)$ is an infinitessimally stochastic matrix, and in the more general case the invariant factor structure of $A(\varepsilon)$ will be related to the existence of a time scale decomposition and to the possible use of amplitude scaling to obtain such decompositions.

Alan S. Willsky (and George C. Verghese, Xi-Cheng Lou, Jan Robin Rohlicek, and Pamela G. Coxson)
Massachusetts Institute of Technology
Cambridge, MA

Minisymposia

1. **Numerical Aspects of Control and Systems**
   Rajnikant Patel
   Concordia University, Montreal, Canada
2. **Matrix Equations: Stability and Inertia**
   David Carlson
   San Diego State University, San Diego, CA
   and
   Hans Schneider
   University of Wisconsin, Madison, WI
3. **Numerical Linear Algebra in Signals, Systems and Control**
   Biswa Nath Datta
   Northern Illinois University, DeKalb, IL
4. **Geometric Methods in Multivariable Control**
   Gregory S. Ammar
   Northern Illinois University, DeKalb, IL
   and
   Clyde F. Martin
   Texas Tech University
   Lubbock, TX
5. **Linear Algebra in Signal Processing**
   George Cybenko
   Tufts University, Medford, MA
6. **The Role of Linear Algebra in Large-Scale Systems**
   Dragoslav D. Siljak
   Santa Clara University, Santa Clara, CA
7. **Geometric and Grassmannian Techniques in Control Theory**
   Lance D. Drager and Robert L. Foote
   Texas Tech University, Lubbock, TX
8. **Linear Algebra on Advanced Computer Architectures**
   Danny C. Sorensen
   Argonne National Laboratory, Argonne, IL
   and
   University of Illinois at Urbana-Champaign, Urbana, IL
9. **Using Macsyma in Control Problems**
   Gilmer L. Blankenship
   University of Maryland, College Park, MD
10. **Least Squares Computations in Signal Processing**
    S. T. Alexander and R. J. Plemmons
    North Carolina State University, Raleigh, NC
11. **Positive Systems**
    Pamela G. Coxson
    The Ohio State University, Columbus, OH
12. **Iterative Solutions for Large Sparse Linear Systems of Equations**
    Richard S. Varga
    Kent State University, Kent, OH
13. **Toeplitz Matrices**
    James R. Bunch
    University of California—San Diego, La Jolla, CA
14. **Numerical Linear Algebra in Systems Theory**
    Nancy K. Nichols
    The University of Reading, Reading, Great Britain

Special Functions

Welcoming Reception
Monday, August 11, 8:00 PM
Convention Hall B

Wine and Cheese Party
Wednesday, August 13, 6:30 PM
Convention Hall B
$15.00

PROGRAM-AT-A-GLANCE

Sunday, August 10/PM

5:00 PM/Convention Hall B (6th floor)
57 Park Plaza Hotel
Registration opens for Short Course on Theoretical and Computational Aspects of Computer Vision

10:00 PM/Convention Hall B
Registration Closes

Monday, August 11/AM

7:00 AM/Convention Hall B (6th floor)
57 Park Plaza Hotel
Registration opens for Short Course

7:45 AM/Lobby
Board buses for Harvard University

8:30 AM/Pierce Hall 209
OVERVIEW
Roger W. Brockett, Harvard University

9:00 AM/Pierce Hall 209
EDGES AND SHAPES
Roger W. Brockett, Harvard University

10:00 AM
Coffee

10:30 AM/Pierce Hall 209
SCALE SPACE ANALYSIS
James J. Clark, Harvard University

Monday, August 11/PM

12:00 PM/Lunch

1:30 PM/Pierce Hall 209
MORPHOLOGICAL IMAGE ANALYSIS
Petros Maragos, Harvard University

3:00 PM
Coffee

3:30 PM/Pierce Hall 209
MOTION ANALYSIS
K. Wohn, Harvard University

5:00 PM/Discussion

5:00 PM/Convention Hall B (6th floor)
57 Park Plaza Hotel
Conference Registration Opens

8:00 PM/Convention Hall B
Welcoming Reception

10:00 PM/Convention Hall B
Registration Closes

Tuesday, August 12/AM

7:00 AM/Convention Hall B (6th floor)
Registration Opens

8:15 AM/Convention Hall A
Opening Remarks

8:30 AM/Convention Hall A
Invited Presentations 1 and 2
Chairs: Roger W. Brockett, Harvard University and Biswa Nath Datta, Northern Illinois University

RECENT RESULTS IN ADAPTIVE CONTROL: OPPORTUNITIES FOR INTELLIGENT AND ARTIFICIALLY-INTELLIGENT CONTROL
Christopher Byrnes
Arizona State University
Tempe, AZ

GENERALIZATIONS AND APPLICATIONS OF BEZOUTIAN MATRICES
L. Lerer
Israel Institute of Technology
Haifa, Israel

10:00 AM/Convention Hall B
Coffee

10:30 AM/CONCURRENT SESSIONS

Minisymposium 1/Convention Hall A
Numerical Aspects of Control and Systems
Chair: Rajnikant V. Patel
Concordia University

Minisymposium 2/Convention Hall C
Matrix Equations: Stability and Inertia
Chairs: David Carlson, San Diego State University and Hans Schneider, University of Wisconsin-Madison

Contributed Papers 1/Carver 1 (Mezzanine)
Adaptive and Robust Control
Chair: Christopher Byrnes
Arizona State University

Contributed Papers 2/Carver 2
Numerical Methods for Signal Processing
Chair: James R. Bunch
University of California, San Diego

Contributed Papers 3/Carver 3
Matrix Fractions and Realization Theory
Chair: Stephen Campbell
North Carolina State University

UPCOMING PROGRAMS

November 17–20, 1986
SIAM/National Bureau of Standards Short Course on Scientific Software for Supercomputing
National Bureau of Standards
Gaithersburg, MD
(For further information, write: Conference Coordinator, SIAM, 117 S. 17th Street, 14th Floor, Philadelphia, PA 19103-5052.)

January 12–14, 1987
SIAM Conference on Industry-University Collaborations in the Mathematical Sciences
The Claremont Colleges
Claremont, CA
(For further information, write: Conference Coordinator, SIAM, 117 S. 17th Street, 14th Floor, Philadelphia, PA 19103-5052.)

Tuesday, August 12/PM

12:30 PM/Lunch

2:00 PM/Convention Hall A
Invited Presentation 3
Chair: Biswa Nath Datta
Northern Illinois University

SYNERGISM IN NUMERICAL LINEAR ALGEBRA AND CONTROL
Alan J. Laub
University of California
Santa Barbara, CA

2:45 PM/Convention Hall B
Coffee

3:15 PM/CONCURRENT SESSIONS

Minisymposium 3/Convention Hall A
Numerical Linear Algebra in Signals, Systems and Control
Chair: Biswa Nath Datta
Northern Illinois University

Minisymposium 4/Convention Hall C
Geometric Methods in Multivariable Control
Chairs: Gregory Ammar, Northern Illinois University and Clyde Martin, Texas Tech University

Contributed Papers 4/Carver 1
Matrix Theory and Applications
Chairs: Richard Brualdi and Hans Schneider, University of Wisconsin-Madison

Contributed Papers 5/Carver 2
Stochastic Processes and Control
Chair: Anders Lindquist, Royal Institute of Technology, Sweden

Wednesday, August 13/AM

8:30 AM/Convention Hall A
Invited Presentations 4 and 5
Chairs: Charles Johnson, Clemson University and David Carlson, San Diego State University

FACTORIZATION OF RATIONAL MATRIX FUNCTIONS AND LINEAR SYSTEMS: RECENT RESULTS AND UNSOLVED PROBLEMS
Israel Gohberg
Tel Aviv University, Israel

OPTIMIZATION OVER SPACES OF MATRIX-VALUED ANALYTIC FUNCTIONS
J. William Helton
University of California, San Diego

10:00 AM/Convention Hall B **Coffee**

10:30 AM/CONCURRENT SESSIONS

Minisymposium 5/Convention Hall A
Linear Algebra in Signal Processing
Chair: George Cybenko, Tufts University

Minisymposium 6/Convention Hall C
The Role of Linear Algebra in Large-Scale Systems
Chair: D. Siljak, University of Santa Clara

Minisymposium 7/Carver 1
Geometric and Grassmannian Techniques in Control Theory
Chairs: Lance D. Drager and Robert L. Foote
Texas Tech University

Contributed Papers 6/Carver 2
Numerical Linear Algebra
Chair: Robert Ward
Oak Ridge National Laboratory

Contributed Papers 7/Carver 3
Systems and Control 1
Chair: S. P. Bhattacharyya
Texas A&M University

Wednesday, August 13/PM

12:30 PM/Lunch

2:00 PM/Convention Hall A
Invited Presentation 6
Chair: Alan Laub
University of California, Santa Barbara

APPLICATIONS OF LINEAR ALGEBRA TECHNIQUES TO KALMAN FILTERING AND MODERN ESTIMATION
Gerald J. Bierman
Factorized Estimation Applications, Inc.
Sherman Oaks, CA

2:45 PM/Convention Hall B
Coffee

3:15 PM/Convention Hall A
MEETING OF THE SIAM ACTIVITY GROUP ON LINEAR ALGEBRA
Chair: Robert Ward
Oak Ridge National Laboratory

4:00 PM/CONCURRENT SESSIONS

Minisymposium 8/Convention Hall A
Linear Algebra and Advanced Computer Architectures
Chair: Danny C. Sorensen
Argonne National Laboratory and University of Illinois, Urbana-Champaign

Minisymposium 9/Convention Hall C
Using MACSYMA in Control Problems
Chair: Gilmer L. Blankenship
University of Maryland

Contributed Papers 8/Carver 1
Numerical Methods for Systems and Control
Chairs: Paul Van Dooren
Philips Research Laboratory, Belgium and Alan Laub, University of California, Santa Barbara

