## TECHNICAL PROGRAM

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<th>CODING</th>
<th>WA</th>
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<td>Wednesday morning</td>
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### WEDNESDAY MORNING

**MAY 23, 1990**

#### PLENARY SESSION I: CHABLIS / BURGUNDY

**Chairman:** D. Gangsaas, Boeing Advanced Systems  
**Co-Chairman:** E. Gai, C.S. Draper Laboratory, Inc.

**Robust Stability and Robust Stabilization**  
M. Mansour, Institut fur Automatik und Industrielle Elektronik, Zurich

#### WA1: Chenin

**DISCRETE EVENT SYSTEMS**

**Chairman:** Y. Bar-Shalom, University of Connecticut  
**Co-Chairman:** M. E. Kaliski, California Polytechnic State University

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<tr>
<td>9:45 - 10:15</td>
<td>Job Shop Scheduling with Simple Precedence Constraints</td>
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<td>D. J. Hoitomt, Pratt and Whitney, P. B. Luh, University of Connecticut, K. R. Pattipati, University of Connecticut</td>
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<tr>
<td>10:15 - 10:45</td>
<td>Control of Discrete-Time Hybrid Stochastic Systems</td>
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<td></td>
<td>L. Campo, University of Connecticut, Y. Bar-Shalom, University of Connecticut</td>
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<tr>
<td>10:45 - 11:15</td>
<td>Control of Systems with Controlled Jump Markov Disturbances: Application to Flexible Manufacturing Systems</td>
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<td></td>
<td>E. K. Boukas, École Polytechnique de Montréal</td>
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<tr>
<td>11:15 - 11:45</td>
<td>Output Feedback Control for a Class of Nondeterministic Discrete Event Systems</td>
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<td>J.-Y. Lin, University of Ottawa, D. Ionescu, University of Ottawa</td>
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<tr>
<td>11:45 - 12:00</td>
<td>Switched Linear Discrete-Event Systems: An Architecture and Simulator</td>
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<td></td>
<td>M. E. Kaliski, California Polytechnic State University, S. Ritz, FMC Corporation</td>
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12:00 - 12:30
Buffer Size Effect Analysis for M/G/1/(\infty, K) Queue
W.-B. Gong, University of Massachusetts at Amherst, J. Pan, University of Massachusetts at Amherst

WA2: Colombard
CONTROL APPLICATIONS TO MILITARY SYSTEMS

Organizer: Herbert E. Cohen, U.S. Army
Chairman: Herbert E. Cohen, U.S. Army, Aberdeen Proving Ground
Co-Chairman: Norman Coleman, U.S. Army ARDEC

9:45 - 10:15 (I) 33
Control of Articulated Structures on Maneuvering Platforms

10:15 - 10:45 (I) 39
Reduced Order Modeling Methods for Turret - Gun System
S. Vittal Rao, University of Missouri - Rolla, Norman P. Coleman, U.S. Army ARDEC

10:45 - 11:15 (I) 1004
A Hierarchical Target Tracker Using Image Data
Dominick Andrisani, Purdue University, M. F. Tenorio, Purdue University, Jun Lu, Purdue University, Frank P. Kuhl, U.S. Army ARDEC

11:15 - 11:45 (I) 44
Restructurable Control Inputs II: The Nonlinear Case
Charles E. Hall, Jr., U.S. Army Missile Command

11:45 - 12:15 (I) 44
Multi-Target Acquisition Fire Control Simulation
Michael J. Krok, General Electric Company, Richard V. Spencer, General Electric Company, John Groff, Ballistic Research Laboratory

12:15 - 12:45 (I) 50
Weapon Control and Stabilization Using Modern Control Techniques
Myung-Ho Pee, FMC Corporation, Vic Syed, FMC Corporation, Jeanette Lappen, FMC Corporation

WA3: Polomar
ADAPTIVE CONTROL SYSTEMS

Chairman: S. Yurkovich, Ohio State University
Co-Chairman: A. Datta, University of Southern California

9:45 - 10:15 55
Decentralized Indirect Adaptive Control of Interconnected Systems
A. Datta, University of Southern California, P. Ioannou, University of Southern California
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<td>On Frequency Domain Loop Shaping for Self-Tuning Control</td>
<td>A. P. Tzes, The Ohio State University, S. Yurkovich, The Ohio State University</td>
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<td>10:45-11:15</td>
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<td>Adaptive Stabilization of Non-Linearizable Systems Under a Matching Assumption</td>
<td>R. Ortega, National University of Mexico, A. Rodriguez, National University of Mexico, G. Espinosa, National University of Mexico</td>
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<td>11:15-11:45</td>
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<td>A New Robust Model Reference Adaptive Control Using Variable Structure Adaptation for Plants with Relative Degree Two</td>
<td>L.-C. Fu, National Taiwan University</td>
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<td>11:45-12:00</td>
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<td>Indirect Techniques for Adaptive Input Output Linearization of Nonlinear Systems</td>
<td>A. Teel, University of California, Berkeley, R. Kadiyala, University of California, Berkeley, P. Kokotovic, University of Illinois, Urbana-Champaign, S. S. Sastry, University of California, Berkeley</td>
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<td>12:00-12:15</td>
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<td>Auto-Tuning of Control Systems</td>
<td>M. Zhuang, University of Sussex Falmer, D. P. Atherton, University of Sussex Falmer, L. Smith, Eurotherm Limited</td>
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<td>Robust Adaptive Control of Linear Systems Having a Polynomial Input Nonlinearity</td>
<td>J. Zhang, Northeast University of Tech., P.R.C.</td>
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<td>Stability Analysis for Leaning Systems</td>
<td>L. Hideg, Oakland University, R. Judd, Oakland University, R. P. Van Til, Oakland University</td>
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<td>A Multi-rate Adaptive FIR Controller for Performance Enhancement of a Fixed Controller</td>
<td>T. T. Tay, National University of Singapore, S. Nungam, National University of Singapore</td>
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**WA4: San Diego and San Fernando**

**APPLICATIONS OF MODELING AND CONTROL TECHNIQUES TO MICROELECTRONICS PROCESSING**

**Organizer:** Christos Georgakis, Lehigh University  
**Chairman:** T. F. Edgar, University of Texas  
**Co-Chairman:** D. E. Seborg, UC Santa Barbara

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<td>Supervisory Control for Semiconductor Processing</td>
<td>David L. Hoerger, University of California at Santa Barbara, Duncan A. Mellichamp, University of California at Santa Barbara, Dale E. Seborg, University of California at Santa Barbara</td>
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10:15-10:45 (I)
Optimal Control and Identification for Optical Lithography
W. F. Ramirez, University of Colorado, Thomas A. Carroll, University of Colorado

