# Table of Contents

Foreword ......................................................................................................................... iii
Organizing Committee ........................................................................................................ v
Author Index ...................................................................................................................... li

## Volume 1 (pages 1-912)

### MANUFACTURING APPLICATIONS I

A Generalized Development Environment for Inspection of Web Materials .................. 1  
_D. P. Brzaković, P. R. Bakić, N. S. Vujović and H. Sari-Sarraf_

An Eye-Hand System for Automated Paper Recycling ....................................................... 9  
_S. Faibish, H. Bacakoglu and A. A. Goldenberg_

A Robotic Gripper System for Limp Material Manipulation: Hardware and Software Development and Integration ................................................................. 15  
_Kimon P. Valavanis, Timothy M. Hebert and Ramesh Kolluru_

An Adaptive Control Strategy for Robotic Cutting .......................................................... 22  
_Ganwen Zeng and Ahmad Hemami_

### CONSTRUCTION

An Industrial Walking Machine for Naval Construction .................................................. 28  
_P. Gonzalez-de-Santos, M. A. Armada and M. A. Jimenez_

Passive Dynamic Quadrupedal Walking ........................................................................ 34  
_Matthew D. Berkemeier and Adam C. Smith_

Assistance System for Crane Operation Using Multimodal Display ............................... 40  
_Fumihito Arai, Mitsunori Yoneda, Toshio Fukuda, Keisuke Miyata and Toru Naito_

Robot Assembly System for the Construction Process Automation ............................ 46  
_E. Gambao, C. Balaguer, A. Barrientos, R. Saltarén and E. A. Puente_

### HAZARDOUS ENVIRONMENT APPLICATIONS

BOA II & PipeTaz: Robotic Pipe-Asbestos Insulation Abatement Systems .................... 52  
_H. Schempf, E. Mutschler, B. Chemel and S. Boehmke_

Modeling and Identification of an Electrohydraulic Articulated Forestry Machine ............. 60  
_Evangelos Papadopoulos, Bin Mu and Real Frenette_

Simulation Tools for Robotic and Teleoperated Hazardous Waste Removal ................... 66  
_L. Love, R. Kress and K. Bills_
Rapid World Modelling from a Mobile Platform ................................................................. 72
Robert E. Barry, Judson P. Jones, Charles Q. Little and Christopher W. Wilson

GRASP ANALYSIS

Kinematics, Statics and Stiffness Effect of 3D Grasp by Multifingered Hand with Rolling Contact at the Fingertip ................................................................. 78
Hitoshi Maekawa, Kazuo Tanie and Kiyoshi Komoriya

A Quality Measure for Compliant Grasps ................................................................. 86
Joel Burdick, Qiao Lin and Elon Rimon

Computation and Analysis of Compliance in Grasping and Fixturing ........................................ 93
Joel Burdick, Qiao Lin and Elon Rimon

Evaluating the Quality of Grasp Configurations for Dextrous Hands ........................................ 100
William A. Gruver, Yuru Zhang, Feng Gao and Yidong Zhang

FORCE FEEDBACK APPROACHES

Haptic Interaction Using a PUMA560 and the ISU Force Reflecting Exoskeleton System ................ 106
Greg R. Luecke and Young-Ho Chai

Virtual Cooperating Manipulator Control for Haptic Interaction with NURBS Surfaces ................ 112
G.R. Luecke, J.C. Edwards and B.E. Miller

Computing Optimal Forces for Generalised Kinesthetic Feedback on the Human Hand During Virtual Grasping and Manipulation ........................................ 118
Costas Tzafestas and Philippe Coiffet

Modeling, Identification, and Control of a Pneumatically Actuated Robot ................................ 124
J.E. Bobrow and B. W. McDonell

3D SENSING

Recent Progress in Structured Light in Order to Solve the Correspondence Problem in StereoVision 130
E. Mouaddib, J. Salvi and J. Battle

Depth from Magnification and Blurring ................................................................. 137
Sukhan Lee, Sang Chul Ahn and Ashok Meyyappan

On 3D Vision Based Active Antenna ................................................................. 143
Makoto Kaneko, Naoki Kanayama and Toshio Tsuji

3D Shape Recognition by Distributed Sensing of Range Images and Intensity Images ................ 149
Kazunori Umeda, Kenji Ikushima and Tamio Arai
HYPER-REDUNDANT MANIPULATORS

Increasing the Maneuvering Ability of Highly Redundant Manipulators ........................................ 155

Rob Buckingham and E. Sahin Conkur

An Obstacle Avoidance Scheme for Hyper-Redundant Manipulators:
Global Motion Planning in Posture Space .......................................................................................... 161

Shugen Ma and Mototsugu Konno

A Discrete Model for the Configuration Control of Hyper-Redundant Manipulators ...................... 167

Kourosh E. Zanganeh, Regina S. K. Lee and Peter C. Hughes

Control of Manipulators with Hyper Degrees of Freedom: Shape Tracking Based on
Curve Parameter Estimation ............................................................................................................. 173

H. Mochiyama, E. Shimemura and H. Kobayashi

BIPED LOCOMOTION

Pattern Generation Using Coupled Oscillators for Robotic and Biorobotic Adaptive Periodic Movement ................................................................. 179

Laci Jalics, Hooshang Hemami and Yuan F. Zheng

Development of a Biped Walking Robot Having Antagonistic Driven Joints Using
Nonlinear Spring Mechanism ............................................................................................................ 185

Jin'ichi Yamaguchi and Atsuo Takanishi

Virtual Model Control of a Bipedal Walking Robot ........................................................................ 193

Jerry Pratt, Peter Dilworth and Gill Pratt

Locomotion of a Biped Robot with Compliant Ankle Joints .......................................................... 199

Keon Young Yi

EVOLUTIONARY COMPUTING I

Trajectory Generation for Redundant Manipulator Using Virus Evolutionary Genetic Algorithm .... 205

Naoyuki Kubota, Toshio Fukuda, Takemasa Arakawa and Koji Shimojima

Natural Motion Generation of Biped Locomotion Robot Using Hierarchical Trajectory
Generation Method Consisting of GA, EP Layers ........................................................................... 211

Takemasa Arakawa and Toshio Fukuda

Stabilization Control of Biped Locomotion Robot Based Learning with GAs Having
Self-Adaptive Mutation and Recurrent Neural Networks .............................................................. 217

Toshio Fukuda, Youichirou Komata and Takemasa Arakawa

Genetic Design of 3D Modular Manipulators .................................................................................. 223