Contributed Papers 9/Carver 2
Filtering, Estimation and Prediction
Chair: Rabinder N. Madan
Office of Naval Research

Contributed Papers 10/Carver 3
Numerical Methods for Signal Processing II
Chair: George Cybenko
Tufts University

6:30 PM/Convention Hall B
Wine and Cheese Party

8:15 PM/Convention Hall A
SPECIAL LECTURE
Roger W. Brockett, Harvard University
SMOOTH SHAPES AND THEIR CHARACTERIZATIONS IN TERMS OF ANALYSIS AND GEOMETRY

Preprints Table

SIAM has reserved a table in the book exhibit area for those attendees who wish to share new results or ideas with other participants at the meeting. We encourage you to bring copies of your work to the meeting and make them available to those who may be interested. *No advertisements or promotions, please.*

Thursday, August 14/AM

8:30 AM/Convention Hall A
Invited Presentations 7 and 8
Chairs: Hans Schneider, University of Wisconsin-Madison and Biswa Nath Datta, Northern Illinois University

THE MINIMALITY AND IRREDUCIBILITY OF BOUNDARY VALUE SYSTEMS
M. A. Kaashoek
Vrije Universiteit
The Netherlands

LINEAR ALGEBRA AND VLSI ARRAY PROCESSORS
S. Y. Kung
University of Southern California
Los Angeles, CA

10:00 AM/Convention Hall B
Coffee

10:30 AM/CONCURRENT SESSIONS

Minisymposium 10/Convention Hall A
Least Squares Computations in Signal Processing
Chairs: S. T. Alexander and Robert J. Plemmons, North Carolina State University

Minisymposium 11/Convention Hall C
Positive Systems
Chair: Pamela Coxson
Ohio State University

Minisymposium 12/Carver 1
Solutions for Large Sparse Linear Systems of Equations
Chair: Richard Varga
Kent State University

Contributed Papers 11/Carver 2
Systems and Control II
Chair: Eduardo Sontag
Rutgers University

Poster Session/Carver 3

Thursday, August 14/PM

12:30 PM/Lunch

2:00 PM/Convention Hall A
Invited Presentation 9
Chair: Robert J. Plemmons
North Carolina State University

AGGREGATION AND TIME SCALE ANALYSIS OF PERTURBED LINEAR SYSTEMS AND FINITE-STATE MARKOV PROCESSES
Alan S. Willsky
Massachusetts Institute of Technology
Cambridge, MA

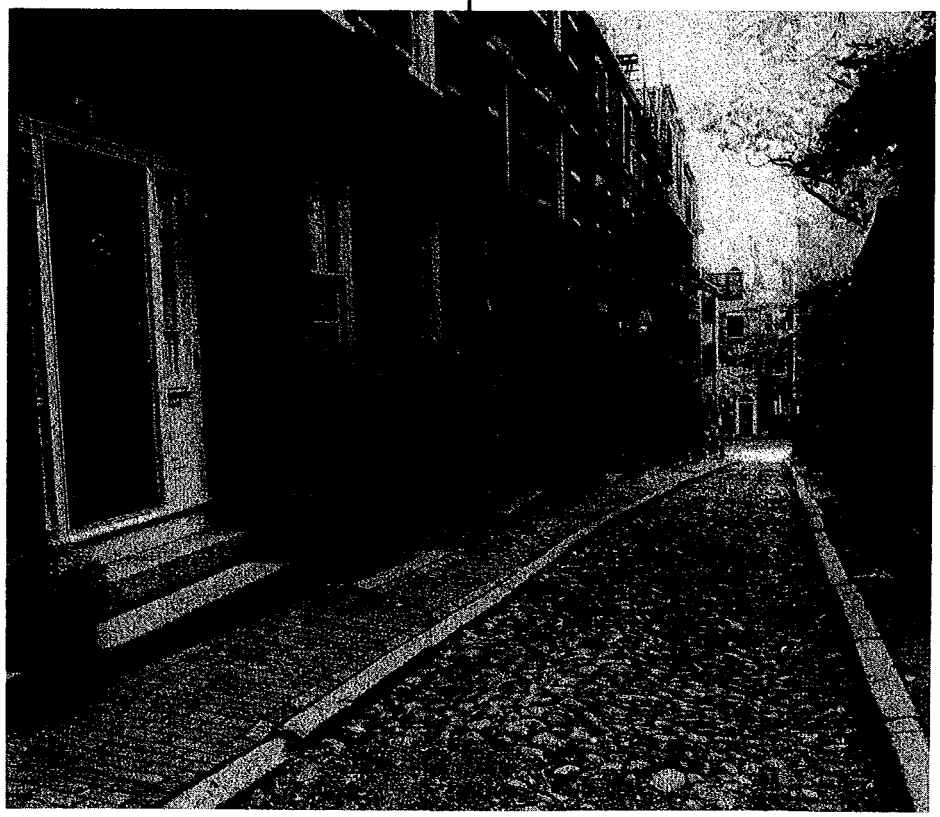
2:45 PM/Convention Hall B
Coffee

3:15 PM/CONCURRENT SESSIONS

Minisymposium 13/Convention Hall A
Toeplitz Matrices
Chair: James R. Bunch
University of California, San Diego

Minisymposium 14/Convention Hall C
Numerical Linear Algebra in Systems Theory
Chair: Nancy Nichols
University of Reading, Great Britain

Contributed Papers 12/Carver 2
Stabilization and Pole Placement
Chair: David Carlson
San Diego State University



Tuesday, August 12/*10:30 AM*
Minisymposium 1/Convention Hall A

NUMERICAL ASPECTS OF CONTROL AND SYSTEMS

In recent years considerable attention has been focused on the numerical and computational problems arising in the analysis and design of multivariable systems. In this minisymposium, we have invited contributions from some of the leading researchers in this area. The minisymposium consists of four papers which address a variety of current numerical and other issues on different aspects of multivariable systems. It should be of interest not only to control engineers but also to numerical analysts and mathematicians working in linear systems.

CHAIR AND ORGANIZER
Rajnikant Patel
Department of Electrical Engineering
Concordia University
Montreal, Quebec, Canada

A Generalized State-Space Approach for Embedding a Polynomial Matrix Into a Unimodular Matrix
T. Beelen
Advanced Systems Group-Class
Philips Eindhoven
Eindhoven, The Netherlands
and
P. Van Dooren
Philips Research Laboratory Brussels
Brussels, Belgium

Recursive Design Algorithms for Implicit Systems
J. D. Aplevich and K. Morris
Department of Electrical Engineering
University of Waterloo
Waterloo, Ontario, Canada

Transfer Function Evaluation for Linear Multivariable Systems
P. Misra and R. V. Patel
Department of Electrical Engineering
Concordia University
Montreal, Quebec, Canada

Robust Stabilization Against Transfer Function Coefficient Perturbations
L. H. Keel and S. P. Bhattacharyya
Department of Electrical Engineering
Texas A&M University
College Station, TX

Tuesday, August 12/*10:30 AM*
Minisymposium 2/Convention Hall C

MATRIX EQUATIONS: STABILITY AND INERTIA

Lyapunov and Ricatti matrix equations, stability (i.e. location of all eigenvalues in the open left-plane), and inertia have long played important roles in differential equations, control theory, and their applications. The location of all eigenvalues in the open unit circle about the origin is of importance in the convergence of matrix algorithms. More recently, eigenvalue location criteria have been found relative to a variety of classes of complex regions. Strengthened forms of stability such as D-stability and Volterra-Lyapunov diagonal stability have been developed, which play a role in equilibrium results in economics and ecology. Special information has been obtained about the eigenvalues of tridiagonal matrices with special combinatorial structures. The speakers will review these and other developments.

CO-CHAIRS AND CO-ORGANIZERS
David Carlson
Department of Mathematical Sciences
San Diego State University
San Diego, CA

Hans Schneider
Department of Mathematics
University of Wisconsin
Madison, WI

General Root-Clustering Theorems
David Carlson
Department of Mathematical Sciences
San Diego State University
San Diego, CA

(title to be announced)
Danny Hershkowitz
Department of Mathematics
Technion-Israel Institute of Technology
Haifa, Israel

Inertia Results for Periodic Riccati Equations
Harald K. Wimmer
Department of Mathematics
University of Wurzburg
Wurzburg, Federal Republic of Germany

Tuesday, August 12/*3:15 PM*
Minisymposium 3/Convention Hall B

NUMERICAL LINEAR ALGEBRA IN SIGNALS, SYSTEMS AND CONTROL

A major objective of the conference is to help bridge the gap of communications between mathematicians and engineers. The minisymposium "Numerical Linear Algebra in Signals, Systems and Control" is a major step forward towards achieving this objective. The use of recently developed sophisticated numerical linear algebraic techniques in solutions of linear control and systems problems will be stressed by all the speakers in the session.

CHAIR AND ORGANIZER
Biswa Nath Datta
Department of Mathematical Sciences
Northern Illinois University
DeKalb, IL

Analysis of A Recursive Least Squares Hyperbolic Rotation Algorithm for Signal Processing
S. T. Alexander, C.-T. Pan and R. J. Plemmons
Center for Communications and Signal Processing and Departments of Computer Science and Mathematics
North Carolina State University
Raleigh, NC

Solution of Some Large-Scale Linear Algebra Problems in Control Theory
Biswa Nath Datta
Department of Mathematical Sciences
Northern Illinois University
DeKalb, IL
and
Youcef Saad
Research Center for Scientific Computation
Yale University
New Haven, CT

Partial Pole Assignment and Robustness
Nancy Nichols
Department of Mathematics
University of Reading
Reading, UK
and Youcef Saad

Restricted Condition Problem in Control or Circuitous Routes to Singularity
Ralph Byers
Department of Mathematics
North Carolina State University
Raleigh, NC

Accurate Solutions of Ill-Posed Problems in Control Theory
James Demmel
Department of Computer Science
Courant Institute of Mathematical Sciences
New York University
New York, NY
and
Bo Kagstrom
Institute of Information Processing
University of Umea
Umea, Sweden

Tuesday, August 12/*3:15 PM*
Minisymposium 4/Convention Hall C

GEOMETRIC METHODS IN MULTIVARIABLE CONTROL

The use of geometric methods has greatly influenced the directions of control theory over the past decade. A major reason for this influence is that geometric techniques provide powerful tools for the analysis of both the local and global behavior of control systems. In this session, current research will be presented that reflects the increasingly important role of geometry in the study of multivariable control problems.