10:45-11:15 (I)
Development of Techniques for Real-Time Monitoring and Control in Plasma Etching
K. J. McLaughlin, University of Texas, T. F. Edgar, University of Texas, I. Trachtenberg, University of Texas

11:15-11:45 (I)
Glow Discharge Modeling: A First Step Towards Plasma Etching Reactor Control
Mark Wilcoxson, and V. Manousiouthakis, University of California at Los Angeles

11:45-12:15 (I)
Modeling, Optimization and Control of the Selective Plasma Etching of Silicon Over Silicon Dioxide
Kevin L. Allred, University of Texas, Isaac Trachtenberg, University of Texas, T. F. Edgar, University of Texas

12:15-12:45 (I)
Panel Discussion by Authors on Control Needs in Microelectronics Processing

WA5: San Antonio and Santa Barbara

POLE PLACEMENT IN LINEAR CONTROL

Chairman: J. L. Rawson, North Dakota State University
Co-Chairman: J. H. Chow, Rensselaer Polytechnic Institute

9:45-10:15 116
A Controller Parameterization and Pole-Placement Design for Simultaneous Stabilization
M. A. Kale, Rensselaer Polytechnic Institute, J. H. Chow, Rensselaer Polytechnic Institute, K. D. Minto, General Electric Company

10:15-10:45 122
Minimum-Norm Pole Placement in Sampled-Data Systems
J. L. Rawson, North Dakota State University, C. S. Hsu, Washington State University

10:45-11:00 128
The Effect of Horizon Length on the Pole-Assignment Property of Receding-Horizon Controllers
E. Yaz, University of Arkansas

11:00-11:30 130
Regional Pole Placement via Optimal Static and Dynamic Output Feedback
W. M. Haddad, Florida Institute of Technology, D. S. Bernstein, Harris Corporation

11:30-11:45 136
Constrained Pole Placement Using Projective Controls Technique
N. S. Rousan, The Wichita State University, M. E. Sawan, The Wichita State University
A Frequency Method for the Design of Linear Suboptimal Controllers for Time Invariant Systems with Structural Constraints
Y. Lin, Shanghai Institute of Railway Technology

9:45 - 10:15
A New Method of Designing Observers for Nonlinear Systems
Z.-Z. Han, Shanghai Jiao Tong University, Z.-J. Zhang, Shanghai Jiao Tong University

10:15 - 10:45
A Nonlinear Observer for Flexible Mechanisms Using Canonical Forms
M. D. Di Benedetto, Via Eudossiana 18, P. Lucibello, Universita di Roma La Sapienza

10:45 - 11:15
Identifying Reduced-Order Models for Large Nonlinear Systems with Arbitrary Initial Conditions and Multiple Outputs Using Prony Signal Analysis
D. A. Pierre, Montana State University, D. J. Trudnowski, Montana State University, J. F. Hauer, Bonneville Power Admin.

11:15 - 11:45
Nonlinear Model Matching: A Local Solution and Two Worked Examples
H. J. C. Huijberts, University of Twente

11:45 - 12:00
Convexity Property of the One-sided Multivariable Stability Margin
J. Tekawy, Northrop Corporation, M. G. Safonov, University of Southern California, R. Y. Chiang, Northrop Corporation

12:00 - 12:15
A Relaxed Mismatch Criterion for Reducing Conservatism in Lyapunov Stability Analysis
K. M. Black, University of Texas at Arlington, C. C. Blackwell, University of Texas at Arlington

12:15 - 12:30
Some Results on the Asymptotic Stability of Nonlinear Dynamical Systems
C. Manfredi, University of Florence

12:30 - 12:45
Partitioning Methods for Global Controllers
Phillip H. Schmidt, University of Akron, Sanjay Garg, MS 77-1, Lorenzo Carl, NASA Lewis Research Center
**WA7: Cuyamaca**

**CONTROL OF LIGHTWEIGHT ROBOTIC SYSTEMS**

**Organizer:** Enrique Barbieri, Tulane University  
**Chairman:** E. Barbieri, Tulane University  
**Co-Chairman:** P. Rastgoufard, Tulane University

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<td>Configuration Control Under Optimal Assignment of Set-Points in Flexible Robots</td>
<td>Enrique Barbieri, Tulane University</td>
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<td>10:15 - 10:45</td>
<td>I</td>
<td>Vibration Control of Flexible-Link Manipulators</td>
<td>Farshad Khorrami, Polytechnic University, Shihua Zheng, Polytechnic University</td>
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<td>Frequency Shaped Variable Structure Control</td>
<td>K. D. Young, Lawrence Livermore National Lab., Umit Ozguner, The Ohio State University</td>
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<td>11:15 - 11:45</td>
<td>I</td>
<td>An Inverse Dynamic Method Yielding Flexible Manipulator State Trajectories</td>
<td>D.-S. Kwon, Georgia Institute of Technology, Wayne J. Book, Georgia Institute of Technology</td>
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<td>Flexible-Link Manipulator Force Control</td>
<td>Anthony P. Tzes, The Ohio State University, Stephen Yurkovich, The Ohio State University</td>
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<td>12:15 - 12:45</td>
<td>I</td>
<td>High Bandwidth Control of Flexible Robots: Proof of Concept Experiments for Momentum Management</td>
<td>M. A. Timmerman, Georgia Institute of Technology, Stephen L. Dickerson, Georgia Institute of Technology</td>
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**WA8: Chardonnay**

**ANALYSIS AND CONTROL OF REdundant MANIPULATORS I**

**Organizer:** Bruno Siciliano, Universita Degli Studi Di Napoli Federico II  
**Chairman:** Bruno Siciliano, Universita Degli Studi Di Napoli Federico II  
**Co-Chairman:** Yoshihiko Nakamura, University of California, Santa Barbara

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<td>Coordinating Kinematically Redundant Degrees of Freedom</td>
<td>D. P. Martin, Boston University, John Baillieul, Boston University</td>
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<td>10:15 - 10:45</td>
<td>I</td>
<td>Utilizing Kinematic Redundancy in Robotic Systems: Practical Implementations and Fundamental Limitations</td>
<td>Anthony A. Maciejewski, Purdue University, Rodney G. Roberts, Purdue University</td>
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On the Global Behavior of Kinematically Redundant Manipulators
Tzila Shamir, Weizmann Institute of Sciences

Efficient Dynamic Resolution of Robot Redundancy
Alessandro De Luca, University di Roma, La Sapienza, Giuseppe Oriolo, University di Roma, La Sapienza