O. Chocron and P. Bidaud
### Actuator Dynamics & Control

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficient Reinforcement Learning: Model-Based Acrobot Control</td>
<td>229</td>
</tr>
<tr>
<td>Gary Boone</td>
<td></td>
</tr>
<tr>
<td>Resolved-Rate and Resolve-Acceleration-Based Robot Control in the Presence of Actuators’ Constraints</td>
<td>235</td>
</tr>
<tr>
<td>Nenad Kircanski and Manja Kircanski</td>
<td></td>
</tr>
<tr>
<td>Stability of Control for the Preisach Hysteresis Model</td>
<td>241</td>
</tr>
<tr>
<td>R.B. Gorbet, K.A. Morris and D.W.L. Wang</td>
<td></td>
</tr>
<tr>
<td>Robust Torque Control of Harmonic Drive Under Constrained-Motion</td>
<td>248</td>
</tr>
<tr>
<td>H.D. Taghirad and P.R. Bélanger</td>
<td></td>
</tr>
</tbody>
</table>

### Chemical & SMA Actuators

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Controller for a High Strain Shape Memory Alloy Actuator: Quenching of Limit Cycles</td>
<td>254</td>
</tr>
<tr>
<td>Vincent Hayward and Danny Grant</td>
<td></td>
</tr>
<tr>
<td>Design and Comparison of High Strain Shape Memory Alloy Actuators</td>
<td>260</td>
</tr>
<tr>
<td>Vincent Hayward, Alexandra Lu and Danny Grant</td>
<td></td>
</tr>
<tr>
<td>Development of the Micro Pump Using ICPF Actuator</td>
<td>266</td>
</tr>
<tr>
<td>Shuxiang Guo, Tatsuya Nakamura, Toshio Fukuda and Keisuke Oguro</td>
<td></td>
</tr>
<tr>
<td>Dynamic Sensor Selection for Robotic Systems</td>
<td>272</td>
</tr>
<tr>
<td>G.E. Hovland and B.J. McCarragher</td>
<td></td>
</tr>
</tbody>
</table>

### Human-Robot Interaction I

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stochastic Similarity for Validating Human Control Strategy Models</td>
<td>278</td>
</tr>
<tr>
<td>Yangsheng Xu and Michael C. Nechyba</td>
<td></td>
</tr>
<tr>
<td>Learning Force Sensory Patterns and Skills from Human Demonstration</td>
<td>284</td>
</tr>
<tr>
<td>Marjorie Skubic and Richard A. Volz</td>
<td></td>
</tr>
<tr>
<td>Human Integration into Robot Control Utilising Potential Fields</td>
<td>291</td>
</tr>
<tr>
<td>Peter Aigner and Brenan McCarragher</td>
<td></td>
</tr>
<tr>
<td>Motion Recognition Based Cooperation Between Human Operating Robot and Autonomous Assistant Robot</td>
<td>297</td>
</tr>
<tr>
<td>H. Kimura and G. Kajiura</td>
<td></td>
</tr>
</tbody>
</table>

### Manufacturing Applications II

<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A Behaviour-Based Approach to Robotic Grasp Formulation: Experimental Evaluation in a Food Product Handling Application</td>
<td>304</td>
</tr>
<tr>
<td>J. J. Rowland, M.J. Neal and M.H. Lee</td>
<td></td>
</tr>
</tbody>
</table>
A Robotic Gripper System for Limp Material Manipulation: Modeling, Analysis and Performance Evaluation ........................................................................................................ 310
Kimon P. Valavanis, Ramesh Kolluru and Timothy M. Hebert

Freeform Fabrication of Polymer-Matrix Composite Structures ................................................................. 317
Stephen G. Kaufman, Barry L. Spletzer and Tommy L. Guess

The Dynamics of an Articulated Forestry Machine and its Applications ................................................. 323
Evangelos Papadopoulos and Soumen Sarkar

MILITARY ROBOTICS

The BUGS "Basic UXO Gathering System" Project for UXO Clearance and Mine Countermeasures ........ 329
Christopher DeBolt, Chris O'Donnell, Craig Freed and Tuan Nguyen

The Multifunction Automated Crawling System (MACS) ................................................................. 335
Paul G. Backes, Yoseph Bar-Cohen and Benjamin Joffe

Control of Small Robotic Vehicles in Unexploded Ordnance Clearance .............................................. n/a
Tony Healey and Y. Kim

The Next Generation Munitions Handler Advanced Technology Demonstrator Program ...................... 341

ROBOTIC APPLICATIONS I

A Vision-Guided Object Tracking and Prediction Algorithm for Soccer Robots ........................................ 346
J.S. Lee, C.S. Hong, S. M. Chun and K.S. Hong

A Sensor-Based Automation System for Handling Nuclear Materials ..................................................... 352
William Drotning, Howard Kimberly, Walter Wapman, David Darras, Dan Homan, Paul Johnson, Brian Kast, Joel Kuhlmann, R. Charleene Lennox and Carla Montoya

Dynamic Manipulation with a One Joint Robot ......................................................................................... 359
Kevin M. Lynch and Matthew T. Mason

Case Studies in the Manipulation of Flexible Parts Using a Hybrid Position/Force Approach .................. 367
Werner Kraus, Jr. and Brenan J. McCarragher

GRASP SYNTHESIS

Parallel Algorithms for Synthesis of Whole-Hand Grasps ................................................................. 373
Nancy S. Pollard

3-D Flexible Fixturing Using a Multi-Degree of Freedom Gripper for Robotic Fixtureless Assembly .... 379
Gary M. Bone and William J. Plut