CO-CHAIRS AND CO-ORGANIZERS
Gregory S. Ammar
Department of Mathematical Sciences
Northern Illinois University
DeKalb, IL

Clyde F. Martin
Department of Mathematics
Texas Tech University
Lubbock, TX

Geometric Techniques for the Control of Mechanisms
John Baillieul
College of Engineering
Boston University
Boston, MA

On Constant-Ratio Proportional and Derivative Feedback for Generalized Linear Systems
Mark A. Shayman
Department of Systems Science and Mathematics
Washington University
St. Louis, MO

Qualitative Behavior of Flexible Space Structures
Mark Levi
Department of Mathematics
Boston University
Boston, MA

Systems Theory for Two-Point Boundary-Value Descriptor Systems
Ramine Nikoukhah, Alan S. Willsky and Bernard C. Levy
Department of Electrical Engineering and Computer Science
Massachusetts Institute of Technology
Cambridge, MA

Directions of Geometry in Numerical Linear Algebra
Gregory S. Ammar
Department of Mathematical Sciences
Northern Illinois University
DeKalb, IL

Wednesday, August 13/*10:30 AM*
Minisymposium 5/Convention Hall A

LINEAR ALGEBRA IN SIGNAL PROCESSING

Linear algebra is playing a fundamental role in modern signal processing applications. While structured linear systems and least squares problems, such as Toeplitz and circulant forms, are fundamental and familiar, many other linear algebraic problems are integral to the field. This minisymposium consists of four talks dealing with novel algebraic problems arising naturally in signal processing.

CHAIR AND ORGANIZER
George Cybenko
Department of Computer Science
Tufts University
Medford, MA

Linear Algebra and the Discrete Fourier Transform
Bradley Dickinson
Department of Electrical Engineering
Princeton University
Princeton, NJ

A Better Way to Compute Partial Correlations
Ilse Ipsen
Department of Computer Science
and
Jean-Marc Delosme
Department of Electrical Engineering
Yale University
New Haven, CT

A New Recursive Method for Solving the Nevanlinna-Pick Problem
Yves Genin
Philips Research Laboratory
Brussels, Belgium

Applications of the Generalized Singular Value Decomposition
Charles Van Loan
Department of Computer Science
Cornell University
Ithaca, NY

Wednesday, August 13/*10:30 AM*
Minisymposium 6/Convention Hall C

THE ROLE OF LINEAR ALGEBRA IN LARGE-SCALE SYSTEMS

In analysis and design of control systems in as diverse fields as large space structures and electrical power systems, communication networks and manufacturing, the traditional "one shot" methods are often impossible to use (too much computer memory needed), uneconomical to carry out (too much computer time required), and impractical (too slow or unreliable to implement). For these reasons, new "piece-by-piece" decentralized approaches have been developed, which can take advantage of the special structural features of relevant mathematical models and bring about substantial, conceptual and numerical simplifications. In the spirit of this development, the minisymposium is devoted to the new trends in the decentralized control theory, which are based upon the matrix algebra as well as the abstract geometric concepts.

CHAIR AND ORGANIZER
Dragoslav D. Siljak
School of Engineering
Santa Clara University
Santa Clara, CA

Decomposition and Decentralized Control of Weakly Coupled Systems: The Role of Spectral Estimation
William H. Bennett
Systems Engineering, Inc.
Greenbelt, MD

On Almost Invariant Subspaces of Structured Systems
Yoshikazu Hayakawa
Department of Information Engineering
Nagoya University
Nagoya, Japan
and
Dragoslav D. Siljak
(chair and organizer)

Control Design Under Stratonovich Models: Robust Stability Guarantees Via Lyapunov Matrix-Function Theory
David C. Hyland
Government Aerospace Systems Division
Harris Corporation
Melbourne, FL

The Decentralized Servo Compensator and Closed-Loop Balancing
Ümit Özgüner and Altug Iftar
Department of Electrical Engineering
The Ohio State University
Columbus, OH

Interconnection Rejection and Nulling Concepts for Decentralized Control
K. David Young
Lawrence Livermore National Laboratory
Livermore, CA

Wednesday, August 13/*10:30 AM*
Minisymposium 7/Carver 1

GEOMETRIC AND GRASSMANNIAN TECHNIQUES IN CONTROL THEORY

The theme of the minisymposium is the interaction between geometric and Grassmannian techniques and linear control theory and related problems. Techniques from differential geometry, algebraic geometric and topology will be discussed. Among the topics to be covered are the geometry of curves in Grassmannians, Riccati equations and controllability, the structure of the space of matrix rational functions, maximum likelihood estimates for linear models with errors in the variables, and the structure of the variety (in the Grassmannian) of invariant subspaces of a nilpotent transformation. Relationships with other problems, open questions and directions for future research will be discussed.

CO-CHAIRS AND CO-ORGANIZERS
Lance D. Drager and Robert L. Foote
Department of Mathematics
Texas Tech University
Lubbock, TX

Some Remarks on the Topology of rat(n)
Bijoy Gosh and W. P. Dayawansa
Department of Systems Science and Mathematics
Washington University
St. Louis, MO

Differential Geometry of Riccati Flows and Controllability of Linear Systems
Lance D. Drager, Robert L. Foote and Clyde F. Martin
Department of Mathematics
Texas Tech University
Lubbock, TX

Maximum Likelihood Estimation for Errors-in-the-Variable Models
Anthony Michael Bloch
Department of Mathematics
The University of Michigan
Ann Arbor, MI

On Varieties of Invariant Subspaces II
William H. Gustafson
Department of Mathematics
Texas Tech University
Lubbock, TX

Wednesday, August 13/*4:00 PM*
Minisymposium 8/Convention Hall A

LINEAR ALGEBRA ON ADVANCED COMPUTER ARCHITECTURES

Advanced computer architectures offer new opportunities to solve large scale linear algebra problems. However, new algorithms and new software techniques are required to exploit the capabilities of this new technology. This minisymposium will focus upon ideas for new algorithms and software methodology that is appropriate for a variety of leading edge computer technologies. Architectures that will be represented include tightly coupled parallel-vector machines, hypercubes and systolic arrays of processors.

CHAIR AND ORGANIZER
Danny C. Sorensen
Mathematics and Computer Science Division
Argonne National Laboratory
Argonne, IL
and
Center for Supercomputing Research and Development
University of Illinois at Urbana-Champaign
Urbana, IL

Fast-Fourier Transform Algorithms for Parallel Vector Processors
Dennis Gannon
Department of Computer Science
Indiana University
Bloomington, IN
and
Center for Supercomputing Research and Development
University of Illinois at Urbana-Champaign
Urbana, IL

Systolic Algorithms for Linear Algebra Problems Arising in Control Theory
Sven Hammarling
NAG
Oxford, England

Architectural and Software Issues for Large-Scale Multiprocessors
Oliver McBryan
Courant Institute of Mathematical Sciences
New York University
New York, NY

A Parallel Algorithm for the Symmetric Eigenvalue Problem
Jack J. Dongarra
Mathematics and Computer Science Division
Argonne National Laboratory
Argonne, IL
and
Danny C. Sorensen
(chair and organizer)

Wednesday, August 13/*4:00 PM*
Minisymposium 9/Convention Hall C

USING MACSYMA IN CONTROL PROBLEMS

Computer algebra systems offer several advantages in engineering design, including assistance in construction and reduction of models for complex systems and capabilities for programming design algorithms in symbolic form. Systems developed in MACSYMA which illustrate both aspects will be described in this minisymposium. An expert system for control system design built around various MACSYMA programs will be presented together with systems for the automatic construction of models for robot dynamics. Representative work at General Electric, which has made a substantial commitment to this area, will also be discussed.

CHAIR AND ORGANIZER
Gilmer L. Blankenship
Department of Electrical Engineering
University of Maryland
College Park, MD

Expert System for Control System Design
(to be presented by the chair and organizer)

Symbolic Algebra for Robotic Modeling
P. S. Krishnaprasad
Department of Electrical Engineering
University of Maryland
College Park, MD

Use of Computer Algebra for Mechanical Systems and Related Problems
M. A. Hussain
Corporate Research and Development
General Electric Co.
Schenectady, NY

Symbolic Computation in Control
Eduardo Sontag
Department of Mathematics
Rutgers University
New Brunswick, NJ

Thursday, August 14/*10:30 AM*
Minisymposium 10/Convention Hall A

LEAST SQUARES COMPUTATIONS IN SIGNAL PROCESSING

As least squares estimation methods find increasing applicability in signal processing it becomes more important to analyze the accuracy of the new fast algorithms. In this minisymposium each presentation will address some aspect of this problem. S. T. Alexander investigates how some elegant and intuitive geometric concepts aid in the derivation and understanding of fast adaptive least squares filters. J. J. Cioffi presents a mathematical interpretation of the highly undesirable numerically induced divergence effects that manifests themselves in many of the fast algorithms. F. T. Luk provides an analysis of a recently suggested recursive least squares filter in the presence of rounding errors. Finally, A. O. Steinhardt discusses recent work in which a novel approach is suggested to fast least squares updating methods, which is based upon the use of hyperbolic Householder transformations.

