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) 988  
Memory-Based Learning in Intelligent Control Systems  
Christopher G. Atkeson, Mass. Institute of Technology

9:15 - 9:30 (I) 989  
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) 1011  
Some Linear Algebraic Formulas of the Performance Sensitivities of Queueing Networks  
Xi-Ren Cao, Digital Equipment Corporation

9:00 - 9:30 (I) 1017  
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) 1022  
Convergence of Recursive Optimization Algorithms Using IPA Derivative Estimates  
E. K. Chong, Princeton University, P. J. Ramadge, Princeton University

10:00 - 10:30 (I) 1028  
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

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
An Improved Nonlinear Model for On-Line Application of Functional Electrical Stimulation
Grazyna A. Pajunen, Florida Atlantic University, Warren Price, Florida Atlantic University, Ravi Shankar, Florida Atlantic University, Leon E. Smith, Florida Atlantic University

**TA3: Polomar**

**ADAPTIVE CONTROL SYSTEMS II**

**Chairman:** C. R. Johnson, Cornell University  
**Co-Chairman:** J. Walls, Auburn University

8:30 - 9:00

A New Approach for Solving Model Reference Adaptive Control Problems for Fast Time-Varying Unknown Plants with Relative Degree One  
L.-C. Fu, National Taiwan University, C.-J Chien, National Taiwan University

9:00 - 9:30

Nonlinear Interactions Between Signals and Parameters in Robust Adaptive Control  
G. J. Rey, Cornell University, C. R. Johnson, Cornell University, R.R. Bitmead, Australian National University

9:30 - 10:00

Reduced Order Adaptive Observation with Nonspecific Adaptive Law  
J. H. Lilly, University of Louisville

10:00 - 10:30

Adaptive Robust Control Scheme Applied to a Single-Zone HVAC System  
Y.H. Chen, Georgia Institute of Technology, K.M. Lee, Georgia Institute of Technology, W.J. Wepfer, Georgia Institute of Technology

10:30 - 10:45

Active Control of the Gamma-Ray Imaging Device (GRID) Experiment: A Linear Adaptive Approach  
J. Walls, Auburn University, M. Greene, Auburn University

10:45 - 11:00

Covariance Reset - A Solution to Filter Divergence in Estimation with a Sinusoidal Measurement  
X. Qin, Stanford University

11:00 - 11:15

The Application of a Class of Adaptive Control Algorithms to Hydraulic Servosystems  
S. Ananthakrishnan, McDonnell Douglas Astronautics Co., R. Fullmer, Iowa State University

11:15 - 11:30

An Implicit Quadratic $H_{\infty}$ Self-Tuning Controller  
R.A. Hashim, University of Strathclyde, M.J. Grimble, University of Strathclyde
11:30 - 11:45 1091
An Approach to Adaptive Control of Continuous-Time Systems Using Multiple Parallel Predictive Models
T. H. Lee, National University of Singapore, E. K. Koh, National University of Singapore

11:45 - 12:00 1093
Direct Determination of Controller Parameters in Adaptive Pole Placement
E. W. Kamen, University of Pittsburgh

12:00 - 12:15 1095
Adaptive Regulation of a Class of Nonminimum Phase Systems with Full Cauchy Index
R. Ortega, National University of Mexico

TA4: San Diego and San Fernando
MANUFACTURING PROCESSES CONTROL
Organizer: Yoram Koren, The University of Michigan
Chairman: Yoram Koren, University of Michigan
Co-Chairman: Jeffrey Stein, University of Michigan

8:30 - 9:00 (I) 1097
Robust Nonlinear Control of Positioning Systems with Stiction
Masayoshi Tomizuka, University of California, Berkeley, A. Jabbari, University of California, Berkeley, T. Sakaguchi, University of California, Berkeley

9:00 - 9:30 (I) 1103
Time Optimal Contour Tracking for Machine Tool Controllers
F. Imamura, Rensselaer Polytechnic Institute, Howard Kaufman, Rensselaer Polytechnic Institute

9:30 - 10:00 (I)
Modeling and Control of Gas-Metal Arc Welding
David E. Hardt, Mass. Institute of Technology, M. Hale, Mass. Institute of Technology

10:00 - 10:15 (I)
Performance Evaluation of a State and Input Observer for Machine Diagnostics
Y. Park, The New Jersey Institute of Technology, Jeffrey Stein, The University of Michigan

10:15 - 10:30 (I)
Identification of the Normal Force Response to Feed Input in a Turning Operation
R. Furness, The University of Michigan, A. Galip Ulsoy, The University of Michigan

10:30 - 11:00 (I)
Adaptive Pole Placement Force Control of End Milling
Francis M. Kolarits, The Torrington Company, Warren DeVries, Rensselaer Polytechnic Institute

11:00 - 11:30 (I)
Sliding Mode Controller for Force Constrained Cutting Process
Xiao-Nan Luo, University of Minnesota, Q. Zhang, Renault Automotive, Inc.
Chairman:  J. D. Powell, Stanford University
Co-Chairman:  P. Kabamba, University of Michigan

8:30 - 9:00  1127
A New Approach to the Discretization of Continuous-Time Controllers
J. P. Keller, Australian National University, B. D. O. Anderson, Australian National University