On Three Phases for Achieving Enveloping Grasps: Inspired by Human Grasping .......................... 385
Makoto Kaneko, Yutaka Hino and Toshio Tsuji
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stable Poses of 3-Dimensional Objects</td>
<td>391</td>
</tr>
<tr>
<td>Joel Burdick, Richard Mason and Elon Rimon</td>
<td></td>
</tr>
<tr>
<td>Operation of Remote Systems I</td>
<td></td>
</tr>
<tr>
<td>Interactive Benchmark for Planning Algorithms on the Web</td>
<td>399</td>
</tr>
<tr>
<td>Antonio Bicchi, Simone Piccinocchi, Massimo Ceccarelli and Federico Piloni</td>
<td></td>
</tr>
<tr>
<td>Tele-Teaching by Human Demonstration in Virtual Environment for Robotic Network System</td>
<td>405</td>
</tr>
<tr>
<td>Yasuharu Kunii and Hideki Hashimoto</td>
<td></td>
</tr>
<tr>
<td>Web Interface for Telescience (WITS)</td>
<td>411</td>
</tr>
<tr>
<td>Paul G. Backes, Gregory K. Tharp and Kam S. Tso</td>
<td></td>
</tr>
<tr>
<td>Virtual Collaborative Control to Improve Intelligent Robotic System Efficiency and Quality</td>
<td>418</td>
</tr>
<tr>
<td>Michael J. McDonald, Daniel E. Small, Charles C. Graves and David Cannon</td>
<td></td>
</tr>
<tr>
<td>Active Vision</td>
<td></td>
</tr>
<tr>
<td>Improving Task Reliability by Fusion of Redundant Homogeneous Modules Using Voting Schemes</td>
<td>425</td>
</tr>
<tr>
<td>Paolo Pirjanian, Jeffrey A. Fayman and Henrik I. Christensen</td>
<td></td>
</tr>
<tr>
<td>Trajectories for Optimal Temporal Integration in Active Vision Systems</td>
<td>431</td>
</tr>
<tr>
<td>James J. Clark and Lei Wang</td>
<td></td>
</tr>
<tr>
<td>Visually Guided Manipulation Using Active Camera-Lens Systems</td>
<td>437</td>
</tr>
<tr>
<td>Bradley J. Nelson and Pradeep K. Khosla</td>
<td></td>
</tr>
<tr>
<td>A Robotic System Emulating the Adaptive Orienting Behavior of the Barn Owl</td>
<td>443</td>
</tr>
<tr>
<td>M. Rucci, J. Wray, G. Tononi and G.M. Edelman</td>
<td></td>
</tr>
<tr>
<td>Redundant Manipulator Design</td>
<td></td>
</tr>
<tr>
<td>Design of Macro/Mini Manipulators for Optimal Dynamic Performance</td>
<td>449</td>
</tr>
<tr>
<td>Alan Bowling and Oussama Khatib</td>
<td></td>
</tr>
<tr>
<td>Design of the Chained Form Manipulator</td>
<td>455</td>
</tr>
<tr>
<td>Woojin Chung and Yoshihiko Nakamura</td>
<td></td>
</tr>
<tr>
<td>Development and Evaluation of Seven-D.O.F. MIA ARM</td>
<td>462</td>
</tr>
<tr>
<td>Toshio Morita and Shigeki Sugano</td>
<td></td>
</tr>
<tr>
<td>Criteria Based Analysis and Design of Three Degree of Freedom Planar Manipulators</td>
<td>468</td>
</tr>
<tr>
<td>William A. Gruver, Feng Gao and Fabrice Guy</td>
<td></td>
</tr>
</tbody>
</table>
LEGGED LOCOMOTION I

Gait Planning for Energy Efficiency in Walking Machines ........................................... 474
David E. Orin and Duane W. Marhefka

Building Walking Gaits for Irregular Terrain from Basis Controllers ............................. 481
Roderic A. Grupen and Willard S. MacDonald

Self-Stabilizing Running .................................................................................................. 487
Robert Ringrose

TITAN VII: Quadruped Walking and Manipulating Robot on Steep Slope ......................... 494
Hideyuki Tsukagoshi, Kan Yoneda and Shigeo Hirose

EVOLUTIONARY COMPUTING II

Learning Dextrous Manipulation Skills Using the Evolution Strategy ............................... 501
Olac Fuentes and Randal C. Nelson

Task Based Design of Modular Robot Manipulator Using Efficient Genetic Algorithm .... 507
W.K. Chung, Jeongheon Han, Y. Youm and S.H. Kim

A GA Embedded Dynamic Search Algorithm over a Petri Net Model for an FMS Scheduling 513
Li-Chen Fu and Yung-Feng Chiu

Evolving an Intelligent Vehicle for Tactical Reasoning in Traffic ................................... 519
Rahul Sukthankar, Shumeet Baluja and John Hancock

ADAPTIVE ROBOT CONTROL

Adaptive Position/Force Control of BDC-RLED Robots Without Velocity Measurements 525
M.S. de Queiroz, D. M. Dawson and H. Canbolat

An Adaptive Learning Control Method for Constrained Motion of Uncertain Robotic Systems 531
Jin S. Lee, B.H. Park and S.Y. Park

Experiments in Nonlinear Adaptive Control ........................................................................ 537
E. Burdet, B. Sprenger and A. Codourey

Adaptive Control of the Hexaglide, a 6 dof Parallel Manipulator ...................................... 543
M. Honegger, A. Codourey and E. Burdet

COLLISION AVOIDANCE I

Planning Collision-Free Motions for Underactuated Manipulators in Constrained Configuration Space 549
Yangsheng Xu and Marcel Bergerman

Window-Shaped Obstacle Avoidance for a Redundant Manipulator .................................. 556
Fan-Tien Cheng, Yu-Der Lu and York-Yin Sun
Path Planning by Robot Decomposition and Parallel Search ............................................. 562
   M. Tarokh and A. Hourtash

Experiments in Real-Time Collision Avoidance for Dexterous 7-DOF Arms ....................... 569
   Homayoun Seraji, Bruce Bon and Robert Steele

HUMAN-ROBOT INTERACTION II

Human Interaction with a Service Robot: Mobile-Manipulator Handing Over an Object to a Human .......... 575
   Arvin Agah and Kazuo Tanie

Realization of Expressive Mobile Robot ................................................................. 581
   Hiroshi Mizoguchi, Tomomasa Sato, Katsuyuki Takagi, Masayuki Nakao and Yotaro Hatamura

Situation Reactive Handiwork Support Through Behavior Understanding .......................... 587
   Takeshi Mori, Tomomasa Sato and Hiroshi Mizoguchi

Position Control of Collision-Tolerant Passive Mobile Manipulator with Base Suspension Characteristics ... 594
   Nak Young Chong, Kazuhito Yokoi, Sang-Rok Oh and Kazuo Tanie

ASSEMBLY I

Evaluation of Task-Performance of a Manipulator for a Peg-in-Hole Task ......................... 600
   Ryuichi Yokogawa, Kei Hara and Yoshihiro Kai

Effect of Tolerancing on the Relative Positions of Parts in an Assembly .......................... 606
   Frédéric Cazals and Jean-Claude Latombe

General Translational Assembly Planning ......................................................................... 612
   Achim Schweikard and Fabian Schwarzer