Translational and Rotational Manipulability of Robotic Manipulators
Tsunoe Yoshikawa, Kyoto University

Adaptive Cartesian Control of Redundant Manipulators
Gunter Niemeyer, Mass. Institute of Technology, Jean-Jacques E. Slotine, Mass. Institute of Technology

WA9: Laguna
AEROSPACE VEHICLE GUIDANCE AND TRAJECTORY OPTIMIZATION - I
Organizer: P.K. A. Menon, Georgia Institute of Technology and D.D. Moerder, NASA Langley Research Center
Chairman: P.K. A. Menon, NASA Ames Research Center
Co-Chairman: M. D. Ardema, University of Santa Clara

Finite Element Solution of Optimal Control Problems with Inequality Constraints
Robert Bless, Georgia Institute of Technology, Dewey H. Hodges, Georgia Institute of Technology

Trajectory Optimization for Real-Time Guidance: Part 1, Time-Varying LQR on a Parallel Processor
Mark L. Psiaki, Cornell University, K. Park, Cornell University

Optimal Trajectories for an Aerospace Plane
Angelo Miele, Rice University, W. Y. Lee, Rice University

An Ascent Guidance Algorithm Using LIDAR Wind Measurements
Evin J. Cramer, Boeing Computer Services, J. E. Bradt, Boeing Aerospace and Electronics, J. W. Hardtla, Boeing Aerospace and Electronics

Aircraft Trajectory Optimization with Direct Collocation Using Movable Gridpoints
M. Paus, German Aerospace Research Establishment

Computational Singular Perturbation Method for Aircraft Flight Path Optimization
Mark D. Ardema, University of Santa Clara
WA10: Cabernet

INTELLIGENT VEHICLE HIGHWAY SYSTEMS I

Organizer: A. M. Karmel, Ford Motor Company, J. H. Rillings, General Motors Corporation, S. E. Shladover, PATH and J. K. Hedrick, University of California at Berkeley

Chairman: A. M. Karmel, Ford Motor Company

Co-Chairman: S. E. Shladover, University of California, Berkeley - PATH

9:45 - 10:15 (I) 268

Vision-Based Convoy Following by Recursive Filtering
N. Kehtarnavaz, Texas A & M University, J. S. Lee, Texas A & M University, N. C. Griswold, Texas A & M University

10:15 - 10:45 (I) 274

An Expert System for Automated Highway Driving
Axel Niehaus, Princeton University, Robert F. Stengel, Princeton University

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An Intelligent Roadway Reference System for Vehicle Lateral Guidance/Control
Wei-bin Zhang, University of California at Berkeley, Robert E. Parsons, University of California at Berkeley, Tom West, Caltrans

11:15 - 11:45 (I) 287

Motorist Information Systems in Minnesota
Richard A. Stehr, Minnesota Dept. of Transportation

11:45 - 12:15 (I) 291

Longitudinal Control of a Platoon of Vehicles
S. Sheikholeslam, University of California at Berkeley, Charles A. Desoer, University of California at Berkeley

12:15 - 12:45 (I) 297

Vehicle Modelling and Control for Automated Highway Systems
Donn H. McMahon, University of California at Berkeley, J. K. Hedrick, University of California at Berkeley, S. Shladover, University of California at Berkeley

WA11: Gamay

MODELLING AND REALIZATION

Chairman: R. Horowitz, University of California at Berkeley

Co-Chairman: E. Yaz, University of Arkansas

9:45 - 10:00 304

Optimal Model Matching in the Sense of L1-norm Minimization
C.-C. Kung, Tatung Institute of Technology, Y.-H. Lin, Tatung Institute of Technology, T.-H. Hung, Tatung Institute of Technology, C.-K. Lee, Tatung Institute of Technology
10:00 - 10:30
Functional Persistence of Excitation and Observability
J.B. Moore, Australian National University, R. Horowitz, UC Berkeley, W. Messner, UC Berkeley

10:30 - 10:45
Multi-Step Ahead Predictions for Multivariable Linear Stochastic Systems Via Model Recursion
T. Shou, Beijing Polytechnic University, N.-S. Xu, Beijing Polytechnic University

10:45 - 11:00
Optimal State Estimation with Correlated Multiplicative and Additive Noise and Its Application to Measurement Differencing
E. Yaz, University of Arkansas

11:00 - 11:15
On Computing the Induced Norm of Sampled Data Systems
P. Kabamba, The University of Michigan, S. Hara, Tokyo Institute of Technology

11:15 - 11:30
Estimating Poles of a Linear System Using Erroneous Markov Parameters
M. Verhaegen, Delft University of Technology

11:30 - 11:45
Existence of Solution and Regularity Results for the $H_{\infty}$ Riccati Equation
D. Fragopoulos, University of Strathclyde

12:00 - 12:15
Synthesis of Disturbance Attenuating, Noise Rejecting Regulator Control via the Matrix Riccati Equation
C. Blackwell, University of Texas at Arlington

12:15 - 12:30
Piecewise Multiple Chebyshev Polynomials and Their Applications to Analysis and Identification of Time-Delay Systems
X.-S. Gu, East China University of Chemical Technology, Y.-Z. Hu, East China University of Chemical Technology

12:30 - 12:45
Partial Integrity
P. M. G. Ferreira, Pontificia Universidade Catolica, Rio de Janeiro

WA12: Reisling
EXPERIMENTAL CONTROL OF FLEXIBLE STRUCTURES

Organizer: Thomas E. Alberts, Old Dominion University
Chairman: T. E. Alberts, Old Dominion University
Co-Chairman: S. Yurkovich, Ohio State University
Adaptive CSI Compensation for Reduced-Order-Model-Based Control of a Flexible Robot Manipulator
Roger A. Davidson, University of Colorado, Mark J. Balas, University of Colorado, Brian T. Reisenauer, University of Colorado

Flexible Beam Control Using an Adaptive Truss
Thomas J. Warrington, VPI and State University, C. Garnett Horner, NASA Langley Research Center

Experiments with End-Point Control of a Flexible Link Using the Inverse Dynamics Approach and Passive Damping
Thomas E. Alberts, Old Dominion University, L. J. Love, Old Dominion University, Eduardo Bayo, University of CA at Santa Barbara, H. Moulin, University of CA at Santa Barbara

Reduced Order Robust Controllers for an Experimental Flexible Grid

Controlling Coupled Flexible Links Rotating in the Horizontal Plane
Steve Yurkovich, Ohio State University, A. Tzes, Ohio State University, K. Hillsley, Ohio State University