9:00 - 9:15  1133
Generalized Sampled State Hold Functions Applied to Feedback Control of Non Periodic Linear Systems
J. Whitesell, Michigan State University

9:15 - 9:45  1137
Sample Rate Effects on Disturbance Rejection for Digital Control Systems
H. Hirata, Stanford University, J. D. Powell, Stanford University

9:45 - 10:15  1145
Towards Less Conservative Stability Criterion for Discrete-Time Linear Uncertain Systems
K. Gu, Oakland University, W. J. Chai, Oakland University, N. K. Loh, Oakland University

10:15 - 10:45  1150
Analysis and Design of Repetitive Control Systems Using the Regeneration Spectrum
K. Srinivasan, Ohio State University, F. R. Shaw, Ohio State University

10:45 - 11:00  1156
A Frequency Domain Design Method of Sampled-Data Compensators
H. H. Niemann, Technical University of Denmark, O. Jannerup, Technical University of Denmark

11:00 - 11:15  1159
Robust Schur-Stability of Discrete-Time Interval Plants
A. Katbab, University of Miami, E. I. Jury, University of Miami

11:15 - 11:30  1162
On Computing the Induced Norm of Sampled Data Systems
P. Kabamba, The University of Michigan, S. Hara, Tokyo Institute of Technology

11:30 - 11:45  1162
On the Spurious Zeros of Discrete-Transfer Functions
K. Diekmann, Ruhr University of Bochum, K. H. Fasol, Ruhr University of Bochum, S. Jayasuriya, Texas A & M University, M. Rabins, Texas A & M University
Stabilization of Uncertain Discrete Systems by Observer Based Controllers
J.-C. Shen, National Cheng Kung University, B.-S. Chen, National Tsin Hua University, F. C. Kung, National Cheng Kung University

CONTROL OF NONLINEAR MECHANICAL SYSTEMS: THEORY AND APPLICATIONS

Organizer: J. Bentsman, University of Illinois at Urbana-Champaign
Chairman: J. Bentsman, University of Illinois
Co-Chairman: C. J. Radcliffe, Michigan State University

8:30 - 9:00 (I)
Output Tracking of Nonlinear Systems with Uncertainties
S. Behtash, University of California, Berkeley, S. M. Shahruz, University of California, Berkeley

9:00 - 9:30 (I)
Sliding Compensators for a Class of Nonlinear Systems
S. Raghavan, University of California, Berkeley, J. K. Hedrick, University of California, Berkeley

9:30 - 10:00 (I)
On the Stability and Estimation of Ultimate Boundedness of Nonlinear/Uncertain Dynamic Systems with Bounded Controllers
Mehrez Hached, Purdue University, S. Mehdi Madani-Esfahani, Purdue University, Stanislaw H. Zak, Purdue University

10:00 - 10:30 (I)
Stable Adaptive Teleoperation

10:30 - 11:00 (I)
Exact Linearization with Configuration Optimization
P. Hsu, University of Illinois

11:00 - 11:30 (I)
Properties of Stick-Slip Friction Models which Promote Limit Cycle Generation
Clark J. Radcliffe, Michigan State University, Steve C. Southward, Michigan State University

11:30 - 11:45 (I)
Parameter Estimation Using Nonlinear Observer Theory
S. A. Bortoff, University of Illinois, Mark W. Spong, University of Illinois

11:45 - 12:00 (I)
Control of Steam Generation Processes
J. Bentsman, University of Illinois, N. R. Miller, University of Illinois, D. Drake, University of Illinois, Jamel Fakhfakh, University of Illinois, Thomas Jolly, University of Illinois
TA7: Cuyamaca
MODELLING AND CONTROL OF FLEXIBLE MANIPULATOR ARMS

Chairman: J. H. Park, Massachusetts Institute of Technology
Co-Chairman: F. D. Chichester, New Jersey Institute of Technology

8:30 - 9:00
A Vertical-Plane Motion Control of an Electrohydraulically-Actuated Single-Flexible-Link Arm
L.-W. Chang, Naval Postgraduate School, K.S. Park, Naval Postgraduate School

9:00 - 9:30
Implementation of a Vertical-Plane Motion Control of an Electrohydraulically-Actuated Single-Flexible-Link Arm
L.-W. Chang, Naval Postgraduate School, M. Kirkland, Naval Postgraduate School

9:30 - 10:00
Design and Analysis of Flexible Arms for Minimum-Phase Endpoint Control
J.H. Park, M.I.T., H. Asada, M.I.T.

10:00 - 10:30
Extension of a Rigid Link Model of a Robot Arm to a Flexible Link Model
F. D. Chichester, New Jersey Institute of Technology, G. A. Downes, New Jersey Institute of Tech.