CO-CHAIRS AND CO-ORGANIZERS
S. T. Alexander and R. J. Plemmons
Center for Communications and Signal Processing and Departments of Computer Science and Mathematics
North Carolina State University
Raleigh, NC

Geometric Properties of Recursive Least Squares Filters
S. T. Alexander
(Co-organizer)

A Mathematical Interpretation of Limited-Precision Divergence Effects in Fast RLS Adaptive Algorithms
J. M. Cioffi
Information Systems Laboratory
Stanford University
Stanford, CA

Analysis of a Recursive Least Squares Signal Processing Algorithm
Franklin T. Luk
School of Electrical Engineering
and
Sanzheng Qiao
Center for Applied Mathematics
Cornell University
Ithaca, NY

Hyperbolic Householder Transformations and Least Squares Updating
Allan O. Steinhardt and Charles M. Rader
Lincoln Laboratory
Massachusetts Institute of Technology
Lexington, MA

Thursday, August 14/*10:30 AM*
Minisymposium 11/Convention Hall C

POSITIVE SYSTEMS

A positive system is a dynamic system in which the state is constrained to lie in the positive orthant. Interest in positive systems is motivated by examples from electrical engineering, economics, chemical processing, and biology, where physical considerations impose the positivity constraint. In this minisymposium we will examine system theoretic properties of positive systems, with a focus on qualitative differences between positive and unconstrained systems. Individual presentations will consider controllability, reachability, observability, realizability, and feedback control of positive linear systems, and positive orthant controllability of bilinear systems. In addition to outlining progress in these areas, there will be discussion of unresolved issues and limitations of the current theories.

CHAIR AND ORGANIZER
Pamela G. Coxson
Department of Mathematics
The Ohio State University
Columbus, OH

Controllability of Positive Bilinear Systems
William M. Boothby
Department of Mathematics
Washington University
St. Louis, MO

Reachability, Observability and Realizability of Continuous-time Positive Systems
Yoshito Ohta, Hajime Maeda and Shinzo Kodama
Department of Electronic Engineering
Osaka University
Osaka, Japan

Positive Input Reachability and Controllability of Positive Systems
Pamela G. Coxson
Department of Mathematics
The Ohio State University
Columbus, OH
and
Helene Shapiro
Department of Mathematics
Swarthmore College
Swarthmore, PA

Some Linear Feedback Problems Involving M-Matrices and Irreducibility
Abraham Berman
Department of Mathematics
Technion, Israel Institute of Technology
Haifa, Israel
and
Ronald J. Stern
Department of Mathematics
Concordia University
Montreal, Quebec, Canada

Thursday, August 14/*10:30 AM*
Minisymposium 12/Carver 1

ITERATIVE SOLUTIONS FOR LARGE SPARSE LINEAR SYSTEMS OF EQUATIONS

In this minisymposium, there will be three lecturers: W. Niethammer (Karlsruhe), R. S. Varga (Kent), and D. M. Young (Austin). Topics to be included in the associated lectures will be conjugate gradient methods for nonsymmetric linear systems of equations, exact convergence domains for the SOR iterative methods for p-cyclic matrices, new identities for the SSOR and USSOR iterative methods for p-cyclic matrices, and an overview of k-step iterative methods derived from function theory and summability methods.

CHAIR AND ORGANIZER
Richard S. Varga
Department of Mathematical Sciences
Kent State University
Kent, OH

Conjugate Gradient Methods
David M. Young, Jr.
Numerical Analysis Center
University of Texas at Austin
Austin, TX

A Survey of Recent Results on SOR and SSOR Iterative Methods
(to be presented by the chair and organizer)

Iterative Solutions of Non-Symmetric Problems
A. W. Niethammer
University of Karlsruhe
Institut fur Practische Mathematik
Karlsruhe, Federal Republic of Germany

Thursday, August 14/*3:15 PM*
Minisymposium 13/Convention Hall A

TOEPLITZ MATRICES

Algorithms for solving linear systems and eigenproblems when the matrix is Toeplitz will be considered in this minisymposium. These problems arise in many areas, e.g., signal processing and time series analysis.

CHAIR AND ORGANIZER
James R. Bunch
Department of Mathematics
University of California, San Diego
La Jolla, CA

The Stability, Strong Stability, and Weak Stability of Algorithms for Solving Toeplitz Systems
(to be presented by the chair and organizer)

Asymptotically Superfast Solution of Positive Definite Toeplitz Systems
Greg Ammar
Department of Mathematical Sciences
Northern Illinois University
DeKalb, IL
and
William Gragg
Department of Mathematics
University of Kentucky
Lexington, KY

On Fast Toeplitz Orthogonalization Algorithms
Franklin T. Luk
School of Electrical Engineering
and
Sanzheng Qiao
Center for Applied Mathematics
Cornell University
Ithaca, NY

Numerical Solution of the Eigenvalue Problem for Symmetric Rationally Generated Toeplitz Matrices
William F. Trench
Department of Mathematics and Computer Science
Drexel University
Philadelphia, PA
and
Department of Mathematics
Trinity University
San Antonio, TX

Computational Considerations for Toeplitz Matrices
Lokesh Datta
Department of Electrical Systems Engineering
Wright State University
Dayton, OH
and
Salvatorre D. Morgera
Department of Electrical Engineering
McGill University
Montreal, Quebec, Canada

Thursday, August 14/*3:15 PM*
Minisymposium 14/Convention Hall C

NUMERICAL LINEAR ALGEBRA IN SYSTEMS THEORY

Various numerical difficulties arise in the realization of linear systems, and in particular, in polynomial representation of multivariable systems. Numerically robust methods depend on stable factorizations of matrices and on orthogonal basis formulations. In this session reliable numerical techniques for constructing system representations are discussed. The problems investigated concern factorizations of rational matrices, construction of polynomial system representations for multivariable system reduction by AKK, minimal system realization by polynomial matrix fractions, and stable numerical techniques for implementing the structure theorem and for balanced realization of linear systems.

CHAIR AND ORGANIZER
Nancy K. Nichols
Department of Mathematics
The University of Reading
Reading, Great Britain

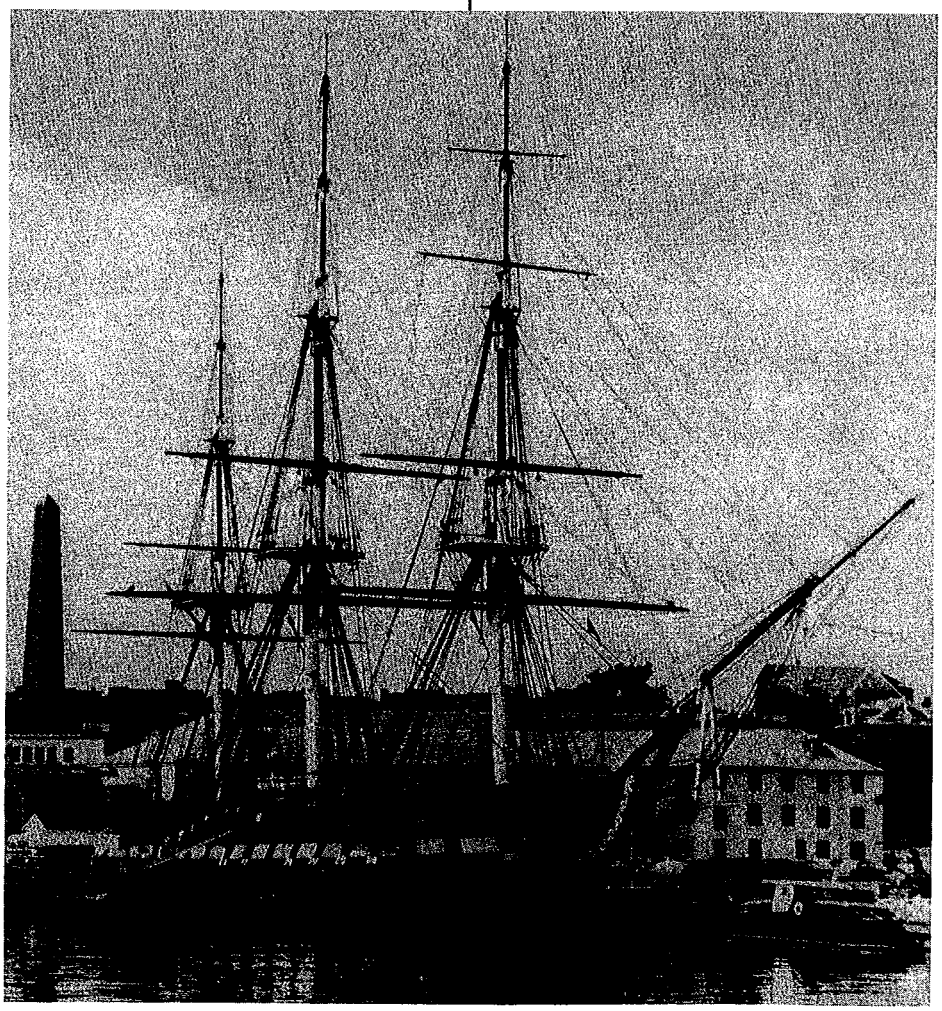
A State-Space Approach for a Class of Factorizations of a General Rational Matrix
P. Van Dooren
Philips Research Laboratory
Brussels, Belgium

Numerical Experiments for Approximation of Linear Systems Using the Method of AAK
J. Decorte, A. Bultheel and M. Van Barel
Department of Computer Science
Katholieke Universiteit Leuven
Leuven (Heverlee), Belgium

Some Comments on the Inexact Minimal Partial Realization Problem
M. Van Barel and A. Bultheel
Department of Computer Science
Katholieke Universiteit Leuven
Leuven (Heverlee), Belgium