Decentralized Control Experiments on the JPL Flexible Spacecraft
Umit Ozguner, Ohio State University, K. Ossman, Ohio State University, J. Donne, Ohio State University, M. Boesch, Ohio State University, A. Ahmed, Jet Propulsion Laboratory

Information-Based Complexity: An Overview
G. W. Wasilkowski, University of Kentucky

Ill-Posed Problems in Various Settings: an Information-Based Survey
A. G. Werschulz, Fordham University

Some Complexity Issues for Ill-Posed Identification Problems
T. I. Seidman, University of Maryland
Identification in H∞: A Robustly Convergent, Nonlinear Algorithm
A. J. Helmicki, Georgia Institute of Technology, C. A. Jacobson, Northeastern University, C. N. Nett, Georgia Institute of Technology

Learning and Adaptation in Machine Vision

Panel Discussion: Systems Theory Potential of Information-Based Complexity Theory
All Session Participants

WA14: Sauvignon
DECENTRALIZED AND LARGE SCALE SYSTEMS
Chairman: N. Ozturk, Manhattan College
Co-Chairman: D. Li, University of Virginia

9:45 - 10:15
Concurrent Control of Active Systems
A. Lerner, Weizmann Institute of Science

10:15 - 10:45
A Textured Decomposition Based Algorithm for Large Scale Multicommodity Network Flow Problems
S.Y. Lin, National Chiao Tung University

10:45 - 11:15
On Zero-Order Hold Equivalents of Distributed Parameter Systems
A. J. Helmicki, Georgia Institute of Technology, C. A. Jacobson, Northeastern University, C. N. Nett, Georgia Institute of Technology

11:15 - 11:45
A New Solution Approach to Salukvadze's Problem
D. Li, University of Virginia

11:45 - 12:00
Stability Analysis of a Certain Class of Distributed Parameter Systems
N. Ozturk, Manhattan College

12:00 - 12:30
On Decentralized Observers
V. M. P. Leite, Escola Politecnica da Universidad de Sao Paulo

12:30 - 12:45
Nonlinear Control Design in Discrete-Time Bilinear Interconnected Systems
W. J. Wang, National Central University, Taiwan, J. S. Chio, National Central University, Taiwan

12:45 - 13:00
On Turnpikes and Hedging Points for Piecewise Deterministic Control Systems
C. Van Delft, University of Geneva, A. Haurie, University of Geneva
A Control System Design Methodology for Large-Scale Interconnected Systems
Karl Flueckiger, C.S. Draper Laboratory, John R. Dowdle, C.S. Draper Laboratory, Timothy C. Henderson, C.S. Draper Laboratory

The Approximate Inverse Approach to Control System Design
Michael Athans, Mass. Institute of Technology

Robustness Properties of Feedback Systems with Multiple Sources of Uncertainty
Jie Chen, University of Michigan, James Freudenberg, University of Michigan

Robust Performance of Large Scale Integrated Systems
Douglas P. Looze, University of Massachusetts, Jor-Yan Wong, University of Massachusetts

Decentralized Robust Control for Dynamic Routing of Large Scale Networks
A. Iftar, University of Toronto, E. J. Davidson, University of Toronto

Decentralized $H_2/H_{\infty}$ Controller Synthesis
Wassim M. Haddad, Florida Institute of Technology, Dennis S. Bernstein, Harris Corporation, Carl N. Nett, Georgia Institute of Technology

Decentralized Control of a Class of Large-Scale Systems by Uncertainty Estimator
Min-Shin Chen, National Taiwan University
2:00 - 2:30
Monotonicity and Maximal Solution of Generalized Algebraic Riccati Equations
C. E. de Souza, University of Newcastle Australia, M. D. Fragoso, National Laboratory for Scientific Computing Brazil

2:30 - 3:00
A Relative Error Bound for Discrete Balanced Stochastic Truncation
W. Wang, University of Southern California, M. G. Safonov, University of Southern California

3:00 - 3:30
Stochastic Stability and Performance Robustness of Linear Multivariable Systems
L.E. Ryan, Princeton University, R.F. Stengel, Princeton University

3:30 - 4:00
A Tighter Relative-Error Bound for Balanced Stochastic Truncation
W. Wang, University of Southern California, M. G. Safonov, University of Southern California

4:00 - 4:30
Stochastic Modeling of Lateral Web Dynamics
C.E. Kardamilas, Newben Systems, G.E. Young, Oklahoma State University

4:30 - 5:00
Optimal Linear Feedback Control for Non-Linear-Non-Quadratic-Non-Gaussian Problems
R.-J. Chang, National Cheng Kung University, Taiwan

5:00 - 5:30
Non-Linear Controller Design for Stochastic Systems
K.S. Chang, University of California, Berkeley, D.M. Auslander, University of California, Berkeley

5:30 - 5:45
Right Nilpotent Interactor Matrix and Its Application to Multivariable Stochastic Control
A. P. Paplinski, Chisholm Institute of Technology, M. W. Rogozinski, CSIRO

WP2: Colombard
Automation Aids for Air Traffic Control

Organizer: Heinz Erzberger, NASA Ames Research Center
Chairman: Leonard Tobias, NASA Ames Research Center
Co-Chairman: Heinz Erzberger, NASA Ames Research Center

2:00 - 2:30 (I)
Arrival Planning and Sequencing with COMPAS-OP at the Frankfurt ATC Center
Uwe Volckers, DLR Institute for Flight Guidance

2:30 - 3:00 (I)
MAESTRO - A Metering and Spacing Tool
Jean-Luis Garcia, CENA, France
A Prototyping Effort to Develop a New ARTS-III A
Automation Aid
David R. Barker, MITRE Corporation, Jennifer Levin,
MITRE Corporation

The Traffic Management Advisor
William Nedell, San Jose State University, Heinz
Erzberger, NASA Ames Research Center, Frank Neuman,
NASA Ames Research Center

Simulator Evaluation of the Final Approach
Spacing Tool
Thomas J. Davis, NASA Ames Research Center, Heinz
Erzberger, NASA Ames Research Center, Steven M.
Greene, NASA Ames Research Center

Quantification and Analysis of Controller
Behavior in a Simulated TRACON Environment
Hugh P. Bergeron, NASA Langley Research Center, Gary
W. Lohr, Embry-Riddle Aeronautical University

A Taxi and Ramp Management and Control
System (TARMAC)
D. Dippe, DLR Institute for Flight Guidance

Analysis of the Potential Benefits of Terminal Air
Traffic Control Automation (TATCA)
S. Boswell, MIT Lincoln Laboratory, John W. Andrews,
MIT Lincoln Laboratory, Jerry D. Welch, MIT Lincoln
Laboratory