10:30 - 10:45
Dynamics Identification of a Flexible Robot Using Multichannel Nonlinear Systems
A. Krzyzak, Concordia University, J. Sasiadek, Carleton University

10:45 - 11:15
Distributed Modal Identification and Vibration Control of Continua: Theory and Applications
H. S. Tzou, University of Kentucky

11:15 - 11:45
Distributed Modal Identification and Vibration Control of Continua: Piezoelectric Finite Element Formulation and Analysis.
H. S. Tzou, University of Kentucky, C. I. Tseng, University of Kentucky

11:45 - 12:15
Optimal Decision Control for Robot with Series Compliance and Bounded Inputs

TA8: Chardonnay
MODELLING AND DESIGN OF MECHANICAL SYSTEMS AND ROBOTS

Chairman: N. G. Chalhoub, Wayne State University
Co-Chairman: M. Lynch, Tulane University
On the Modeling and Simulation of Friction

Dynamic Model and Response of Robot Manipulators with Joint Irregularities
R.J. Chang, National Cheng Kung University, T.C. Jiang, National Cheng Kung University

Effect of a Self-Locking Drive Mechanism on the Performance of a Flexible Robot Arm
N.G. Chalhoub, Wayne State University, A.G. Ulsoy, University of Michigan

Velocity Control of a Manipulator Joint Driven Through a Worm Gear Transmission
S. Jayasuriya, Texas A&M University, D.C. May, Texas A&M University, B.W. Mooring, IBM

Selection of Optimal Axis Configurations in a Robot Path
A. Gunta, Carnegie-Mellon University, M. Lynch, Tulane University

Structure of the Minimum-Time Control Law for Multiple Robot Arms Handling a Common Object
Y. Chen, The George Washington University

Mechanically Induced Path Deviations in an Industrial Parallelogram Robot
P. De Smet, Wayne State University, E.I. Rivin, Wayne State University, Y. Lou, Wayne State University

A Space Station/Payload Pointing System Simulation Using TREETOPS
M. Ram, Fairchild Space Company, M. Shamma, Fairchild Space Company

Optimizing Scanning Mirror System Performance Using Solid State Piezoelectric Actuators
M. G. Harris, University of Central Florida, R. J. Martin, Actran Systems, Inc., T. J. Tomasetti, Martin Marietta Corporation

Precision Instrument Pointing Control for the Earth Observing System
L. Robeck, CalTech Jet Propulsion Laboratory, D. Rathbun, CalTech Jet Propulsion Laboratory, D. Lehman, CalTech Jet Propulsion Laboratory
Satellite Stabilization Using Space Leeches
M. W. Walker, University of Michigan, D.-M. Kim, University of Michigan

9:45 - 10:15
A Computational Algorithm for Spacecraft Control and Momentum Management
J. Dzielski, Pennsylvania State University, E. Bergmann, Charles Stark Draper Laboratory, Inc., J. Paradiso, Charles Stark Draper Laboratory, Inc.

Robust Stabilization of Linear Systems in the Presence of Unbounded Uncertain Parameters with Applications to Yaw Stabilization of a Satellite
S. K. Biswas, Temple University

10:45 - 11:15
Total Energy Control System Autopilot Design with Constrained Parameter Optimization
C.T. Voth, University of Washington, Uy-Loi Ly, University of Washington

Modeling and Stability of Segmented Reflector Telescopes: A Decentralized Approach
H. A. Ryaciotaki-Boussalis, California State University, C.-H. C. Ih, Jet Propulsion Laboratory

TA10: Cabernet
ADVANCED CONTROL OF ACTIVE SUSPENSION SYSTEMS

Organizer: D. Dan Cho, Princeton University
Chairman: Robert H. Fries, Failure Analysis Associates
Co-Chairman: A. Matthew Karmel, Ford Motor Company

8:30 - 9:00 (I)
Application of Model References Adaptive Control to Active Suspension Systems
Myoungho Sunwoo, GM Research Laboratories, K. C. Cheok, Oakland University, N. J. Huang, Oakland University

9:00 - 9:30 (I)
Stability Robustness of LQG Active Suspensions
A. Galip Ulsoy, University of Michigan, Davor Hrovat, Ford Motor Company

9:30 - 10:00 (I)
Low-Bandwidth Semi-Active Damping for Suspension Control
Robin Redfield, Texas A & M University

10:00 - 10:30 (I)
Analysis of Control Issues for a Flexible One-Half Car Suspension Model
William N. Patten, University of Oklahoma, Rao M. Chalasani, General Motors Corporation, David S. Allsup, University of Oklahoma, John B. Blanks, University of Oklahoma
**TA11: Gamay**

**ESTIMATION APPLICATIONS**

Chairman: Moshe Kam, Drexel University  
Co-Chairman: Robert Fischl, Drexel University

<table>
<thead>
<tr>
<th>Time</th>
<th>Title</th>
<th>Authors/Institutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30-8:45</td>
<td>Predicting the Position of an Agile Target</td>
<td>D. Sworder, University of California at San Diego, R.G. Hutchins, Orincon Corp.</td>
</tr>
<tr>
<td>8:45-9:15</td>
<td>On Optimal Filtering and Detection of Echoes in Laser-Based Aerial Bathymetric Surveying</td>
<td>T. Jurand, Drexel University, M. Kam, Drexel University, R. Fischl, Drexel University</td>
</tr>
<tr>
<td>9:45-10:15</td>
<td>Estimation of Physical Parameters for Dynamic Processes with Application to an Industrial Robot</td>
<td>R. Isermann, Technical University of Darmstadt</td>
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<td>11:15-11:30</td>
<td>Titration Curve Estimation for Adaptive pH Control</td>
<td>M. Gulaian, Bailey Controls Company, J. D. Lane, Bailey Controls Company</td>
</tr>
<tr>
<td>11:30-11:45</td>
<td>Optimal Control of a Shallow Running Torpedo</td>
<td>M. J. Seidl, Royal Naval Engineering College, B. A. Stacey, Royal Naval Engineering College</td>
</tr>
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CONTROL / STRUCTURE INTERACTION GUEST INVESTIGATOR PROGRAM