Towards a Standardized Cost Measure of Assembly Operations ....................................... 620
   Sukhan Lee and Raúl Suárez

ENTERTAINMENT ROBOTICS

Development of a Multi-Agent System for Robot Soccer Game ........................................ 626
   Sung-Wook Park, Jung-Han Kim, Eun-Hee Kim and Jun-Ho Oh

Robots Playing to Win: Evolutionary Soccer Strategies .................................................. 632
   Arvin Agah and Kazuo Tanie

A Cooperative Multi-Agent System and Its Real Time Application to Robot Soccer ................ 638

The Development of a Micro Robot System for Robot Soccer Game .................................. 644
   Hyung-Suck Cho, Kyung-Hoon Kim, Kuk-Won Ko, Joo-Gon Kim and Su-Ho Lee

xiv
CONTROL ISSUES IN HAZARDOUS ENVIRONMENTS

Development and Implementation of Real-Time Control Modules for Robotic Waste Management
K. Glass and R. Colbaugh

A Simulated Annealing Optimization Algorithm Implemented Within an Operator-Assist Interface
Richard Hooper

Waste Tank Cleanup Manipulator Modeling and Control
Reid Kress, Lonnie Love, Rajiv Dubey and Angela Gizelar

Modeling and Control of a Hydraulically Actuated Flexible-Prismatic Link Robot
Lonnie Love, Reid Kress and John Jansen

REAL-TIME GRASPING & STABILITY

Using Tactile and Visual Sensing with a Robotic Hand
Peter K. Allen, Andrew T. Miller, Paul Y. Oh and Brian S. Leibowitz

Recursive Algorithms for Real-Time Grasping Force Optimization
Martin Buss, Leonid Faybusovich and John B. Moore

Specifying and Verifying Visual Grasping Tasks
Eugenia Shkel and Nicola J. Ferrier

Evaluation of Contact Stability Between Objects
Yong Yu and Tsuneo Yoshikawa

OPERATION OF REMOTE SYSTEMS II

Feedback Control of a 3-DOF Planar Underactuated Manipulator
Hirohiko Arai, Kazuo Tanie and Naoji Shiroma

Impedance Shaping Based on Force Feedback Bilateral Control in Macro-Micro Teleoperation System
Kenji Kaneko, Hiroki Tokashiki, Kazuo Tanie and Kiyoshi Komoriya

The PantoScope: A Spherical Remote-Center-of-Motion Parallel Manipulator for Force Reflection
Roger Baumann, Willy Maeder, Dominique Glauser and Reymond Clavel

Dynamic Simulation of Virtual Mechanisms with Haptic Feedback Using Industrial Robotics Equipment
C.L. Clover, G.R. Luecke, J.J. Troy and W.A. McNeely

ACTIVE VISION FOR MOBILE ROBOTS

Motion Strategies for Maintaining Visibility of a Moving Target
Steven M. LaValle, Jean-Claude Latombe, Craig Becker and Héctor H. González-Baños

Finding an Unpredictable Target in a Workspace with Obstacles
Steven M. LaValle, David Lin, Jean-Claude Latombe, Leonidas J. Guibas and Rajeev Motwani
Active Sensor Placement for Complete Scene Reconstruction and Exploration
Francois Chaumette and Eric Marchand

Selective Reconstruction of a 3-D Scene with an Active Stereo Vision System
Atsushi Okubo, Atsushi Nishikawa and Fumio Miyazaki

REDUNDANT MANIPULATORS I
Analysis of a 5-Bar Finger Mechanism Having Redundant Actuators with Applications to
Stiffness and Frequency Modulations
Byung-Ju Yi, Il Hong Suh and Sang-Rok Oh

A Unified Approach for Local Resolution of Kinematic Redundancy with Inequality Constraints and its
Application to Nuclear Power Plant
Ki C. Park, Pyung H. Chang and J. Kenneth Salisbury

Evaluation of Velocity Capabilities for Redundant Parallel Robots
Francois Pierrot and Pasquale Chiacchio

Inverse Kinematics of a Serial Manipulator: Kinematic Redundancy and Two Approaches for
Closed-Form Solutions
Keum-Shik Hong, Young-Min Kim, Chintae Choi and Kitae Shin

LEGGED LOCOMOTION II
Optimal Gait Selection for Nonholonomic Locomotion Systems
Jim Ostrowski, Jaydev P. Desai and Vijay Kumar

Bifurcation and Chaos in a Simple Passive Bipedal Gait
Benoit Thuilot, Ambarish Goswami and Benurd Espiau

Investigation of Bipedal Robot Locomotion Using Pneumatic Muscle Actuators
Darwin G. Caldwell, G.A. Medrano-Cerda and C.J. Bowler

Approximate Return Maps for Quadrupedal Running
Matthew D. Berkemeier

FUZZY CONTROL
Adaptive Fuzzy Visual Servoing in Robot Control
Maw-Kae Hor, Dong-Ming Chuang and Shiaw-Chian Wu

Fuzzy Parameter Adaptation for a Sliding Mode Controller as Applied to the Control of an
Articulated Arm
Imre Rudas, Kemalettin Erbatur and Okyay Kaynak

Approximate Reasoning for the Control of a Robot in an Uncertain Environment:
A Multi-Model Approach
Laurent Dubois, Toshio Fukuda, François Delmotte and Pierre Borne
Adaptive Fuzzy-Behavior Hierarchy for Autonomous Navigation ............................................. 829
Edward Tunstel, Harrison Danny, Tanya Lippincott and Mo Jamshidi

COMPLIANT CONTROL

Mechanical Analogies in Hybrid Position/Force Control .................................................. 835
L.D. Joly, C. Andriot and V. Hayward

A Compliant Motion Control for Insertion of Complex Shaped Objects Using Contact .......... 841
Sung C. Kang, Mun S. Kim, Yong K. Hwang, Chong W. Lee and Kyo-Il Lee

Contact Transition Stability in the Impedance Control ................................................... 847
Dragoljub T. Šurdilović

On the Control of Space Free-Flyers Using Multiple Impedance Control ....................... 853
Evangelos Papadopoulos and S. Ali A. Moosavian

COLLISION AVOIDANCE II

Fast Optical Hazard Detection for Planetary Rovers Using Multiple Spot Laser Triangulation .... 859
Tucker Balch, Larry Matthies and Brian Wilcox

Collision-Free and Continuous-Curvature Path Planning for Car-Like Robots ................ 867
A. Scheuer and Th. Fraichard