A Generalized Singular Value Decomposition for Product of Two Matrices and Balanced Realisation
K. Vince Fernando and Sven J. Hammarling
Numerical Algorithms Group Ltd.
Oxford, Great Britain

Computing Rank-Deficiency of Rectangular Matrix Pencils
Daniel Boley
Department of Computer Science
University of Minnesota
Minneapolis, MN



Tuesday, August 12/*10:30 AM*
Contributed Papers 1/Carver 1
ADAPTIVE AND ROBUST CONTROL

Augmented Diophantine Equations and their Impact on Robust Control
Theodore E. Djaferis, Electrical and Computer Engineering, University of Massachusetts, Amherst, MA

Robotics: Optimum Trajectory Planning for Obstacle Avoidance
Chen-Han Sung and William J. Hoskins, Department of Mathematics, San Diego State University, San Diego, CA

Designing a Linear Reduced-Order Robust Regulator
Thomas G. Marinko and Ken Tomiyama, Electrical Engineering Department, The Pennsylvania State University, University Park, PA

Dynamic High-Gain Stabilization of Multivariable Linear Systems, With Application to Adaptive Control
Bengt Mårtensson, Department of Automatic Control, Lund Institute of Technology, Lund, Sweden

Optimal Projection/Guaranteed Cost Control Design Synthesis: Robust Performance Via Fixed-Order Dynamic Compensation
Dennis S. Bernstein, Harris Corporation, Melbourne, FL

The Randomized Linear Control Policy Method and Some Bounds for the Multiple Model Adaptive Control Problem
Kailash Birmiwal, Department of Electrical Engineering and Computer Science, The University of Connecticut, Storrs, CT

Supermartingales of Adaptive Control
Rolf Johansson, Department of Automatic Control, Lund Institute of Technology, Lund, Sweden

Robustness for Descriptor Variable Systems: A Quantitative Analysis Method
Dai Liyi, Institute of Systems Science, Academia Sinica, Beijing, China

To the Robust Stabilization Problem of Linear Periodic Systems
Günter Kern, Technische Universität Graz, Institüt für Mathematik, Graz, Austria

Tuesday, August 12/*10:30 AM*
Contributed Papers 2/Carver 2
NUMERICAL METHODS FOR SIGNAL PROCESSING I

Toeplitz Systems and Conjugate Gradients
Gilbert Strang, Department of Mathematics, Massachusetts Institute of Technology, Cambridge, MA

A Fast Algorithm for Toeplitz System of Linear Equations
Hari Krishna, Electrical and Computer Engineering Department, Syracuse University, Syracuse, NY; and Salvatore D. Morgera, Department of Electrical and Computer Engineering, McGill University, Montreal, Quebec, Canada

A Highly Concurrent Algorithm for Minimum Eigenvalue and Corresponding Eigenvector
Seth Kalson, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA; and Kung Yao, University of California-Los Angeles, School of Engineering and Applied Science, Electrical Engineering Department, Los Angeles, CA

Parallel Algorithms for Linear Algebra Problems With 2D Shuffle-Exchange Network
Wentai Liu, G. Mei, and T. Hildebrandt, Department of Electrical and Computer Engineering, North Carolina State University, Raleigh, NC; and R. Calvin III, Semiconductor Research Corporation, Research Triangle Park, NC

A Simple Nonclassical Weighted Recursive Least Squares Algorithm and its Use in Linear Predictive Coding of Speech
John R. Deller, Jr., Digital Signal Processing Lab: Speech Processing Sector, Department of Electrical and Computer Engineering, Northeastern University, Boston, MA; Tat Chiu Luk, Baldwin Technology Corporation, Countryside, IL; and Dong Hsu, Digital Signal Processing Lab: Speech Processing Sector, Department of Electrical and Computer Engineering, Northeastern University, Boston, MA

Covariance Difference Eigenstructure Method for Source Bearing Estimation for a Class of Noise Fields
S. Prasad, Department of Electrical Engineering, Pennsylvania State University, University Park, PA, and Indian Institute of Technology-Delhi, New Delhi, India; and R. Williams, A. K. Mahalanabis, and L. Sibul, Department of Electrical Engineering, Pennsylvania State University, University Park, PA

Parallel Methods for Toeplitz Systems
Dante Briones and Karabi Datta, Department of Mathematical Sciences, Northern Illinois University, DeKalb, IL

Tuesday, August 12/*10:30 AM*
Contributed Papers 3/Carver 3
MATRIX FRACTIONS AND REALIZATION THEORY

On the Direct Relationship Between the Maximal [A,B]-Invariant Subspace in KerC and Matrix Continued Fractions
T. Shamir, Department of Applied Mathematics, Weizmann Institute of Science, Rehovot, Israel

Matrix Fraction Description Approach in Modal Control of Singular Systems
Manolis Christodoulou, School of Engineering, Department of Computer Engineering and (CTI) Computer Technology Institute, University of Patras, Patras, Greece

Stable Realizations of 2D Matrix Fraction Descriptions and State Feedback Stabilizability
M. Bisiacco, E. Fornasini, and G. Marchesini, Department of Electrical Engineering, University of Padova, Padova, Italy

Stabilization of Polynomial Matrices Under Parametrical and Degree Changes
M. De la Sen, Departamento de Fisica, Universidad del Pais Vasco, Bilbao, Spain

Balanced Realization Via Permutation Symmetric Jordan Realizations
J. A. De Abreu and F. W. Fairman, Department of Electrical Engineering, Imperial College of Science and Technology, London, England

Stability Properties of Minimal Factorizations
Harm Bart, Econometric Institute, Erasmus University Rotterdam, Rotterdam, The Netherlands

Tuesday, August 12/*3:15 PM*
Contributed Papers 4/Carver 1
MATRIX THEORY AND APPLICATIONS

Singular Value Inequalities for Hadamard Products
Roger A. Horn, Department of Mathematical Sciences, The Johns Hopkins University, Baltimore, MD

An Analog of the Schur Triangular Factorization for Orthogonal Similarity and Consimilarity
Dipa Choudhury, Mathematics Department, Loyola College, Baltimore, MD; and Roger A. Horn, Department of Mathematical Sciences, The Johns Hopkins University, Baltimore, MD

Eigenvalues of Centrosymmetric Matrices
James R. Weaver, Department of Mathematics and Statistics, The University of West Florida, Pensacola, FL

Block Irreducible Matrices Under Unitary Similarities
Yoopyo Hong, Department of Mathematical Sciences, Northern Illinois University, DeKalb, IL

On the Solution of the Equation TA − FT = LC and Its Applications
Chia-Chi Tsui, Department of Electrical and Computer Engineering, Northeastern University, Boston, MA

An Algorithm for Computing all the Vertices of a Certain Convex Polyhedron
Enzio Marchi, Department of Mathematical Sciences, Northern Illinois University, DeKalb, IL, and Instituto de Matematica Aplicada, San Luis, Argentina; and Luis G. Quintas, Instituto de Matematica Aplicada, San Luis, Argentina

Mixed-Multiplicativity for L_p Norms of Matrices
M. Goldberg, Department of Mathematics, University of California-Los Angeles, Los Angeles, CA and Israel Institute of Technology, Technion, Haifa, Israel

A Mixed Integer Programming Model for Planning an Integrated Services Network
Marcia P. Helme, GTE Laboratories Inc., Network Architecture Department, Waltham, MA

In Search of New Generalized Inverses
Jovan D. Kečkic, Institute of Mathematics, Belgrade, Yugoslavia

The Geometric Mean of Vectors, Complex Numbers and Quaternions
W. N. Anderson Jr., Department of Mathematics and Computer Science, Fairleigh Dickinson University, Teaneck, NJ; and G. Trapp, Department of Statistics and Computer science, West Virginia University, Morgantown, WV

Tuesday, August 12/*3:15 PM*
Contributed Papers 5/Carver 2
STOCHASTIC PROCESSES AND CONTROL

Rational Spectral Modeling in the Presence of Unit Circle Zeros
C. V. K. Prabhakara Rao, Department of Electrical and Computer Engineering, College of Engineering, Drexel University, Philadelphia, PA

A Comparative Study of Two Minimum Variance Regulators for Linear Stochastic Systems
A. K. Mahalanabis and Premal P. Desai, Department of Electrical Engineering, Pennsylvania State University, University Park, PA

A Comparison of Stein's Estimator With a Wiener Filter Approach
Peter Sherman, School of Mechanical Engineering, Purdue University, West Lafayette, IN

Fault Detection in Multiply Redundant Measurement Systems
Asok Ray, Department of Mechanical Engineering, The Pennsylvania State University, University Park, PA; and Mukund Desai, The Charles Stark Draper Laboratory, Cambridge, MA

Stochastic Control for Singular Systems
Masoud Shafiee, Department of Electrical and Computer Engineering, Louisiana State University, Baton Rouge, LA

On a Novel Predictor Space Representation of ARMA Processes
S. Prasad, Department of Electrical Engineering, Pennsylvania State University, University Park, PA, and Indian Institute of Technology-Delhi, New Delhi, India; and S. D. Joshi, Department of Electrical Engineering, Indian Institute of Technology-Delhi, New Delhi, India

Adaptive Stochastic Algorithms and Their Applications
Mohamed El-Sharkawy, Electrical Engineering Department, Bucknell University, Lewisburg, PA

Caractérisation de la Solution de l'Equation Différentielle Stochastique Matricielle
Ching-Sung Chou, Institute of Mathematics, National Central University, Chung-Li, Taiwan

On the Static Optimization of a Linear Nonstationary Process
Victor A. Skormin, Milton Roy Company, Analytical Products Division, Research and Development, Rochester, NY

Application of Positive Matrices to Stochastic Game Theory
Stavros A. Belbas, Department of Mathematics, University of Alabama, University, AL

Wednesday, August 13/*10:30 AM*
Contributed Papers 6/Carver 2
NUMERICAL LINEAR ALGEBRA