Organizer: Jerry Elliott, NASA Langley Research Center
Chairman: Rudeen Smith-Taylor, NASA Langley Research Center
Co-Chairman: Jerry R. Newsom, NASA Langley Research Center

8:30 - 9:00 (I) 1422
Failure Detection and Isolation Experiments with the Langley Mini-Mast

9:00 - 9:30 (I) 1428
Active Structural Control Design and Experiment for the Mini-Mast
Bong Wie, Arizona State University, Lucas Horta, NASA Langley Research Center, Jeff Sulla, NASA Langley Research Center

9:30 - 10:00 (I) 1435
Closed Loop Lab Tests of NASA's Mini-Mast
C. Hsieh, Purdue University, J. Kim, Purdue University, Robert E. Skelton, Purdue University

10:00 - 10:15 (I) 1441
Practical Experience with Identification of Large Flexible Structures
Randall J. Allemang, University of Cincinnati, S. Shelley, University of Cincinnati, D. L. Brown, University of Cincinnati, Q. Zhang, University of Cincinnati

10:15 - 10:30 (I) 1445
Practical Experience with Multivariable Positivity Controllers
Gary Slater, University of Cincinnati, A. Bosse, University of Cincinnati, Q. Zhang, University of Cincinnati

10:30 - 11:00 (I) 1449
Design and Implementation of Robust Decentralized Control Laws for the ACES Structure at Marshall Space Flight Center
Emmanuel G. Collins, Harris Aerospace Systems Division, Douglas J. Phillips, Harris Aerospace Systems Division, David C. Hyland, Harris Aerospace Systems Division

11:00 - 11:30 (I) 1451
Experience with Robust Control Design for Flexible Structures Using the ACES Experimental Facility
John C. Doyle, California Institute of Technology

INTELLIGENT AND FUZZY CONTROL

Chairman: K. G. Shin, University of Michigan
Co-Chairman: A. V. Sebald, University of California
An Improved Qualitative Controller
B. Abdulmajid, University of Manchester, UK, R. J. Wynne, University of Manchester, UK

Design of a Knowledge-Based Controller for Intelligent Control Systems
K. G. Shin, University of Michigan, X. Cui, University of Michigan

An Intelligent Rule-Based Compensator for Control System Input Nonlinearities
M. Marcos, Universidad del Pais Vasco, Spain, P. E. Wellstead, Control Systems Center UMIST, U.K.

Fuzzy Control of a Three Fin Torpedo

Nonlinear Fuzzy Control Based on the Vector Fields of the Phase Portrait Assignment Algorithm
H. Kang, Georgia Institute of Technology, G. Vachtsevanos, Georgia Institute of Technology

An Optimization Approach for Fuzzy Controller Design
S. Isaka, University of California at San Diego, A. V. Sebald, University of California at San Diego

Fuzzy Logic Controller to a Steam Generator Feedwater Flow
G. V. S. Raju, Ohio University, J. Zhou, Ohio University, R. Kisner, Oak Ridge National Lab.

TA14: Sauvignon

TIME-DELAYED AND PERIODIC CONTROL SYSTEMS

Chairman: D. Jordan, University of Connecticut
Co-Chairman: D. S. Flamm, Princeton University

Observer Design for Non-Lexicographic-Fixed Time-Varying Continuous Systems
W. Chai, Oakland University, N.K. Loh, Oakland University, H. Hu, Oakland University

On Extreme Point Results for Time Delay Systems
J. Ackermann, German Aerospace Research organization, DLR, H. Hu, German Aerospace Research organization, DLR, C. V. Hollot, University of Massachusetts, R. Tempo, CENS/-CNR Politecnico Di Torino

Multirate Systems Performance Evaluation Using Singular Value Analysis
I. S. Apostolakis, University of Connecticut, D. Jordan
A New Shift-Invariant Representation for Periodic Linear Systems
D. S. Flamm, Princeton University

Feedforward Tracking Controller for Systems Containing Time Delays in Both State and Control Variables
D. H. Chyung, University of Iowa

Generalized Nyquist Stability Criterion for Linear Time Periodic Systems
S. R. Hall, Massachusetts Institute of Technology, N. M. Wereley, Massachusetts Institute of Technology

Torque Ripple Reduction in Three-Phase Switched Reluctance Motors
R. S. Wallace, Georgia Institute of Technology, D. G. Taylor, Georgia Institute of Technology

LUNCHEON: Cuyamaca/Laguna

Flight Testing and Flight Research: From the Wright Brothers to the Space Shuttle
Richard P. Hallion, Air Force Systems Command

THURSDAY AFTERNOON
MAY 24, 1990

TP1: Chenin

PROCESS IDENTIFICATION: NEW DEVELOPMENT AND APPLICATIONS

Identification of Distillation Process Dynamics Comparing Process Knowledge Based and Black Box Based Approaches
K. H. Rasmussen, Technical University of Denmark, C. S. Nielsen, Technical University of Denmark, Sten Bay Jorgensen, Technical University of Denmark