Real-Time Path Planning Using Harmonic Potentials in Dynamic Environments ............. 874
Hans Jacob S. Feder and Jean-Jacques E. Slotine

Geometric Collision Detection and Potential Field Based Time Delay Planning for Dual Arm Systems .... 882
Sukhan Lee, Hadi Moradi, George Kardaras and Sung-Kwon Kim

ROBOTIC MANIPULATION - INTERACTION, CONTROL & ACCURACY

Instructing Cooperating Assembly Robots Through Situated Dialogues in Natural Language .... 888
A. Knoll, B. Hildebrandt and J. Zhang

Arm-Manipulator Coordination for Load Sharing Using Variable Compliance Control .......... 895
Yuan F. Zheng and Omar M. Al-Jarrah

Real-Time Trajectory/Profile Learning for Robots in Human-Robot Interactions ............... 901
J.Y.S. Luh and Shuyi Hu

Mechanical Impedance Characteristics of Robots for Coexistence with Humans ................ 907
Mohamed Sahbi Ben-Lamine, Satoru Shibata, Akira Shimizu and Kanya Tanaka
Constraint-Based Interactive Assembly Planning ........................................ 913
   Randall H. Wilson, Rondall E. Jones and Terri L. Calton

New Properties of the Remote Center of Compliance ................................ 921
   Harvey Lipkin and Namik Cibikak

Tolerance Analysis for Multi-Chain Assemblies with Sequence and Functionality Constraints ..................... 927
   Sukhan Lee and Chunsik Yi

Force Control Command Synthesis for Assembly Using a Discrete Event Framework .......................... 933
   David Austin and Brenan McCarragher

Dynamic Control of Manufacturing Systems Based on a Novel State Reconstruction Algorithm ............. 939
   Paolo Valigi, Francesco Martinelli and Salvatore Nicosia

Deadlock-Free Scheduling of an Automated Manufacturing System Based on Petri Nets ..................... 945
   MengChu Zhou and Huanxin Henry Xiong

Genetically Tuned Fuzzy Scheduling for Flexible Manufacturing Systems .................................. 951
   Aydan M. Erkmen, Mustafa Erbudak, Ömer Anlağan and Özgür Ünver

Schedule Revision in a Distributed Job Shop with the Makespan Objective ................................. 957
   Kang G. Shin and Thomas Tsukada

Shared Control of Multiple-Manipulator, Sensor-Based Telerobotic Systems ................................ 962
   Robert L. Williams, II, F. Wallace Harrison and Donald I. Soloway

Natural Terrain Hazard Detection with a Laser Rangefinder ............................................. 968
   Lars Henriksen and Eric Krotkov

Image Based Autodocking Without Calibration .......................................................... 974
   Venugopal Varma, Herry Sutanto and Rajeev Sharma

A Systematic Error Analysis of Robotic Manipulators: Application to a High Performance Medical Robot .................................................. 980
   C. Mavroidis, S. Dubowsky, P. Drouet, J. Hintersteiner and J. Flanz
REGRASPING

Planning Quasi-Static Motions for Re-Configuring Objects with a Multi-Fingered Robotic Hand .......... 986
Kamal K. Gupta and Moez Cherif

Dextrous Manipulation with Rolling Contacts .................................................. 992
Z.X. Li, Y.S. Guan, Q. Shi, L. Han and J.C. Trinkle

Multi-Fingered Regrasping Using On-Line Grasping Force Optimization ......................... 998
Martin Buss and Thomas Schlegl

Transition from Enveloping to Fingertip Grasp: A Way of Reorientation by a Multifingered Hand ...... 1004
Toru Omata and Tomoyuki Sekiyama

OPERATION OF REMOTE SYSTEMS III

Telerobotic Remote Handling of Protein Crystals .................................................... 1010
Blake Hannaford, James Hewitt, Thavida Maneewarn, Steven Venema, Matthew Appleby and Robert Ehresman

Analysis and Design of Telerobot Control Based on Human Motor Behavior Study .................... 1016
Leonid Slutski, Irina Gurevich and Yael Edan

Virtual Tele-Operation of Underwater Robots ...................................................... 1022
Qingping Lin and Chengi Kuo

Prototypes of Teleoperation Systems via a Standard Protocol with a Standard Human Interface .......... 1028
Hirohisa Hirukawa, Toshihiro Matsui, Hiromu Onda, Kunikatsu Takase, Yoichi Ishiwata and Kenji Konaka

VISION FOR MOBILE ROBOTS

Mobile Robot Motion Estimation from a Range Scan Sequence .................................... 1034
Javier Gonzalez and Rafael Gutierrez

Image-Based Prediction of Landmark Features for Mobile Robot Navigation ......................... 1040
Gregory D. Hager, David Kriegman, Erlang Yeh and Christopher Rasmussen

Computational Complexity of Terrain Mapping Perception in Autonomous Mobility .................. 1047
Alonzo Kelly and Anthony Stentz

Building a Global Map of the Environment of a Mobile Robot: The Importance of Correlations ........ 1053
J.A. Castellanos, J.D. Tardos and G. Schmidt

REDUNDANT MANIPULATORS II

A Modular Approach to Redundant Robot Control ............................................... 1060
Robert J. Anderson
Reactive Multi-Agent Based Control of Redundant Manipulators ................................................. 1067
P. Bohner and R. Lippen

Generalized Impedance Control of a Redundant Manipulator for Handling Tasks with Position Uncertainty While Avoiding Obstacles ......................................................... 1073
Max Donath and Chen-Fu Liao

Extended Impedance Control of Redundant Manipulators Using Joint Space Decomposition ........... 1080
W.K. Chung, Yonghwan Oh and Y. Youm

WALKING ROBOTS

Calculation of the Direct Dynamic Model of Walking Robots: Comparison Between Two Methods .... 1088
C. Chevallereau, B. Perrin and C. Verdier

Control of a Walking Robot with Feet Following a Reference Trajectory Derived From Ballistic Motion 1094
C. Chevallereau, B. Perrin and A. Formal’sky

Tethering System Design for Dante II ......................................................................................... 1100
Murali Krishna, John Bares and Ed Mutschler

Design and Simulation of a Cockroach-Like Hexapod Robot .................................................... 1106
G.M. Nelson, R.D. Quinn, R.J. Bachmann, W.C. Flannigan, R.E. Ritzmann and J.T. Watson