Combined Direct, Indirect and Variable Structure
Method for Robust Adaptive Control
Kumpati S. Narendra, Yale University, Jovan Boskovic,
Yale University

Observer-Based Adaptive Control of Nonlinear
Systems Under Matching Conditions
I. Kanellakopoulos, University of Illinois at Urbana-
Champaign, Petar V. Kokotovic, University of Illinois at
Urbana-Champaign, R. H. Middleton, University of
Newcastle

On Some Performance Issues in Robust Adaptive
Control
Kostas S. Tsakalis, Arizona State University
Adaptive Control of Linear Time-Varying Systems
Anuradha M. Annaswamy, Boston University

Adaptive Filtering and GPC
D. S. Shook, University of Alberta, C. Mohtadi, University of Alberta, S. L. Shah, University of Alberta

Robust and Adaptive Stabilization of Systems with Known and Unknown Time-Delays
Andrzej W. Olbrot, Wayne State University

Indirect Adaptive Control Based on DAC Theory
J. Z. You, University of Alabama Huntsville, C. D. Johnson, University of Alabama Huntsville

Parameter Convergence in Robust Adaptive Control Systems
Petros A. Ioannou, University of Southern California, Jing Sun, Wayne State University

On Computing the Equilibrium of the Averaged System for the Self Tuning Regulator
S. M. Phillips, Case Western Reserve University, R. Kosut, Integrated Systems, Inc.

Estimation and Control of Continuous Stirred Tank Polymerization Reactors
K. J. Kim, University of Maryland, K. Y. Choi, University of Maryland

Nonlinear Model Predictive Control of a Production Scale Batch Reactor
John Wassick, Dow Chemical Company, Paul Guilfoyle, Massachusetts Institute of Technology, Tom Meadowcroft, Massachusetts Institute of Technology, Jeff Feerer, Massachusetts Institute of Technology

Robust Inferential Control for a Packed-Bed Reactor
Hector M. Budman, California Institute of Technology, Chris Webb, California Institute of Technology, Manfred Morari, California Institute of Technology

Application of Multistep Newton-type Controllers to Fluid Catalytic Cracking
4:00 - 4:30 (I)
The Nonlinear Control of Instantaneous Reaction Systems
Jeffrey C. Kantor, University of Notre Dame

4:30 - 5:00 (I)
Statistical Analysis Methodology for Controller Robustness
Charles D. Schaper, University of California, Dale E. Seborg, University of California, Duncan A. Mellichamp, University of California

5:00 - 5:30
Nonlinear Control of Non-Isothermal Chemical Reactors: An Approach Based on a Geometric Characterization Which Incorporates Stoichiometry and Kinetics
R. Suarez, Universidad Autonoma Metropolitana, J. Alvarez, Universidad Autonoma Metropolitana

WP5: San Antonio and Santa Barbara
LINEAR AND NONLINEAR ROBUST CONTROL: THE QFT APPROACH

Organizer: Osita D.I. Nwokah, Purdue University
Chairman: C. H. Houpis, AFIT / WPAFB
Co-Chairman: O. D.I. Nwokah, Purdue University

2:00 - 2:30 (I)
Frequency Response Specifications and Sensitivity Functions in Quantitative Feedback Theory
David F. Thompson, Purdue University, O. D.I. Nwokah, Purdue University

2:30 - 3:00 (I)
On the Determination of the Worst Allowable Persistent Bounded Disturbance for a System with Constraints
S. Jayasuriya, Texas A&M University

3:00 - 3:30 (I)
Robust Design of MIMO Feedback Systems Having an Uncertain Nonlinear MIMO Plant
O. Yaniv, Tel-Aviv University

3:30 - 4:00 (I)
Application of Fixed Point Theory to Uncertain Nonlinear and MIMO Feedback Problems
I. M. Horowitz, University of California, Davis

4:00 - 4:30 (I)
A Nonlinear QFT Design with Pipelined Inverse
R. A. Zachery, University of California, Davis, S. H. Wang, University of California, Davis, I. M. Horowitz, University of California, Davis

4:30 - 5:00
Optimal Loop Synthesis in Quantitative Feedback Theory
D.F. Thompson, Purdue University, O.D.I Nwokah, Purdue University
### NONLINEAR CONTROLS II

**Chairman:** N. H. McClamroch, University of Michigan  
**Co-Chairman:** W. J. Rugh, The Johns Hopkins University

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| 2:00-2:30  | Feedback Linearization of Nonlinear Systems Using Generalized Sampled-Data Hold Functions  
Y.-S. Hung, University of Michigan, P. T. Kabamba, University of Michigan |
| 2:30-3:00  | The Optimal Multiplier Method for Nonlinear Robustness Analysis  
J. T. Wen, Rensselaer Polytechnic Institute, X. Chen, Rice University |
| 3:00-3:30  | Approximate Noninteracting Control with Stability for Nonlinear Systems  
J. Huang, The John Hopkins University, W. J. Rugh, The Johns Hopkins University |
| 3:30-4:00  | On the Construction of Coprime Factorization of Nonlinear Feedback Control Systems  
G. Chen, Rice University, R. J. F. de Figueiredo, Rice University |
| 4:00-4:15  | Functional Series and the Control of Nonlinear Systems  
F. D. King, University of South Florida |
| 4:15-4:30  | Approximate Switched-Markov Filtering for Nonlinear Systems  
P. D. West, Georgia Tech Research Institute, A. H. Haddad, Northwestern University |
| 4:30-4:45  | The Riccati PDE's Associated with Invariant Distributions and Minimal Factorization of Systems  
A. Ben-Artzi, University of California at San Diego, B. Helton, University of California at San Diego |
| 4:45-5:00  | Nonparametric Models for Nonlinear Dynamic Systems: A Case Study  
A. A. Georgiev, Medical University of South Carolina |
| 5:00-5:15  | Nonlinear Controllers for Non-Integrable Systems: The Acrobat Example  
J. Hauser, University of Southern California, R. M. Murray, University of California at Berkeley |
Waveform Disturbance Minimization for Nonlinear Systems with Disturbance Models Having Unknown Parameters
T. W. Martin, University of Arkansas, E. Yaz, University of Arkansas

Neural Networks for Function Approximation in Nonlinear Control
D.J. Linse, Princeton University, R. F. Stengel, Princeton University

The Unbiased Variance Sum of N Independent Estimates revisited: A Gradient Matrix Formulation
Hugh McCabe, Dublin City University