Experimental Design of Fermentations for Model Identification
Volker C. Hass, Institut fur Biosystemtechnik, Axel Munack, Institut fur Biosystemtechnik

Process Identification using Nonlinear Programming Techniques
Phani B. Sistu, Rensselaer Polytechnic Institute, B. Wayne Bequette, Rensselaer Polytechnic Institute
TP2: Colombard

DISTRIBUTED PARAMETER SYSTEMS

Chairman: S. E. Burke, C.S. Draper Laboratory
Co-Chairman: C. D. Mote, University of California at Berkeley

2:30 - 3:00 1552
Shape Control of Distributed Parameter Systems: Modelling and Performance Analysis
S. E. Burke, 555 Technology Square, J. E. Hubbard, Jr., C. S. Draper Laboratory, Inc.

3:00 - 3:30 1558
Frequency Domain Vibration Control of Distributed Gyroscopic Systems
B. Yang, University of Southern California, C. D. Mote, Jr., University of California at Berkeley

3:30 - 4:00 1564
Controllability and Observability of Distributed Gyroscopic Systems
B. Yang, University of Southern California, C. D. Mote, Jr., University of California at Berkeley

4:00 - 4:30 1570
Robust Stabilization in the Gap Metric: Controller Design for Distributed Plants
T. T. Georgiou, University of Minnesota, M. C. Smith, The Ohio State University

4:30 - 5:00 1576
An Averaging Approach to Optimal Adaptive Control of Large Space Structures
D. S. Bayard, California Institute of Technology

5:00 - 5:30 1583
Controller Design for Unstable Distributed Plants
H. Ozbay, University of Rhode Island, M. C. Smith, Ohio State University, A. Tannenbaum, University of Minnesota

5:30 - 6:00 1589
Distributed Parameter Control Systems Synthesis: An Iterative Approach
N. E. Wu, State University of New York at Binghampton
Energy Equivalent Expansion
N. Patel, GE Astro Space, A. Yousuff, Drexel University

TP3: Polomar
ADAPTIVE PROCESS CONTROL
Organizer: Christos Georgakis, Lehigh University
Chairman: Won-Kyoo Lee, Ohio State University
Co-Chairman: Paul H. Guscia, Chevron Corporation

2:30 - 3:00 (I) 1599
Practical Experiences of Adaptive Techniques
Karl J. Astrom, Lund Institute of Technology, T. Hagglund, Lund Institute of Technology

1599
3:00 - 3:30 (I) 1607
Nonminimal Model Based Long Range Predictive Control
W. Lu, University of Alberta, D. Grant Fisher, University of Alberta

1607
3:30 - 4:00 (I) 1614
An Adaptive Nonlinear Predictive Controller
J. D. Morningred, University of California, Santa Barbara, B. G. Paden, University of California, Santa Barbara, D. E. Seborg, University of California, Santa Barbara, D. A. Mellichamp, University of California, Santa Barbara

1614
4:00 - 4:30 (I) 1620
Multivariable Constrained Generalized Predictive Control: A Comparison with QDMC
D. J. Wilkinson, University of Newcastle-Upon-Tyne, A. J. Morris, University of Newcastle-Upon-Tyne, M. T. Tham, University of Newcastle-Upon-Tyne

1620
4:30 - 5:00 (I) 1626
On the Use of Linear Programming to Solve Adaptive Predictive Control Problems
C. K. Finn, University of Massachusetts, B. Erik Ydstie, University of Massachusetts

1626
5:00 - 5:30 1632
Supervision and Coordination of Parameter-Adaptive Controllers
T. Knapp, Technical University of Darmstadt, R. Isermann, Technical University of Darmstadt

1632

TP4: San Diego and San Fernando
BATCH PROCESS CONTROL
Organizer: C. G. Georgakis, Lehigh University
Chairman: L. T. Biegler, Carnegie Mellon University
Co-Chairman: E. Zafiriou, University of Maryland

2:30 - 3:00 (I) *
Application of Observer Using Differential Information to Bench-Scale Reactor
H. A. Preisig, University of New South Wales, D. W. T. Rippin, Swiss Federal Institute of Technology

* 1638
3:00 - 3:30 (I) 1638
On the Analytical Computation of Optimal Trajectories for Batch Reactors
J. C. Kantor, Notre Dame University
Optimal Control of Semi-Batch Processes in the Presence of Modeling Error
Evanghelos Zafiriou, University of Maryland, J. M. Zhu, University of Maryland

Modeling, Estimation and Control of Polymer Composite Processing
Kathryn A. Soucy, University of Washington, Bradley R. Holt, University of Washington

Simultaneous Model Identification and Control of a Semi-Batch Chemical Reactor
E. S. Meadows, University of Texas, J. B. Rawlings, University of Texas

Dynamic Modeling of Batch and Semi-Continuous Processes Using BATCHES

Supervisory Control of Batch Plants
S. Macchiello, Imperial College of Science & Tech., B. J. Cott, Imperial College of Science & Tech.