FUZZY LOGIC I

A Study on Multifingered Gripper Control .................................................................................... 1112
Th. Doersam, O. Hamerschmidt and L.A. Munoz

Neural Network Based Identification of Robot Dynamics Used for Neuro-Fuzzy Controller .......... 1118
Kishan K. Kumbla and Mohammad Jamshidi

Evolutionary Fuzzy Control of a Flexible-Link .............................................................................. 1124
M.-R. Akbarzadeh-T., M. Jamshidi and Y.T. Kim

Design Limitations of PD Versus Fuzzy Controllers for the Acrobat ........................................ 1130
Michael H. Smith, Michael A. Lee, Mihaela Ulieru and William A. Gruver

DYNAMIC ROBOT CONTROL

Parallel Force/Position Control With Stiffness Adaptation ......................................................... 1136
Bruno Siciliano, Stefano Chiaverini and Luigi Villani

Motion Planning and Dynamic Control of a Linked Manipulator Using Modified Magnetic Fields 1142
Harry Stephanou, Leena Singh and John Wen

Global Regulation of Uncertain Manipulators Using Bounded Controls .................................... 1148
R. Colbaugh, E. Barany and K. Glass
Dynamics and Control of Direct-Drive Robots with Positive Joint Torque Feedback .......................... 1156
M. Buehler, F. Aghili and J.M. Hollerbach

COLLISION AVOIDANCE III

Fast Swept-Volume Distance for Robust Collision Detection .................................................. 1162
Patrick G. Xavier

Path Planning for Everyday Robotics with SANDROS ............................................................... 1170
Peter Watterberg, Patrick Xavier and Yong Hwang

Gain Scheduling and Integral Action in Manipulator Collision Control ........................................ 1176
Sukhan Lee and David Chiu

The Gilbert-Johnson-Keerthi Distance Algorithm: A Fast Version for Incremental Motions ........... 1183
Elmer G. Gilbert and Chong Jin Ong

ELECTRIC & PNEUMATIC ACTUATORS

Modelling of a Novel Spherical Permanent Magnet Actuator .................................................... 1190
D. Howe, J. Wang and G.W. Jewell

Accurate Position Control of a Pneumatic Actuator Using On/Off Solenoid Valves ....................... 1196
Gary M. Bone and Robert B. van Varseveld

Force Characterization and Commutation of Planar Linear Motors .......................................... 1202
Arthur E. Quaid, Yangsheng Xu and Ralph L. Hollis

Transmission-Based Electrical Servoactuators: A Concept for Improving Robot Manipulator Performance .................................................. 1208
W.R. Hamel and T.C. Widner

AGILE MANUFACTURING

Advances in Agile Manufacturing ......................................................................................... 1216
Roger D. Quinn, Frank L. Merat, Nicholas A. Barendt, Greg C. Causey, Wyatt S. Newman,
Virgilio B. Velasco, Jr., Andy Podgurski, Yoohwan Kim, Gultekin Ozsoyoglu and Ju-Yeon Jo

Virtual Testing of Agile Manufacturing Software Using 3D Graphical Simulation ....................... 1223
Ju-Yeon Jo, Yoohwan Kim, Andy Podgurski and Wyatt S. Newman

Automatic Tool Path Generation for Finished Machining ....................................................... 1229
Kwan S. Kwok, Cliff S. Loucks and Brian J. Driessen

Design of a Flexible Parts Feeding System .............................................................................. 1235
Greg C. Causey, Roger D. Quinn, Nicholas A. Barendt, David M. Sargent and Wyatt S. Newman
TOOLS & CALIBRATION APPROACHES FOR MANUFACTURING SYSTEMS

5-Axis Control Rough Cutting of an Impeller with Efficiency and Accuracy .......................... 1241
Yoshimi Takeuchi and Koichi Morishige

Performance Analysis of Localization Algorithms .......................................................... 1247
Y.X. Chu, J.B. Gou, B. Kang, K.T. Woo and Z.X. Li

A Polynomial-Complexity Tool for Evaluating the Performance of Structurally Controlled FMS 1253
Spyros A. Reveliotis and Placid M. Ferreira

A CAD-Based Probing and Localisation Method for Arbitrarily Fixed Workpiece .............. 1259
B. Kang, J.B. Gou, Y.X. Chu and Z.X. Li

HEALTHCARE ROBOTICS

Navigational Support for Robotic Wheelchair Platforms: An Approach that Combines Vision and Range Sensors ................................................................. 1265
P.E. Trahanias, M.I.A. Lourakis, A.A. Argyros and S. C. Orphanoudakis

Health Care Robotics: A Progress Report ................................................................. 1271
Paolo Fiorini, Khaled Ali and Homayoun Seraji

A Reconfigurable Holonomic Omnidirectional Mobile Bed with Unified Seating (RHOMBUS) for Bedridden Patients .................................................. 1277
Haruhiko H. Asada, Stephen Mascaro and Joseph Spano

The GuideCane - A Computerized Travel Aid for the Active Guidance of Blind Pedestrians 1283
Johann Borenstein and Iwan Ulrich

TELEROBOTICS & TELEOPERATION I

Probabilistic Octree Modeling of a 3-D Dynamic Environment ................................. 1289
D. Laurendeau, P. Payeur, P. Hébert and C. M. Gosselin

Model-Based Telerobotics with Vision ................................................................. 1297
John E. Lloyd, Jeffrey S. Beis, Dinesh K. Pai and David G. Lowe

Object Resolved Teleoperation ............................................................................... 1305
C.H. Spenny and D.L. Schneider

Efficient Digitizing of Sculptured Surfaces Using Wavelet Transform ......................... 1312
Yuan F. Zheng and Chia-Chun Huang

AUGMENTED REALITY

The Design and Control of a Tactile Display Based on Shape Memory Alloys .................. 1318
P.M. Taylor, A. Moser and A. Creed
Interactive Training Simulator for a Pipe Diversion Task in the Nuclear Industry ........................................ 1324
   P. E. Mort, A.K. Bicknell and C. Smith

Multimodal Interface for a Virtual Reality Based Computer Aided Design System ................................. 1329
   Rajit Gadh, Chi-Cheng P. Chu and Tushar H. Dani

Computer Vision Assisted Semi-Automatic Virtual Reality Calibration ...................................................... 1335
   Won S. Kim, Donald B. Gennery and Eugene C. Chalfant

CAMERA CALIBRATION

Hand/Eye Calibration for Electronic Assembly Robots ...................................................................................... 1341
   Hanqi Zhuang