CONTROL OF FLEXIBLE MANIPULATOR ARMS

Chairman: B. Paden, UC Santa Barbara
Co-Chairman: D. Tesar, University of Texas

Exponentially Stable Tracking Control for Multi-Joint Flexible-Link Manipulators
B. Paden, University of California at Santa Barbara, B. Riedle, University of California at Santa Barbara, E Bayo, University of California at Santa Barbara

Flexible Robotic Arm Control: Nonlinear Ultimate Boundedness and Linear Stabilization
P. J. Nathan, Motorola, Inc., S. N. Singh, University of Nevada, Las Vegas

A Theoretical and Experimental Investigation on the Control of a Single-Link Flexible Robotic Manipulator Fabricated from Composite Materials
S.B. Choi, Michigan State University, B.S. Thompson, Michigan State University, M.V. Gandi, Michigan State University

Tip-Position Control of a Flexible Beam: Modelling Approaches and Experimental Verification

Tip-Contact Force Control of One-Link Flexible Manipulator: An Inherent Performance Limitation
D. Li, MIT

Variable Structure Control of a Single-Link Flexible Arm Robot
T. Singh, University of Waterloo, M. F. Golnaraghi, University of Waterloo, R. N. Dubey, University of Waterloo
### WP8: Chardonnay

**ROBUSTNESS ISSUES IN ROBOT CONTROL**

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<tr>
<td>2:00-2:30 (I)</td>
<td>Survey of Robust Control of Robots</td>
<td>C. Abdallah, University of New Mexico, P. Dorato, University of New Mexico, M. Jamshidi, University of New Mexico</td>
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<tr>
<td>2:30-3:00 (I)</td>
<td>Robust Control for the Tracking of Robot Motion</td>
<td>D. M. Dawson, Georgia Institute of Technology, Z. Qu, Georgia Institute of Technology, F. L. Lewis, Georgia Institute of Technology, J. F. Dorsey, Georgia Institute of Technology</td>
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<td>3:00-3:30 (I)</td>
<td>Deterministic and Stochastic Robustness of the Computed Torque Scheme</td>
<td>E. Yaz, University of Arkansas, S. Fadali, University of Nevada-Reno, M. Zohdy, Oakland University</td>
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<td>3:30-3:45 (I)</td>
<td>A Positive-Real Design for Robotic Manipulators</td>
<td>C. Abdallah, The University of New Mexico, R. Jordan, The University of New Mexico</td>
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<tr>
<td>3:45-4:00 (I)</td>
<td>A Robust Controller Design Approach for Flexible Robot Manipulators</td>
<td>A. Iftar, University of Toronto</td>
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<tr>
<td>4:00-4:30 (I)</td>
<td>An Observer-Based Design for Robust Control of Robot Manipulators</td>
<td>W. Grossman, Polytechnic University, F. Khorrami, Polytechnic University, B. Friedland, Kearfott Corporation</td>
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<td>4:30-5:00 (I)</td>
<td>Stability Investigations into the Force Control of Robots with Nonlinearities</td>
<td>J. J. Gonzalez, Colorado State University, L. Chirinos, Colorado State University, G. R. Widmann, Colorado State University</td>
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WP9: Laguna

AIRCRAFT AND MISSILE CONTROL

Chairman: A. G. Mittal, Georgia Institute of Technology
Co-Chairman: M. Klepl, North American Aviation, Rockwell International

2:00 - 2:30
Nonlinear Adaptive Control of a Twin Lift Helicopter System
M. Mittal, Georgia Institute of Technology, J.V.R. Prasad, Georgia Institute of Technology, D.P. Schrage, Georgia Institute of Technology

2:30 - 3:00
Robustness of Eigenstructure Assignment Approach in Flight Control System Design

3:00 - 3:30
A Comparison of Six Tests Evaluating Missile Autopilot Robustness to Uncertain Aerodynamics
K. A. Wise, McDonnell Douglas MSC

3:30 - 4:00
Accommodation of Failures in the Flight Control System of the F-16 Aircraft using Adaptive Control
F. Ahmed-Zaid, University of Southern California, P. Ioannou, University of S. California, K. Gousman, Lockheed California Co., R. Rooney, Lockheed California Co.

4:00 - 4:15
Roll and Maneuver Load Alleviation Control Law Design for a Wind Tunnel model by LQG/LTR Methodology
M. Klepl, North American Aircraft R. I. 100

4:15 - 4:45
Performance Evaluation of a Doppler Radar System for Wind Shear Detection
C. S. Khalaf, Old Dominion University, J. L. Hibey, Old Dominion University, L. D. Staton, NASA Langley Research Center

4:45 - 5:15
A Proposed Computational Technique for Obtaining Hypersonic Air Data on a Sharp-Nosed Vehicle
J.B. Tarasidis, Georgia Tech. Research Institute, R. F. Hellbaum, Georgia Tech. Research Institute, H.D. Garner, NASA Langley Research Center
WP10: Cabernet

INTELLIGENT VEHICLE HIGHWAY SYSTEMS - II

Organizer: A. M. Karmel, Ford Motor Company, J. H. Rillings, General Motors Corporation, S. E. Shladover, PATH and J. K. Hedrick, University of California at Berkeley

Chairman: J. H. Rillings, General Motors Corporation

Co-Chairman: J. K. Hedrick, University of California at Berkeley

2:00 - 2:30 (I)

Description and Performance of NAVMATE, an In-Vehicle Route Guidance System

Hidekazu Oshizawa, Diesel Kiki Co., W. Clay Collier, Navigation Technologies

2:30 - 3:00 (I)

Vehicle Lateral Control for Highway Automation

Huei Peng, University of California, M. Tomizuka, University of California

3:00 - 3:30 (I)

Robust Control for Automatic Steering

Juergen Ackermann, University of California at Irvine, Wolfgang Sienel, University of California at Irvine

3:30 - 4:00 (I)

Stability Analysis of Automatic Lateral Motion Controlled Vehicle with Four Wheel Steering System


4:00 - 4:30 (I)

Computerized Defensive Driving Rules for Highway Maneuvers

T. Pilutti, The University of Michigan, V. Raschke, The University of Michigan, Y. Koren, The University of Michigan

4:30 - 5:00 (I)

Panel Discussion: Development of IVHS Technologies

A. M. Karmel, Ford Motor Company, J. K. Hedrick, University of California Berkeley, J. H. Rillings, General Motors Corporation, S. E. Shladover, PATH

WP11: Gamay

OPTIMAL CONTROL

Chairman: M. J. Grimble, University of Strathclyde

Co-Chairman: P. Sannuti, Rutgers University

2:00 - 2:30

A New Stable Compensator Design for Exact and Approximate Loop Transfer Recovery

B. M. Chen, Washington State University, A. Saberi, Washington State University, P. Sannuti, Rutgers University
On Control Systems Described by a Class of Linear Differential-Algebraic Equations: State Realization and Linear Quadratic Optimal Control
H. Krishnan, University of Michigan, N. H. McClamroch, University of Michigan