TP5: San Antonio and Santa Barbara
ADVANCED EIGENSTRUCTURE DESIGN METHODS

Organizer: R. J. Patton, University of York
Chairman: R. J. Patton, University of York
Co-Chairman: S. K. Spurgeon, Loughborough University of Technology

Pole Placement Extensions for Multivariable Systems - A Survey
S. K. Spurgeon, Loughborough University of Technology

A Numerical Approach to Pole Assignment by Output Feedback
J. F. Magni, CERT/DERA, France

The Use of Deflation in Eigenstructure Assignment of Descriptor Systems
G. S. Miminis, Mémorial University of Newfoundland

Robust Eigenstructure Assignment Under Restricted Perturbations
J. Kautsky, Flinders University of S. Australia, N. K. Nichols, University of Reading

Optimal Eigenstructure Assignment for Multiple Design Objectives
S. Burrows, University of York, R. J. Patton, University of York
TP6: San Carlos
THE ROLE AND LIMITATIONS OF LINEAR MODELS IN NONLINEAR CONTROL PROBLEMS

Organizer: Michael K. Sain, University of Notre Dame
Chairman: Michael K. Sain, University of Notre Dame
Co-Chairman: Panos J. Antsaklis, University of Notre Dame

2:30-3:00 (I) Analytical Framework for Gain Scheduling
Wilson J. Rugh, The Johns Hopkins University

3:00-3:30 (I) Application of Brunowsky Forms in Multi-Mode Flight Control
George Meyer, NASA Ames Research Center

3:30-4:00 (I) On Coordinated Feedforward Excitation of Nonlinear Servomechanisms
Patrick M. Sain, University of Notre Dame, Michael K. Sain, University of Notre Dame, A. N. Michel, University of Notre Dame

4:00-4:30 (I) On Control Systems Described by a Class of Nonlinear Differential-Algebraic Equations: State Realizations and Local Control
N. Harris McClamroch, The University of Michigan

4:30-5:00 (I) Local Regulation of Nonlinear Dynamics
Harry G. Kwatny, Drexel University, William H. Bennett, Techno-Sciences, Inc., Jordan Berg, Drexel University

5:00-5:30 (I) Adaptive Control Design for a Class of Nonlinear Systems
I. Kanellakopoulos, University of Illinois Urbana-Champaign, P. V. Kokotovic, University of Illinois Urbana-Champaign, R. Marino, II University Di Roma

5:30-6:00 Predictive Control of Nonlinear Systems Based on Extended Linearization
H. Sun, Shanghai Jiao-tong University, Y.-G. Xi, Shanghai Jiao-tong University, S.-J. Shi, Shanghai Jiao-tong University, Z.-J. Zhang, Shanghai Jiao-tong University
EXPERIMENTS IN THE CONTROL OF FLEXIBLE MANIPULATORS

Organizer: Glenn Widmann, Colorado State University
Chairman: Glenn Widmann, Colorado State University
Co-Chairman: Eric Schmitz, Martin Marietta Astronautics

2:30 - 3:00 (I) 1723
Robust Controller Application to Flexible Manipulators
E. M. Nebot, PLAPIQUI, Argentina, A. Desagues, PLAPIQUI, Argentina, J. Romagnoli, PLAPIQUI, Argentina, Glenn R. Widmann, Colorado State University

3:00 - 3:15 (I) 1729
LQR Design for an Experimental Planar Elastic Arm with a Large Tip Payload
M. F. Ramey, Martin Marietta Astronautics Group, Eric Schmitz, Martin Marietta Astronautics Group

3:15 - 3:45 (I) 1733
A Single-Axis Testbed for Slewing Control Experiments
Jonathan Hamilton, North Carolina State University, Gordon K.F. Lee, North Carolina State University, Jer-nan Juang, NASA Langley Research Center

3:45 - 4:15 (I) 1738
Experimental Verification of Command Shaping Methods for Controlling Residual Vibration in Flexible Robots
Neil C. Singer, Convolve, Inc., Warren P. Seering, MIT

4:15 - 4:45 (I) 1745
Formulation of an Improved Set of Weighting Functions for H∞ Control of Flexible Beam-like Systems
R. Michael Stoughton, Martin Marietta Space Systems Co.

4:45 - 5:15 (I) 1752
End-Point Controller Design for an Experimental Two-Link Flexible Manipulator Using Convex Optimization Techniques
C. M. Oakley, Stanford University, C. H. Barratt, Stanford University

5:15 - 5:45 (I)
Design of Force/Torque Control for Flexible, Microgravity Manipulators in Laboratory Environment
C. J. Hwang, Lockheed Engineering and Sciences Company, T. K. Nguyen, Lockheed Engineering and Sciences Company