An Optimized Two-Step Camera Calibration Method ...................................................................................... 1347
   M. Kamel and H. Bacakoglu

Panoramic Sensor Calibration Using Computational Projective Geometry ...................................................... 1353
   R. Benosman, T. Maniere and J. Devars

Active Self-Calibration of Hand Cameras and Hand-Eye Relationships with Motion Planning .................. 1359
   Guo-Qing Wei, Klaus Arbter and Gerd Hirzinger

MODELING & SIMULATION I

A Statistical and Harmonic Model for Robot Manipulators ............................................................................ 1365
   Alexandra Galhano and J.A. Tenreiro Machado

A Robustness Bound of Computed Torque Linearization for Control of a Manipulator in Contact Task .... 1371
   Sang-Moo Lee

Affine Connections for the Cartesian Stiffness Matrix ...................................................................................... 1376
   Miloš Žefran and Vijay Kumar

Compliant Contact Models for Rigid Body Collisions ..................................................................................... 1382
   Vijay Kumar and Peter R. Kraus

MOBILE ROBOTS - CONTROL

Estimation of Track-Soil Interactions for Autonomous Tracked Vehicles ...................................................... 1388
   David C. Rye, Ahn Tuan Le and Hugh F. Durrant-Whyte

Curvature-Constrained Motion within a Limited Workspace ........................................................................... 1394
   Vladimir J. Lumelsky and Andrei M. Shkel

Anti-Lock Braking and Traction Control Concept for All-Terrain Robotic Vehicles .................................... 1400
   Jan van der Burg and Pierre Blazevic
Planning and Control of Self Calibrated Manipulation for a Robot on a Mobile Platform ........................................ 1406  
Bijoy K. Ghosh, Di Xiao, Ning Xi and Tzyh-Jong Tarn

FUZZY LOGIC II

A Fuzzy PD Controller for Multi-Link Robot Control: Stability Analysis ........................................ 1412  
Edgar Sanchez, Ya-Chen Hsu and Guanrong Chen

On-Line Learning of B-Spline Fuzzy Controller to Acquire Sensor-Based Assembly Skills ................ 1418  
Jianwei Zhang, Yorck von Collani and Alois Knoll

Deadzone Compensation in Motion Control Systems Using Adaptive Fuzzy Logic Control ................. 1424  
K.T. Woo, F.L. Lewis, Li-Xin Wang and Z.X. Li

A New Adaptive Fuzzy Control Scheme with Application to the Position/Force Control of Constrained Flexible-link Manipulators ................................................................. n/a  
Xiaoping Fan, J. M. Xu, Y. S. Ho and T. P. Leung

MOTION PLANNING I

Near-Optimal Motion Planning for Nonholonomic Systems with State/Input Constraints via Quasi-Newton Method ......................................................... 1430  
Chih-Chen Yih and Paul I. Ro

Path Planning by Analogy ................................................................. 1436  
Hiroyuki Ogata and Makoto Mizukawa

Locally Controllable Polygons by Stable Pushing ................................................................. 1442  
Kevin M. Lynch

A Simple Strategy for Opening an Unknown Door ................................................................. 1448  
Günter Niemeyer and Jean-Jacques E. Slotine

MICRO ROBOTS

Manipulation of DNA Molecule Utilizing the Conformational Transition in the Higher Order Structure of DNA ......................................................... 1454  
Toshio Fukuda, Keisuke Morishima, Fumihito Arai and Kenichi Yoshikawa

Design of a Minimum Surface-Effect Tendon-Based Microactuator for Micromanipulation .......... 1460  
Michael Goldfarb and James H. Lipsey

Design of a Minimum Surface-Effect Three Degree-of-Freedom Micromanipulator ................. 1466  
Michael Goldfarb and John E. Speich

Adhesion-Type Micro Endeffector for Micromanipulation ......................................................... 1472  
Fumihito Arai and Toshio Fukuda
MULTIPLE MANIPULATOR CONTROL I

Cooperation of Multiple Manipulators with Passive Joints ........................................ 1478
Yun-Hui Liu and Yangsheng Xu

Cooperative System for Multiple Position-Controlled Robots with Free Joint Mechanisms .......... 1484
Hisashi Osumi, Manabu Ono, Mitsuyuki Fujibayashi and Manabu Kagatani

On Coordinated Control of Multiple Flexible Joint Robots Holding a Constrained Object .......... 1490
Tian Lin and A.A. Goldenberg

Learning and Adaptive Controls for Coordination of Multiple Manipulators Without Knowing Physical Parameters of an Object ......................................................... 1496
T. Naniwa, S Arimoto and K. Wada

ASSEMBLY, DISASSEMBLY & FLEXIBLE AUTOMATION

Determining Alignment Between Threaded Parts Using Force and Position Data from a Robot Hand .... 1503
M.A. Diftler and I. D. Walker

Agile Assembly Architecture: An Agent Based Approach to Modular Precision Assembly Systems ..... 1511
Alfred A. Rizzi, Jay Gowdy and Ralph L. Hollis

Rapid Setup of System Control in a Flexible Automated Production System ........................ 1517
Li-Chen Fu, Han-Shen Huang and Jane Yung-Jen Hsu

Supervisory Control of an Automated Disassembly Workcell Based on Blocking Topology .......... 1523
Kok-Meng Lee and Michael Martin Bailey-Van Kuren

MECHANISMS & ACTUATORS DESIGN

Design and Planning of a Novel Modular End-Effector for Agile Assembly ......................... 1529
Miao Hong and Shahram Payandeh

Development of a Dextrous Gripper for Nuclear Applications ...................................... 1536

Parcel Manipulation and Dynamics with a Distributed Actuator Array: The Virtual Vehicle ........ 1541
Howie Choset, Jonathan E. Luntz and William Messner

Development of a Hydraulic Manipulator Servoactuator Model: Simulation and Experimental Validation .................. 1547
Evangelos Papadopoulos and Glen Bilodeau

MEDICAL ROBOTICS

A Robotic Case Study: Optimal Design for Laparoscopic Positioning Stands ...................... 1553
Ali Faraz and Shahram Payandeh
Micro Force Sensor for Intravascular Neurosurgery ................................. 1561
\textit{Mitsutaka Tanimoto, Fumihito Arai, Toshio Fukuda, Hitoshi Iwata, Kouichi Itoigawa, Yisuhiro Gotoh, Masushi Hashimoto and Makoto Negoro}