Error Analysis of the Bjorck-Pereyra Algorithms for Solving Vandermonde Systems
Nicholas J. Higham, Department of Mathematics, University of Manchester, Manchester, England

Tree-Splitting Iterative Methods for Reparable Systems
Jon Arne Sjogren, Department of Computer Science, Duke University, Durham, NC

Convergence of Parallel Multisplitting Iterative Methods for M-matrices
Michael Neumann, Department of Mathematics, University of Connecticut, Storrs, CT; and Robert J. Plemmons, Departments of Computer Science and Mathematics, North Carolina State University, Raleigh, NC

An Out-of-Core Scheme for Cholesky Factorization
Joseph W. H. Liu, Department of Computer Science, York University, North York, Ontario, Canada

The Relation of the Gram-Schmidt Process to Givens Rotations in a Coherent Side-Lobe Cancellation System
John J. Santapietro, Lockheed Electronics Company Inc., Systems Division, Plainfield, NJ

Structure of a Weighted Graph According to its Eigenvalue
David Powers, Department of Mathematics and Computer Science, Clarkson University, Potsdam, NY

Nonlinear Eigenvalue Approximation
William F. Moss, Department of Mathematical Sciences, Clemson University, Clemson, SC; Philip W. Smith, IMSL, Houston, TX; and Joseph D. Ward, Department of Mathematics, Texas A&M University, College Station, TX

Wednesday, August 13/*10:30 AM*
Contributed Papers 7/Carver 3
SYSTEMS AND CONTROL I

Rational Interpolation Problem
A. C. Antoulas, Department of Electrical Engineering, Rice University, Houston, TX

Geometric and Computational Aspects of the Gap Metric for Multivariable Control Systems
Ahmed K. El-Sakkary, University of Petroleum and Minerals, Department of Systems Engineering, Dhahran, Saudi Arabia

Noninteracting Decomposition of Linear Systems
Daizhan Cheng, Institute of Systems Science, Academia Sinica, Beijing, People's Republic of China

On Limit Sets of Linear Control Systems
Emilio O. Roxin, Department of Mathematics, University of Rhode Island, Kingston, RI; and Vera W. de Spinadel, University of Buenos Aires, Buenos Aires, Argentina

Reachability of Linear Systems With Subspace Open Constraints
Jia-Yuan Han, Department of Electrical Engineering, Southern Illinois University, Carbondale, IL; and Bostwick F. Wyman, Department of Mathematics, Ohio State University, Columbus, OH

Digital Picture Processing
Efim Khalimsky, Department of Computer Science, College of Staten Island, Staten Island, NY

Motion Simulation Scheme for Robot Manipulators
S. F. Ganesan, A. Gupta and M. G. Kim, Department of Electrical Engineering, Northern Illinois University, DeKalb, IL

Wednesday, August 13/*4:00 PM*
Contributed Papers 8/Carver 1
NUMERICAL METHODS FOR SYSTEMS AND CONTROL

The Numerical Solution of Linear Time Varying Singular Systems of ODE's
Stephen L. Campbell, Department of Mathematics, North Carolina State University, Raleigh, NC

A Block Decomposition Approach to the Design of State Feedback for Large Scale Systems
B. Shafai, Department of Electrical and Computer Engineering, Northeastern University, Boston, MA

Integrating Different Symbolic and Numeric Tools for Linear Algebra and Linear System Analysis
Ulf Holmberg, Mats Lilja, and Bengt Mårtensson, Department of Automatic Control, Lund Institute of Technology, Lund, Sweden

An Algorithm to Assign Eigenvalues in a Hessenberg Matrix
Mark Arnold and Biswa N. Datta, Department of Mathematical Sciences, Northern Illinois University, DeKalb, IL

Two Techniques for the Solution of the Discrete-Time Periodic Riccati Equation
Sergio Bittanti, Dipartimento di Elettronica, Patrizio Colaneri, Centro di Teoria dei Sistemi del CNR, c/o Dipartimento di Elettronica, and Guiseppe De Nicolao, Dipartimento di Elettronica, Politecnico di Milano, Milano, Italy

A State Space Approach to the Design of Orthogonal Models
Srbijanka R. Turajlic and Sydney R. Parker, Department of Electrical and Computer Engineering, Naval Postgraduate School, Monterey, CA

An Efficient Algorithm for Solving a Class of Algebraic Riccati Equations
Cheng-Chih Chu, Scientific Systems Inc., Cambridge, MA

Numerical Solution of the Discrete-Time Optimal Regulator Problem
Volker Mehrmann, Fakultät für Mathematik, Universität Bielefeld, Bielefeld, West Germany

Algorithms for Interpolation With Outer Functions
Chidambar Ganesh, Department of Electrical and Computer Engineering, Rice University, Houston, TX

Coupling of a Model from Physically Equivalent Material and Numerical Analysis
Petr Procházka, Design Institute of Capital Prague, Comp. Center-CAD Development, Prague, Czechoslovakia

Special Notice To Contributed Paper Authors and Chairmen of Contributed Paper Sessions:
Fifteen minutes are allowed for each contributed paper. Presenters are requested to spend a maximum of twelve (12) minutes for presentation of their paper, and three (3) minutes for questions and answers.

Please note:
For papers with more than one author, an underlineation is used to denote the author who will present the paper.

Wednesday, August 13/*4:00 PM*
Contributed Papers 9/Carver 2
FILTERING, ESTIMATION, AND PREDICTION

State Space Approach to Covariance Extension
Hidenori Kimura, Department of Control Engineering, Osaka University, Osaka, Japan

Adamjan-Arov Scattering Matrix Associated With a Stationary Sequence: System Theoretic Properties, Network Interpretation, and Role in Covariance Extensions
Yehuda Avniel, Washington, DC

Maximum Entropy Polyspectral Estimation
Georgios B. Giannakis and Jerry M. Mendel, University of Southern California, Department of Electrical Engineering-Systems, Los Angeles, CA

Applications of the Quotient-Difference Algorithm to Modern Spectral Estimation
J. R. Cruz, School of Electrical Engineering and Computer Science, The University of Oklahoma, Norman, OK

Passive Position Location Estimation Using the Extended Kalman Filter
Karl Springarn, Hughes Aircraft Company, Electro-Optical and Data Systems Group, El Segundo, CA

A Matrix Factorization Approach to the Identification of Large Space Structures
Trevor Williams, School of Computing, Kingston Polytechnic, Kingston upon Thames, England

Approximation With Randomly Spaced Grid Points
C. N. Shen and Y. B. Chen, Electrical, Computer and Systems Engineering Department, Rensselaer Polytechnic Institute, Troy, NY

Digital Filter Design Applied to Electrohydraulic Servos
Laurentino Miguel Arroyo, Rafael Grossi Calleja, and Juan C. Fraile Marinero, Catedra de Automatica e Informatica, Escuela Tecnica Superior de Ingenieros Industriales, Universidad de Valladolid, Valladolid, Spain

Sequential Algorithms for Set-Theoretic Estimation
Ronald K. Pearson, Engineering Research & Development Division, Engineering Physics Laboratory, E. I. du Pont de Nemours & Company (Inc.), Wilmington, DE

Square Root V-Λ Filtering Using Normalized State Estimate
Y. Oshman and I. Y. Bar-Itzhack, Department of Aeronautical Engineering, Israel Institute of Technology, Technion, Haifa, Israel

Wednesday, August 13/*4:00 PM*
Contributed Papers 10/Carver 3
NUMERICAL METHODS FOR SIGNAL PROCESSING II

Performance of Digital Communication Receivers in Additive Noise and Intentional Interference
Daniel Bukofzer, Department of Electrical and Computer Engineering, Naval Postgraduate School, Monterey, CA

Step Response Bounds for Large-Scale Linear Systems Described by M-Matrices, With VLSI Application
John L. Wyatt, Jr., Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, MA; Charles A. Zukowski, Department of Electrical Engineering, Columbia University, New York, NY; and Paul Penfield, Jr., Department of Electrical Engineering and Computer Science, Massachusetts Institute of Technology, Cambridge, MA

Multiple Input Restoration Algorithms
Aggelos K. Katsaggelos, Department of Electrical Engineering and Computer Science, The Technological Institute, Department of Electrical Engineering and Computer Science, Northwestern University, Evanston, IL

Matrix Generation of Multiple Access Codes for Optical Fiber Systems
Martin Kerner, Mary G. O'Connor, and Jawad A. Salehi, Exchange Network Research Division, Bell Communications Research, Morristown, NJ

An Algorithm for Subspace Computation, With Applications in Signal Processing
Daniel R. Fuhrmann, Department of Electrical Engineering, Washington University, St. Louis, MO

Sensitivity Analysis of Digital Filter Structures
V. E. DeBrunner and A. A. (Louis) Beex, Department of Electrical Engineering, Virginia Polytechnic Institute and State University, Blacksburg, VA

Thursday, August 14/*10:30 AM*
Contributed Papers 11/Carver 2
SYSTEMS AND CONTROL II

A Unifying Framework for Robot Controller Design
Vassilios D. Tourassis, Electrical Engineering Department, Production Automation Project, University of Rochester, Rochester, NY

On Relation Norms Compatible With the H∞ Norm
David Bensoussan, Departement d'Électricité, Ecole de Technologie Supérieure, Université du Québec, Montréal, Québec, Canada

Time-Domain Analysis of Multivariable Control Systems Using Convolution Algebra
Muhamad J. Mirza, University of Petroleum and Minerals, Dhahran, Saudi Arabia

Algebraic Conditions for Absolute Tracking Control of Lurie Systems
Ljobomir T. Grujić, Faculty of Mechanical Engineering, University of Belgrade, Belgrade, Yugoslavia

Necessary and Sufficient Conditions for Subspace-Reachability and Controllability of Discrete-Time Linear Time-Invariant Systems
Fumio Hamano, Department of Electrical and Computer Engineering, Florida Atlantic University, Boca Raton, FL