Covariance Controllers: A New Parameterization of the Class of All Stabilizing Controllers
K. Yasuda, Kobe University, R. E. Skelton, Purdue University

A Method for Constrained Dynamic Optimization Problems
J. Shi, University of Connecticut, P. B. Luh, University of Connecticut, S.-C. Chang, National Taiwan University, T.-S. Chang, University of California, Davis

Quadratic Optimization of Motion Coordination and Control
R. Johansson, Lund Institute of Technology

State-Space Approach to LQG Multivariable Predictive and Feedforward Optimal Control
M.J. Grimble, University of Strathclyde

An Analysis of Pole/Zero Cancellation in LTR-Based Feedback Design
H. H. Niemann, Technical University of Denmark, O. Jannerup, Technical University of Denmark

WP12: Reisling
CONTROLS / STRUCTURES INTERACTION RESEARCH

Organizer: Claude R. Keckler, NASA Langley Research Center
Chairman: Claude R. Keckler, NASA Langley Research Center
Co-Chairman: Robert Kosut, Integrated Systems, Inc.

Optimization of Linear Controlled Structures

Simultaneous Control and Structure Design for Large Space Structures
3:00 - 3:30 (I)
Development and Verification of Key Technologies for the Success of Agile Space Missions
V. A. Spector, TRW Space and Technology Group, R. A. Manning, TRW Space and Technology Group, M. L. Narigon, TRW Space and Technology Group, D. W. Wise, TRW Space and Technology Group, M. D. Roesler, TRW Space and Technology Group

3:30 - 4:00 (I)
Demonstration of the Controls/Structures Interaction Phenomenon Using the ASCIE Testbed
Jean-Noel Aubrun and R. Lorell, Lockheed Palo Alto Research Laboratory

4:00 - 4:30 (I)
Approximate Minimum Time Trajectories for 2-Link Flexible Manipulators
G. R. Eisler, Sandia National Laboratories, D. J. Segalman, Sandia National Laboratories, R. D. Robinett, Sandia National Laboratories

4:30 - 4:45
Model Order Effects on the Transmission Zeros of Flexible Space Structures
T. Williams, University of Cincinnati

4:45 - 5:15 (I)
The Cases Flight Experiment: An Overview
John R. Sesak, Lockheed Missle and Space Company, J. Mel Waldman, Lockheed Missiles and Space

WP13: ROBUST STABILITY
Chairman: M. K. Solak, Cleveland State University
Co-Chairman: W. E. Schmitendorf, University of California at Irvine

2:00 - 2:30
A Precondition for the Edge Theorem
A. C. Bartlett, University of Massachusetts

2:30 - 2:45
On the Stability of Polygons of Polynomials with an Application: An Alternative Proof of the Edge Theorem
L. R. Pujara, Wright State University, N. R. Shanbhag, Wright State University

2:45 - 3:00
On the State Feedback Stabilization of Norm Bounded Uncertain Systems
S. Yamamoto, Osaka University, H. Kimura, Osaka University

3:00 - 3:30
A Necessary and Sufficient Condition for the Stability of Nonnegative Interval Discrete Systems
B. Shafai, Northeastern University, K. Perev, Northeastern University, D. Cowley, Northeastern University, Y. Chehab, Northeastern University
Performance and Stability Robustness of LEB (Linear-Ellipsoidal-Bounded) Compensators  
C. D. Antonini, University of Pretoria

On $l_1$ Optimal Simultaneously Stabilizing Controller Design  
D. Sourlas, University of California at Los Angeles, V. Manoussiouthakis, University of California at Los Angeles

On the Strictly-Positive-Realness of Schur Interval Functions  
A. Katbab, University of Miami, E. I. Jury, University of Miami

A Structural Approach to Robust Stability of Polynomials  
M. K. Solak, Cleveland State University

Robust Characteristic Polynomial Assignment  
H. Rotstein, Planta Piloto de Ingenieria Quimica, R. S. Pena, Planta Piloto de Ingenieria Quimica, A. Desages, Planta Piloto de Ingenieria Quimica, J. A. Romagnoli, Planta Piloto de Ingenieria Quimica

A Non-Iterative Riccati Approach to Robust Control Design  
R.M. Dolphus, University of California Irvine, W. E. Schmitendorf, University of California at Irvine

Output Approximate Loop Transfer Recovery for Fixed Order Dynamic Compensators  
A. J. Calise, Georgia Institute of Technology, E.V. Byrns, Georgia Institute of Technology

On Reducing Compensator Bandwidth of LQG/LTR Control: An $H_{\infty}$ Optimization Approach  
K. C. Han, University of California, Davis, T. C. Hsia, University of California, Davis

Observer Feedback Compensator and Cascade PD Compensator Design Based on Loop Transfer Recovery  
C.-C. Tsui, CUNY Staten Island College

Eigenstructure/LTR Feedback Design for Non-Minimum Phase Plants  
P. S. Andersen, SimCorp A/S, H. H. Niemann, Technical University of Denmark
3:45 - 4:00 938
Design of Observer-Based Linear Robust Controllers
F. Jabbari, University of California Irvine, W. E. Schmitendorf, University of California Irvine

4:00 - 4:15 941
The Impact of the Choice of Gains on the Robustness of Control Systems and Observers
C. C. Blackwell, University of Texas at Arlington, I. H. Yu, University of Texas at Arlington

4:15 - 4:30 943
Robust Disturbance Rejection in L1 Optimal Control Systems
M. Khammash, Rice University, J. B. Pearson, Rice University

4:30 - 5:00 945
A Robust Approach to Multirate Controller Design Using Eigenstructure Assignment
Y. Patel, University of York, R. J. Patton, University of York

5:00 - 5:30 952
Optimal Eigenstructure Achievement with Robustness Guarantees
R. F. Wilson, USAF Armament Laboratory, J. R. Cloutier, USAF Armament Laboratory

5:30 - 5:45 958
A New Robustness Measure for Eigenvector Assignment
C. C. Tsui, CUNY Staten Island College

WP15: Burgundy
A BENCHMARK PROBLEM FOR ROBUST H2/H∞ CONTROL DESIGN

Organizers: Bong Wie and Dennis S. Bernstein,
Chairman: Dennis S. Bernstein, Harris Corporation
Co-Chairman: Bong Wie, Arizona State University

2:00 - 2:15 (I) 961
A Benchmark Problem for Robust Controller Design
Bong Wie, Arizona State University, Dennis S. Bernstein, Harris Corp.