5:45 - 6:15 (I) 1760
Reduced-Order Model Based Control of Large Flexible Manipulators: Theory and Experiments
Brian T. Reisenauer, University of Colorado-Boulder, Mark J. Balas, University of Colorado-Boulder, M. Ramey, Martin Marietta Astronautics Group
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<tr>
<td>2:45-3:15</td>
<td>1768</td>
<td>Solutions to Point-to-Point Control Problems Using Laplace Transform Technique</td>
<td>S. P. Bhat, University of California at Los Angeles, D. K. Miu, University of California at Los Angeles</td>
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<td>3:15-3:45</td>
<td>1774</td>
<td>An Asymptotic Observer for Solving the Inverse Kinematic Problem</td>
<td>A. Tornambe, Fondazione Ugo Bordoni</td>
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<tr>
<td>3:45-4:15</td>
<td>1780</td>
<td>Geometric Approach Inverse Kinematics of the RTX Robot: Geometric Approach and the Solution of Non-Uniqueness</td>
<td>Y. Song, University of Ghent, R. M. C. De Keyser, University of Ghent</td>
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<td>5:15-5:45</td>
<td>1798</td>
<td>Efficient Plan Formulation and Organization for Robotic Assemblies and Intelligent Robotic Systems</td>
<td>K. P. Valavanis, Northeastern University, S. J. Carelo, Northeastern University</td>
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<td>5:45-6:15</td>
<td>1804</td>
<td>Force Control for Robotic Rigid Disk Grinding</td>
<td>B. J. Ulrich, McMaster University, L. Liu, McMaster University, M. A. Elbestawi, McMaster University, A.K. Srivastava, McMaster University</td>
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### TP9: Laguna

**AEROSPACE VEHICLE GUIDANCE AND TRAJECTORY OPTIMIZATION - II**

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<td>2:30 - 3:00</td>
<td>(I) Stochastic Trajectory Shaping Guidance for Aerospace Plane Ascent</td>
<td>Daniel D. Moerder, NASA Langley Research Center, E. M. Queen, NASA Langley Research Center, K. E. Dutton, NASA Langley Research Center</td>
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<tr>
<td>3:00 - 3:30</td>
<td>(I) Robust Perturbation Guidance Applied to the Advanced Launch System</td>
<td>Jason L. Speyer, The University of Texas, D. Chichka, The University of Texas</td>
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<tr>
<td>3:30 - 4:00</td>
<td>(I) Hypersonic Vehicle Air Data Collection: Assessing the Relationship Between the Sensor and Guidance and Control System Requirements</td>
<td>Philip D. Hattis, The Charles Stark Draper Lab., Inc.</td>
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<tr>
<td>4:00 - 4:30</td>
<td>(I) A Singular Perturbation Approach to Pitch-Loop Design</td>
<td>Eugene M. Cliff, Virginia Polytechnic Institute and State University</td>
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<td>4:30 - 5:00</td>
<td>(I) An Approach to Optimal Guidance of an Advanced Launch Vehicle Concept</td>
<td>Martin S. Leung, Georgia Institute of Technology, Anthony J. Calise, Georgia Institute of Technology</td>
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<tr>
<td>5:00 - 5:30</td>
<td>(I) Aerospace Plane Guidance Using Geometric Control Theory</td>
<td>Mark A. Van Buren, Princeton University, Kenneth D. Mease, Princeton University</td>
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<tr>
<td>5:30 - 6:00</td>
<td>(I) A Neural Net Approach to Space Vehicle Guidance</td>
<td>Alper K. Caglayan, Charles River Analytics, Inc., S. M. Allen, Charles River Analytics, Inc.</td>
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### TP10: Cabernet

**ADVANCED CONTROL TECHNIQUES FOR AUTOMOTIVE SYSTEMS**

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<td>5:00 - 6:00</td>
<td>(I) A Neural Net Approach to Space Vehicle Guidance</td>
<td>Alper K. Caglayan, Charles River Analytics, Inc., S. M. Allen, Charles River Analytics, Inc.</td>
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Application of Self-tuning to Automotive Cruise Control

Adaptive Control of Automotive Transmissions
K. Glitzenstein, University of California, J. Karl Hedrick, University of California

Emerging Trends in Tire Slip Regulation Systems
Prakash Shrivastava, GM Technical Center, Rao Chalasani, GM Technical Center

An Adaptive Sliding Mode Vehicle Traction Controller Design
Han-Shue Tan, Hughes Aircraft Company, Masayoshi Tomizuka, University of California, Berkeley

Investigation of a Combined Slip Control Braking and Closed Loop Four Wheel Steering System for Automobiles During Combined Gard Braking and Severe Steering Maneuvers
S. Taheri, Clemson University, E. Harry Law, Clemson University

Vehicle Lateral Velocity and Yaw Control With Two Independent Control Inputs
Naoki Matsumoto, Nippondenso Co., Masayoshi Tomizuka, University of California

Continuous Identification of a Four Stroke SI Engine
H Melgaard, Technical University of Denmark, E. Hendricks, Technical University of Denmark, E. Madsen, Technical University of Denmark

Mean Value SI Engine Model for Control Studies
E. Hendricks, Technical University of Denmark, S. C. Sorenson, Technical University of Denmark

TP11: Gamay
IDENTIFICATION

Chairman: S. Hall, Massachusetts Institute of Technology
Co-Chairman: A. J. Helmicki, Georgia Institute of Technology

Parametric System Identification on Logarithmic Frequency Response Data
M. D. Sidman, Digital Equipment Corporation, F. E. DeAngelis, Martin Marietta, G. C. Verghese, MIT
Identification in $H_{\infty}$: The Continuous-Time Case
A. J. Helmicki, Georgia Institute of Tech., C. A. Jacobson, Northeastern University, C. N. Nett, Georgia Institute of Technology