Time-Optimal Control in a Manufacturing System
M. Kudret Yurtseven, School of Engineering and Technology, Purdue University at Indianapolis, Indianapolis, IN; and T. Bak, Department of Industrial Engineering, Middle East Technical University, Ankara, Turkey

A Reading Machine for the Blind People
Victor M. Gutierrez Diez, Rafael C. Grossi Calleja, and Juan C. Fraile Marinero, Catedra de System Engineering, Escuela Tecnica Superior de Ingenieros Industriales, Universidad de Valladolid, Valladolid, Spain

Thursday, August 14/*3:15 PM*
Contributed Papers 12/Carver 2
INERTIA, STABILIZATION AND POLE PLACEMENT

Periodic Lyapunov and Riccati Equations: Recent Results on the Inertia of the Periodic Solutions
Sergio Bittanti, Dipartimento di Elettronica, Paolo Bolzern and Patrizio Colaneri, Centro di Teoria dei Sistemi del CNR, c/o Dipartimento di Eletronica, Politecnico di Milano, Milano, Italy

The Structure of Root Clustering Criteria
Shaul Gutman, Department of Mechanical Engineering, Technion, Israel Institute of Technology, Haifa, Israel

An Efficient Method for Solving the Unit Circle Problem
Ian Duncan, Applied Technology Associates, Albuquerque, NM

Inertia Theorems for Periodic Discrete-Time Lyapunov Equation
Vicente Hérnandez, Department of Applied Mathematics, E.T.S. Industrial Engineering, and Ana Urbano, Department of Applied Mathematics, E.T.S. Agricultural Engineering, Politechnical University of Valencia, Valencia, Spain

Stabilization by Time-Varying High Gain Feedback
D. Pratzel-Wolters, Department of Dynamic Systems, University of Bremen, Bremen, Federal Republic of West Germany

On the Stabilization of Linear Delay Systems
Farzad Pourboghrat, Department of Electrical Engineering, Southern Illinois University, Carbondale, IL

Incomplete Pole Shifting
Frank Uhlig, Department of Mathematics, Auburn University, Auburn, AL

A Parallel Structure for Adaptive Pole Placement Algorithms
Roberto Cristi, Electrical and Computer Engineering Department, Naval Postgraduate School, Monterey, CA

Matrix Pencil Methods in Decentralized Control
Sebastian Engell and Dieter Konik, Universität Duisburg, Duisburg, West Germany

POSTER PRESENTATIONS

Thursday, August 14/*10:30 AM*
Poster Session/Carver 3

Completions of Partial Contractions
L. Rodman, Department of Mathematics, School of Mathematical Sciences, Arizona State University, Tempe, AZ and Tel Aviv University, Tel Aviv, Israel

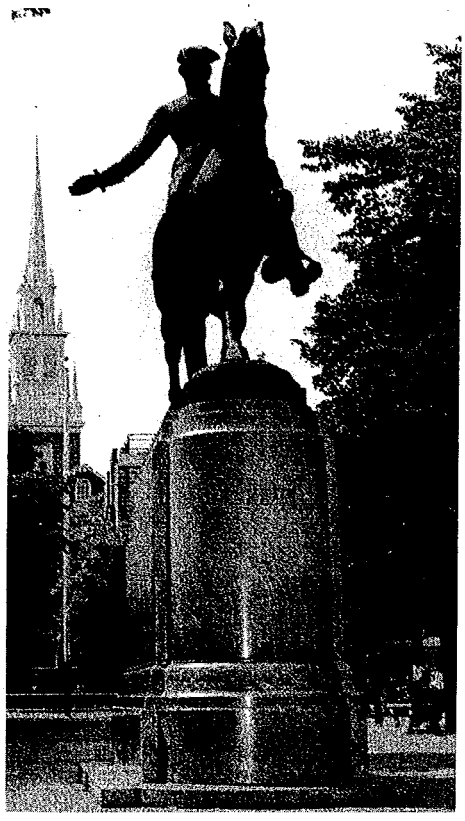
Pade Approximants to Matrix Stieltjes Series—Convergence Properties
Sankar Basu, Electrical Engineering Department, Stevens Institute of Technology, Hoboken, NJ

Total Least Squares Approach for Solving the Linear Prediction Equation
M. Anisar Rahman and Kai-Bor Yu, Department of Electrical Engineering, Virginia Polytechnic Institute and State University, Blacksburg, VA

Possible Consequences for the Violation of Detailed Balance in Measures Made on Single Ion-channel Currents
Michael T. Kirber, Joshua J. Singer, and John V. Walsh, Jr., Department of Physiology, University of Massachusetts Medical School, Worcester, MA

Stability of Families of Polynomials: Geometric Considerations in Coefficient Space
Huang Ling, Department of Mechanics, Peking University, Peking, China, and Department of Mathematics and Statistics, University of Massachusetts, Amherst, MA; C.V. Hollot, Department of Electrical and Computer Engineering, University of Massachusetts, Amherst, MA; and A. C. Bartlett, Department of Computer and Systems Engineering, Rensselaer Polytechnic Institute, Troy, NY

Parallel Approaches to Sequential Estimation
M. Edward Borasky, Floating Point Systems Inc., Portland, OR



THINGS TO DO, PLACES TO SEE

Boston is a mecca for the sightseer, epicurean, historian and naturalist. From the Boston Tea Party to the Boston Celtics, the city is an exciting blend of the old and the new.

The Freedom Trail

Walk the historic Freedom Trail and visit Paul Revere House and Christ Church, where two lanterns hung in 1775 to warn the Colonists of the British attack. See neoclassical Beacon Hill, the old renovated residential area, and beautiful Boston Commons. You can walk to the scene of the Boston Massacre, the rallying point of the independence movement, or visit the Bunker Hill Monument. The Freedom Trail includes the Charlestown Naval Yard, home port for the U.S.S. Constitution and Old Ironsides, the oldest commissioned ship in the U.S. Navy. And don't forget a visit to Harvard University, across the river in Cambridge, founded in 1636 and MIT.

Faneuil Hall and Quincy Market

A potpourri of history, contemporary fashion and, above all, a dining extravaganza, the Faneuil Hall/Quincy Market area of the Waterfront, is not to be missed. The Marketplace's 535 ft. long, 50 ft. wide buildings were first opened in 1926 and then renovated by the Rouse Company and reopened in 1976. The Marketplace boasts 150 boutiques, food stalls, bars and pavilions where the shopper and the diner can find the best of New England. While you're there, walk a few blocks to the New England Aquarium, an innovative addition to the Waterfront.

Urban Attractions

A must for all visitors is a trip to the observatory in the John Hancock Bulding, 750 ft. above the ground atop New England's tallest building. Next door visit Copley Plaza for the most elegant shopping in Boston. The galleries at Copley Plaza house over 100 shops, including Gucci, Tiffany, Godiva, Neiman-Marcus, Alfred Sung and Cache. And don't forget Boston's many museums, including the Museum of Fine Arts, the J.F.K. Library and Museum, Harvard's Fogg Art Museum and the Busch-Reisinger Museum in Cambridge.

Day Trips

Summer attractions include day trips to the Berkshires, Plymouth, Cape Cod, Salem, or the historic area around Concord and Lexington. See the Old Manse, Ralph Waldo Emerson's graceful ancestral home, and Walden Pond, site of Henry David Thoreau's humble cabin. Closer to Boston, take a 40-minute drive to beautiful Cohasset and Hingham along the rugged southern coast. Bring the family and rent a cottage on Cape Cod, before or after the conference!

TRANSPORTATION INFORMATION

By Air

Parkway Travel has been selected to be the official agent for the conference and will guarantee the lowest fares available to Boston. Calling hours are 8:30 am–5:30 pm (EST) Monday through Friday. Call toll-free from the U.S. 1-800-235-6500. If calling from abroad, phone 1-215-977-9666. **Be certain to mention that you are attending the August SIAM Conference on Linear Algebra in Boston.** Parkway Travel will mail you your tickets or arrange for them to be waiting for you at the airport of your choice.

SPECIAL DISCOUNTS: Delta Airlines has been chosen as the official carrier for the conference and they have agreed (through Parkway Travel) to offer up to 40% discounts on certain flights. These special fares will not be available through any agency other than Parkway Travel and we suggest that you call them before making other arrangements. Parkway will give you the lowest fare regardless of which carrier you choose.

In order to get the flight of your choice, we suggest making reservations as soon as possible.

By Car

From Interstate 90 (Massachusetts Turnpike), take exit 22 (Copley-Huntington Avenue) to Stuart Street. The hotel is at 200 Stuart Street, between Church Street and Charles Street Square.

Car Rental

National has been selected as the official car rental agency for the SIAM Conference on Linear Algebra in Signals, Systems and Control. The following rates will apply:

Type of Car	Daily Rate	Weekly Rate
Economy	$33	$169
Compact	$34	$179
Midsize	$36	$189
Fullsize 2-door	$37	$199
Fullsize 4-door	$38	$209

You should make an advance reservation to rent a car, as availability cannot always be guaranteed upon arrival in Boston. **Call toll-free 1-800-328-7949 and give re-cap #6300537. Be certain to mention that you are attending the August SIAM Linear Algebra Conference in Boston.**

- Ask the receptionist for a reservation number, which should be brought to the rental counter when you pick up your car.
- Cars must be picked up and dropped off at the same location.
- Cars will be available at Logan Airport and at the National office at 183 Dartmouth Street in downtown Boston.
- Rates include unlimited mileage.
- You must be 21 years old to rent a car and have a valid drivers license.
- You must have one of the following credit cards to rent a car: AMEX, MC, VISA, Carte Blanche, Diners Club.
- The free unlimited mileage clause applies only if cars are returned to the original rental location.
- The prices quoted do not include gas, tax, optional collision damage waiver, and personal accident insurance.