2:15 - 2:30 (I) 963
Fixed Order Dynamic Compensation for the H2/H∞ Benchmark Problem
Edward V. Byrns, Georgia Institute of Technology, Anthony J. Calise, Georgia Institute of Technology

2:30 - 2:45 (I) 966
H∞ Robust Control Synthesis for an Undamped Non-collocated Spring-Mass System
R. Y. Chiang, University of Southern California, M. G. Safonov, University of Southern California

2:45 - 3:00 (I) 969
Mixed H2/H∞ Control Design for Systems with Structured Uncertainty
Appasaheb N. Madiwale, Mass. Institute of Technology
3:00 - 3:15 (I)  
Robust Control Design Using Nonlinear Constrained Optimization  
Uy-Loi Ly, University of Washington

3:15 - 3:30 (I)  
All Stabilizing Controllers for Robust Multiobjective Control of the Benchmark Problem  
Lee D. Peterson, Purdue University; Robert E. Skelton, Purdue University

3:30 - 3:45 (I)  
Robust Controller Synthesis Using the Left Shift Approach  
D. S. Bernstein and E. G. Collins, Jr., Harris Corporation

3:45 - 4:00 (I)  
Robust Control Design for a Benchmark Problem Using a Structured Covariance Approach  
John Doyle, California Institute of Technology

4:00 - 4:15 (I)  
Robust $H_{\infty}$ Control Design for an Uncertain Dynamical System  
Bong Wie, Arizona State University; K. W. Byun, Dynacs Engineering Co., Inc.

4:15 - 4:30 (I)  
Application of a Game Theoretic Controller to a Benchmark Problem  
I. Rhee, University of Texas at Austin; Jason Speyer, University of Texas at Austin

4:30 - 5:00 (I)  
Panel Discussion  
All Authors, D. Bernstein and B. Wie Moderators

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Evening Session WE: Chablis / Burgundy

THE MYSTIQUE OF INTELLIGENT CONTROL

Organizer: Rahmat Shoureshi, Purdue University  
Chairman: Rahmat Shoureshi, Purdue University  
Co-Chairman: Maribeth Roesler, TRW

7:00 - 7:15 (I)  
Where is the Intelligence in Intelligent Control?  
Karl J. Astrom, The University of Texas at Austin

7:15 - 7:30 (I)  
An Intelligent Control System for Rocket Engines: Need, Vision and Issues  
Carl F. Lorenzo, NASA Lewis Research Center; Walter C. Merrill, NASA Lewis Research Center

7:30 - 7:45 (I)  
Neural Networks for Control: An Overview  
Paul Werbos, National Science Foundation

7:45 - 8:00 (I)  
Neural Networks for Control Systems  
Bernard Widrow, Stanford University

8:00 - 8:15 (I)  
Learning and Decision-Making for Intelligent Control Systems  
Rahmat Shoureshi, Purdue University
8:15-8:30 (I)  
Practical Lessons in the Design and Implementation of Real-Time, Plan-Based Supervisory Process Controls  
Paul Houpt, General Electric Corporation R&D

8:30 - 8:45 (I)  
Neural Networks and Adaptation  
Kumpati S. Narendra, Yale University

8:45 - 9:00 (I)  
The Role of Models in Machine Intelligence  
Guillermo Rodriguez, California Institute of Technology

9:00 - 9:15 (I)  
Memory-Based Learning in Intelligent Control Systems  
Christopher G. Atkeson, Mass. Institute of Technology

9:15 - 9:30 (I)  
Intelligent Controller for a Two-Axis Camera Vision Platform  
Yilmaz E. Sahinkaya, Lockheed Palo Alto Research Lab

THURSDAY MORNING  
MAY 24, 1990

TA1: Chenin  
PERTURBATION ANALYSIS OF DISCRETE EVENT DYNAMIC SYSTEMS

Organizer: Michael C. Fu, University of Maryland  
Chairman: Michael C. Fu, University of Maryland  
Co-Chairman: Xi-Ren Cao, Digital Equipment Corporation

8:30 - 9:00 (I)  
Some Linear Algebraic Formulas of the Performance Sensitivities of Queueing Networks  
Xi-Ren Cao, Digital Equipment Corporation

9:00 - 9:30 (I)  
Derivative Calculation Through Matrix-Geometric Solution Method  
Wei-Bo Gong, University of Massachusetts, Jie Pan, University of Massachusetts, Christos Cassandras, University of Massachusetts

9:30 - 10:00 (I)  
Convergence of Recursive Optimization Algorithms Using IPA Derivative Estimates  
E. K. Chong, Princeton University, P. J. Ramadge, Princeton University

10:00 - 10:30 (I)  
Strong Consistency of Infinitesimal Perturbation Analysis for Networks with Correlated Service Times  
Yorai Wardi, Georgia Institute of Technology, Jian-Qiang Hu, Harvard University
Using Uniformization for Derivative Estimation in Simulation
Pirooz Vakili, Boston University

Sample Path Analysis of Level Crossings in Queues
Michael Zazanis, Northwestern University

Variance Properties of Second Derivative Perturbation Analysis Estimators for Single-Server Queues
Michael Fu, University of Maryland, Jian-Quang Hu, Harvard University

TA2: Colombard
CONTROL APPLICATIONS TO FUNCTIONAL ELECTRICAL STIMULATION

Organizer: Grazyna A. Pajunen, Florida Atlantic University
Chairman: Grazyna A. Pajunen, Florida Atlantic University
Co-Chairman: William K. Durfee, Massachusetts Institute of Technology

Challenges to Control Theory in the Restoration of Paralyzed Muscle Function via Electrical Stimulation
H. J. Chizeck, Case Western Reserve University

Progress in the EMG Control of Functional Electrical Stimulation in Paraplegics
Daniel Groupe, University of Illinois at Chicago

Linear and Nonlinear Approaches to Control of Single Joint Motion by Functional Electrical Stimulation

Modeling FES Actuation and Control of Multisegment Limb Movements
Gary T. Yamaguchi, Arizona State University, Felix E. Zajac, Stanford University

Control Issues for Postural Regulation at the Human Ankle
R. J. Jaeger, Illinois Institute of Technology

Selection of Stimulation Output Specifications based on Recruitment Characteristics of Implanted Electrodes
Donald McNeal, Rancho Rehabilitation Engineering Program, L. L. Baker, University of Southern California, W. Tu, Rancho Rehabilitation Engineering Program, M. A.M. Robben, Twente University