Adaptive Frequency Response Identification Using the Lagrange Filter
Y. Tang, National University of Mexico, F. J. Capistran, National University of Mexico

Corrector Least Squares (CLS) Identification Algorithm for Adaptive Control
I. Sadighi, Montana State University, D. A. Pierre, Montana State University

Parameter Identification of a Class of Nonlinear System via Piecewise Multiple Legendre Polynomials
Y. Z. Hu, East China University of Chemical Technology, Z. G. Ge, East China University of Chemical Technology

An Identification-Based Matched Filtering Method for Fault Detection
M. Barkess, Oakland University, N. Kheir, Oakland University

Model Quality in Recursive Identification of Time-Varying Systems with ARX Structure
S. Gunnarsson, Linkoping University

Discrete Bilinear System Identification and Control
R. R. Mohler, Oregon State University, X. Yang, Oregon State University, Z. Tang, Oregon State University

State-Disturbance Composite Observer for Bilinear Systems
Y. Q. Ying, University of Alberta, M. Rao, University of Alberta, S. Sun, Zhejiang University

TP12: Reisling

ADVANCES IN FLEXIBLE SPACECRAFT CONTROL

Organizer: Suresh M. Joshi, NASA Langley Research Center
Chairman: D. K. Lindner, Virginia Polytechnic University
Co-Chairman: Y. P. Kakad, University of North Carolina

Collocated Versus Non-Collocated Multivariable Control of Flexible Structures
G. J. Balas, University of Minnesota, J. C. Doyle, California Institute of Technology
3:00 - 3:30  
P. C. Hyland, Harris Corporation, Dennis S. Bernstein, Harris Corporation

Power Flow, Energy Balance, and Statistical Energy Analysis for Large-Scale Interconnected Systems

3:30 - 4:00  
K. Liu, Purdue University, R. E. Skelton, Purdue University

Optimal Controllers for Finite Wordlength Implementation

4:00 - 4:30  
P. G. Maghami, NASA Langley Research Center, S. M. Joshi, NASA Langley Research Center

Sensor/Actuator Placement for Flexible Space Structures

4:30 - 5:00  
Y. P. Kakad, University of North Carolina at Charlotte

Slew Maneuvers of Large Flexible Spacecraft

5:00 - 5:30  
Suresh M. Joshi, NASA Langley Research Center, Peiman G. Maghami, NASA Langley Research Center

Dissipative Compensators for Flexible Spacecraft Control

5:30 - 6:00  
E. Garcia, State University of New York at Buffalo, D. J. Inman, State University of New York at Buffalo

Modeling of Actuator-Structure Interaction in the Slewing of Flexible Structures

TP13: Rose

EXPERT SYSTEM APPLICATIONS IN THE PROCESS INDUSTRIES

Organizer: M. N. Karim, Colorado State University
Chairman: R. L. Leah, Gensym Corporation
Co-Chairman: N. Marsolan, International Paper

2:30 - 3:00  
Jonathan Iitt, Lewis Research Center

An Expert System to Perform On-Line Controller Tuning

3:00 - 3:30  
Douglas Myers, Ohio State University, James Davis, Ohio State University, Charles Hurley, Westvaco

A Knowledge Based Approach to Malfunction Diagnosis of Discrete Operations Involving Programmable Logic Controllers

3:30 - 4:00  
Richard Manzini, Alcoa Technical Center, Edwin Roehl, Alcoa Technical Center

Flexible Control of an Organic Matrix Composite Cure Process Using Object Oriented Control Concepts

4:00 - 4:30  
Karl-Erik Arzen, Lund Institute of Technology

Knowledge-Based Control Systems
A Real Time Knowledge Based System for the Operation and Control of a Fermentation Plant
M. Aynsley, University of New Castle Upon Tyne, A. G. Hofland, University of New Castle Upon Tyne, G. A. Montague, University of New Castle Upon Tyne, D. Peel, University of New Castle Upon Tyne, A. J. Morris, University of New Castle Upon Tyne

Fielded Applications of the LINKman Expert Control System
J. C. Taunton, Sira Ltd., T. A. Potts, Sira Inc., D. W. Haspel, Image Automation Ltd.

Expert Systems in the Power Industry - A Future Vision
Tuula Ruokonen, Imatran Voima Power Company

Representations of Robustly Stabilizing Controllers for Systems with Parameter Uncertainty
T. E. Djaferis, University of Massachusetts, J. Ciolfi, University of Massachusetts

Robust Control of Feedback Systems with Combined Plant and Controller Uncertainty
T. T. Georgiou, University of Minnesota, M. C. Smith, Ohio State University

Robust Modal Control of Distributed-Parameter Systems with Uncertainty
Y. H. Chen, Georgia Institute of Technology, E. D. Fiontek, Syracuse University

Uncertainty Estimator
M.-S. Chen, National Taiwan University

Developments in the Design of Multivariable Controllers for the Structural Testing of Systems with Unknown Dynamics
S. Tsavdaras, Loughborough University of Technology, R. W. Pratt, Loughborough University of Technology

An Indicator of Interaction for Systems Under Uncertainty
H. A. Latchman, University of Florida, J. A. Letra, University of Florida

Nyquist, Bode and Nichols Plots of Uncertain Systems
A. C. Bartlett, University of Massachusetts