HOUSING INFORMATION

Hotel

57 Park Plaza Hotel
200 Stuart Street
Boston, MA 02116
(617) 482-1800

SIAM is holding a block of rooms at the conference site, the 57 Park Plaza Hotel. These rooms are being held on a first come, first served basis at $62/single and $62/double. **These rooms will be held for our exclusive use only until July 27, after which date availability cannot be guaranteed.** Overflow requests for hotel reservations will automatically be sent to the Boston Park Plaza Hotel, directly across the street from the conference site. SIAM has also reserved a block of dormitory rooms at Boston University.

We urge you to make your reservations as soon as possible. You may do so by telephoning (617) 482-1800, or via the Hotel Reservation Request Form on the inside back page of this brochure (domestic mail only). **When making reservations by telephone, be certain to obtain the discounted rate by identifying yourself as an attendee at the SIAM Conference on Linear Algebra.**

Late Arrival Policy: If you plan to arrive after 6:00 pm, you must guarantee one nights payment by AMEX, VISA, MC or Diners Club.

Check-in and Check-out Time: 12:00 noon

If you need to change or cancel your reservation, please be certain to contact the hotel by 4:00 pm on your stated day of arrival.

Dormitories

SIAM has reserved a block of dormitory rooms at Boston University in Myles Standish Hall, 620 Beacon Street. Rooms are small, but comfortable, and bathrooms are shared, although segregated according to gender. Linens are supplied and towels may be exchanged daily at the front desk. There are no telephones in the rooms.

The Dormitory Reservation Form, found on the inside back cover of this brochure, and full payment, must be received by the Boston University Housing Office by no later than July 21, 1986. **Rooms are limited and will be assigned on a first come, first served basis. We urge you to make your reservations as soon as possible to guarantee availability.** Confirmation notices and arrival instructions will be mailed to all those whose reservations are received by July 21, 1986.

Rates (per day)

$28/single and $45/double

Please make checks payable to Boston University and mail to: Boston University, c/o Mail Services, Box 900, 25 Buick Street, Boston, MA 02215.

There will be no refunds for cancellations!

Dormitory rooms will be available August 10–15, 1986. Check-in time is 1:00 PM and check-out time is 11:00 AM. Keys and university I.D. cards will be provided upon check-in.

Directions

From the Airport:

Take the free shuttle to the subway terminal, called the "T" stop. Take the blue line in-bound to the Government Center stop. Change to the Green line B to Boston University. Get off at the Kenmore Square stop and Myles Standish Hall will be right in front of you.

To the Conference Site:

SIAM will provide shuttle service in the morning and in the late afternoon. A schedule will be sent to you with your arrival instructions. However, it is faster and more convenient to take the subway. Take the Green line into the city and get off at the Arlington Street exit.

Parking

Parking will be allowed in any university lot, but the closest is the SMG lot at the end of Bay State Road. You must pre-pay and indicate your need for a parking validation sticker on your Dormitory Reservation Form. Your sticker will be presented to you at the check-in desk at Myles Standish Hall.

Information

Call 1-617-353-3520. Be certain to identify yourself as an attendee at the SIAM Conference on Linear Algebra.

Shuttle Service

A schedule of shuttle service between the dormitories and the conference site will be included in your information packet.

REGISTRATION INFORMATION

Please complete the Advance Registration Form, found on the inside back cover of this brochure, and return it to SIAM in the envelope provided (domestic mail only).

We urge Short Course attendees to register in advance, as space is limited and on-site registrations will depend on availability.

The registration desk for the short course and conference will be located in Convention Hall B on the 6th floor of the 57 Park Plaza Hotel and will be open as listed below:

Sunday,	August 10	5:00 PM–10:00 PM
Monday,	August 11	7:00 AM–10:00 PM
Tuesday,	August 12	7:00 AM– 6:00 PM
Wednesday,	August 13	7:30 AM– 6:00 PM
Thursday,	August 14	7:30 AM– 4:00 PM

Registration Fees

		SIAG/LA*	SIAM Member	Non-Member	Student Member	Student Non-Member
Short Course	Advance	$75	$75	$ 90	$25	$35
	On-site	$90	$90	$105	$35	$45
Conference	Advance	$70	$75	$ 95	$ 5	$15
	On-site	$90	$95	$115	$ 5	$15

*There is a $5 special discount for the conference for members of the SIAM Activity Group on Linear Algebra.

Wine and Cheese Party
Wednesday, August 13, 6:30 pm
$15.00

SIAM Corporate Members

Non-member attendees who are employed by SIAM Corporate Members are entitled to the SIAM member rate. See box below for list of SIAM corporate members.

SIAM Corporate Members

Aerospace Corporation
Amoco Production Company
AT&T Bell Laboratories
Boeing Company
Cray Research, Inc.
Culler Scientific Systems Corporation
E.I. Du Pont de Nemours and Company
Eastman Kodak Company
Exxon Production Research Company
Exxon Research and Engineering Company
General Electric Company
General Motors Corporation
Giers Schlumberger
GTE Laboratories, Inc.
IBM Corporation
Institute for Computer Applications in Science and Engineering (ICASE)
IMSL, Inc.
MacNeal-Schwendler Corporation
Marathon Oil Company
Martin Marietta Energy Systems
Mathematical Sciences Research Institute
Standard Oil Company of Ohio (SOHIO)
Supercomputing Research Center, a division of Institute for Defense Analyses
Texaco, Inc.
United Technologies Corporation

Non-member registrants are encouraged to join SIAM in order to obtain the member rate for conference registration and all the other benefits of SIAM membership.

Credit Cards:

SIAM is now accepting credit cards for the 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.

Special Note:

There will be no prorated fees. There will be no refunds after the conference starts.

To Advance Registrants:

Please be certain to process your advance registration form yourself. If this task is delegated to an employee, quite often the form does not reach SIAM by the deadline, and oftentimes not at all.

If SIAM does not receive your advance registration form by the stated deadline, you will be asked to give us a check or a credit card number at the conference. We will not process either until we have ascertained that your registration form has gone astray. In the event that we receive your form after the conference, we will return your check or credit card slip.

HOTEL RESERVATION REQUEST FORM

57 Park Plaza Hotel, Boston, MA
SIAM Conference on Linear Algebra
August 12–14, 1986

A limited number of specially discounted rooms will be held for our exclusive use only until July 27, 1986. After that, reservations will depend on availability. *WE URGE YOU TO MAKE YOUR RESERVATIONS AS SOON AS POSSIBLE.* Your reservation is not confirmed until acknowledged in writing by the hotel or verified by phone (617) 482-1800. Do not forget to place a stamp on the reverse side of this card.

Please reserve: ☐ Single/$62
☐ Double/$62

Arrival Date _____

Arrival Time _____

Check-out Date _____

☐ Please guarantee my room for late arrival (after 6:00 PM)*

☐ AMEX ☐ VISA ☐ MC ☐ Diners Club

Credit card number _____

Expiration date _____

Name _____
(please print)

Phone _____

Address _____

City _____

State _____ Zip _____

*If you list your credit card number, please enclose this card in an envelope and mail to: Reservations, 57 Park Plaza Hotel, 200 Stuart Street, Boston, MA 02116.

DORMITORY RESERVATION FORM

SIAM Conference on Linear Algebra
August 12–14, 1986

Please reserve: ☐ Single/$28 ☐ Double/$45
Gender(s) M F

☐ Smoking ☐ Non-smoking

☐ I would like a parking sticker for ____ days at $4 per day.

Arrival date _____ Departure date _____

Amount Enclosed $ _____
Please pre-pay full amount.
Checks only, payable to Boston University.
Remit by July 21, 1986.

Name _____
(please print)

Phone (___) _____

Address _____

City _____

State _____ Zip _____

Roommate *(if applicable)* _____

Mail in your own envelope to: Boston University, c/o Mail Services, Box 900, 25 Buick Street, Boston, MA 02215

ADVANCE REGISTRATION FORM

SIAM Conference on Linear Algebra

Advance registration form must be received at the SIAM office by August 6, 1986

Registration Fees

		SIAG/LA	SIAM Member	Non-Member	Student Member	Student Non-Member
Short Course	Advance	$75	$75	$ 90	$25	$35
	On-site	$90	$90	$105	$35	$45
Conference	Advance	$70	$75	$ 95	$ 5	$15
	On-site	$90	$95	$115	$ 5	$15

Registration amount enclosed: Short Course $___ $___ $___ $___ $___

Conference $___ $___ $___ $___ $___

Wine and Cheese Party $15.00 $___ $___ $___ $___ $___

TOTAL $___ $___ $___ $___ $___

☐ **Please send me information about membership in SIAM**
Domestic mail: Enclose card with payment in the envelope provided.
Foreign mail: Use your own envelope and mail to SIAM, 117 South 17th Street, 14th Floor, Philadelphia, PA 19103-5052, USA
Telephone: 215-564-2929
My SIAM membership address is
☐ Same as above
☐ Other _____

Please type or print clearly

☐ I wish to pay by credit card. ☐ AMEX ☐ MC ☐ VISA

Card Number _____

Expiration date: _____

Signature _____

Name _____

Telephone _____

Department _____

Institution _____

Address _____

City _____ State _____ Zip _____

Local Address in Boston _____

I am a member of ☐ SIAM ☐ Other(s) _____

From:

Place Stamp Here

Reservations
57 Park Plaza Hotel
200 Stuart Street
Boston, MA 02116

SIAM
117 S. 17th Street
Suite 1400
Philadelphia, PA 19103-5052
U.S.A.

Nonprofit Organization U.S. Bulk Postage-paid SIAM

POSTMASTER PLEASE DELIVER TO:

SIAM CONFERENCE ON LINEAR ALGEBRA IN SIGNALS, SYSTEMS AND CONTROL