A Micro Robotic System for Colonoscopy ............................................. 1567
\textit{P. Dario, M.C. Carrozza, L. Lencioni, B. Magnani, and S. D’Attanasio}

A Miniature Steerable End-Effector for Application in an Integrated System for Computer-Assisted Arthroscopy .............................................. 1573
\textit{P. Dario, C. Paggetti, N. Troisfontaine, E. Papa, T. Ciucci, M.C. Carrozza and M. Marcacci}

\textbf{Telerobotics \& Teleoperation II}

Real-Time Model-Based Obstacle Detection for the NASA Ranger Telerobot .................................................. 1580
\textit{Bruce Bon and Homayoun Seraji}

Integrating Force and Vision Feedback Within Virtual Environments for Telerobotic Systems .............................. 1588
\textit{Bradley J. Nelson and Pradeep K. Khosla}

A Model-Based Space Teleoperation System with Robustness Against Modeling Errors .............................. 1594
\textit{Y. Tsumuki and M. Uchiyama}

Implementation of the Micro-Macro Teleoperation System Without Using Slave-Side Force Sensors ............ 1600
\textit{Koji Takeo and Kazuhiro Kosuge}

\textbf{Controls - Dynamics}

Geometric Algorithms for Operational Space Dynamics and Control .................................................. 1606
\textit{S.R. Ploen, J.E. Bobrow and F.C. Park}

A Body-Oriented Method for Finding a Linear Form of the Dynamic Equation of Fully Parallel Robots ........ 1612
\textit{A. Codourey and E. Burdet}

Using Wave Variables for System Analysis and Robot Control .................................................. 1619
\textit{Giinter Niemeyer and Jean-Jacques E. Slotine}

Improved Model Reference Adaptive Control Using the Euler Operator .................................................. 1626
\textit{Paul Y. Oh}

\textbf{Object Recognition}

Model-Based Objects Recognition in Industrial Environments for Autonomous Vehicles Control .............. 1632
\textit{Joan Marti, Alicia Casals and Joan Batlle}

Manufacturing Primitive-Based Object Identification Using Recognition-by-Components .......................... 1638
\textit{Leda Villalobos and Francis L. Merat}

Vector Quantized Binary Features for Visual Pose Measurement .................................................. 1645
\textit{John Krumm}

\textit{xxvi}
Recognition of 2D Shapes Through Contour Metamorphosis
N.P. Papanikolopoulos, R. Singh and I. Pavlidis

MODELING & SIMULATION II

Dragline Modelling and Control
Peter I. Corke, Graeme J. Winstanley and Jonathan M. Roberts

Modelling and Simulation of an Electro-Hydraulic Mining Manipulator
Peter I. Corke, Zheng D. Li and Hal Z. Gurgenci

Friction Diagnostics and Modeling Using DFT Analysis
M.R. Popovic and A. A. Goldenberg

Dynamic Simulation as a Design Tool for a Microactuator Array
Dan Reznik, Stan Brown and John Canny

MOBILE ROBOTS - MODELING

Automatic Mapping of Dynamic Office Environments
Illah R. Nourbakhsh, Clayton Kunz and Thomas Willeke

A Stochastic Environment Modelling Method for Mobile Robot by Using 2-D Laser Scanner
Jin S. Lee and Young D. Kwon

Stereo Vision Based Mapping and Navigation for Mobile Robots
Cullen Jennings and Don Murray

Sonar Based Map Building for a Mobile Robot
Kok Seng Chong and Lindsay Kleeman

INTELLIGENT CONTROL I

Learning Tasks From A Single Demonstration
Christopher G. Atkeson and Stefan Schaal

Automatic Fixture Synthesis in 3D
Kamen Penev and Aristides A. G. Requicha

Visual Servoing of Nonholonomic Cart
Koichi Hashimoto and Toshiro Noritsugu

Modular Controls Design for Robot Manipulators Using CMAC Neural Networks
S. Commuri and S. Jagannathan
ROBOT CONTROL

Decentralized Adaptive Control for Robot Arm Tracking ........................................... 1731
   Ming Liu

Touch-Driven Robot Control Using a Tactile Jacobian ........................................... 1737
   Hong Zhang, Ning N. Chen and Ray E. Rink

An Experimental Procedure for Autonomous Joint Sensor Estimation Using Adaptive Control ........ 1743
   Vincent Hayward and Oliver Astley

Intelligent Torque Sensing and Robust Torque Control of Harmonic Drive Under Free-Motion ........ 1749
   H.D. Taghirad and P.R. Belanger

DESIGN OF MICROROBOTIC SYSTEMS & MICRO COMPONENTS

The Intelligent Motion Surface: A Hardware/Software Tool for the Assembly of Meso-Scale Devices .... 1755
   Peter M. Will, Murilo G. Coutinho and P. Selvan Viswanathan

Vacuum Tool for Handling of Microobjects in a Nanorobot ...................................... 1761
   Wolfgang Zesch, Markus Brunner and Ariel Weber

PLIF: Piezo Light Intelligent Flea - New Micro-Robots Controlled by Self-Learning Techniques ....... 1767
   G. Muscato, F. De Ambroggi and L. Fortuna

A New Inter-Phalangeal Actuator for Dexterous Micro-Grippers ................................... 1773
   Nelly Troisfontaine, Philippe Bidaud and Guillaume Morel

Vector Fields for Task-level Distributed Manipulation: Experiments with Organic Micro Actuator Arrays . 1779
   Karl-Friedrich Bohringer, John W. Suh, Bruce Randall Donald and Gregory T.A. Kovacs

MULTIPLE MANIPULATOR CONTROL II

Modeling and Impedance Control of a Two-Manipulator System Handling A Flexible Beam .......... 1787
   Dong Sun and Yunhui Liu

A Closed-Chain Jacobian-Based Hybrid Control for Two Cooperating Arms with a Passive Joint:
   An Application to Sawing Task .............................................................................. 1793

Distributed Impedance Control of Multiple Robot Systems ......................................... 1801
   Jérôme Szewczyk, Guillaume Morel and Philippe Bidaud

An Experimental Comparison of Tradeoffs in Using Compliant Manipulators for Robotic Grasping Tasks . 1807
   Sudipto Sur and Richard M. Murray
Volume 3 (pages 1815-2734)

AUTOMATION APPLICATIONS

A Robotic System for Rapid Prototyping ................................................. 1815
W.C. Tse and Y. H. Chen

Automatic Landing Method of a Reclaimer on the Stockpile ...................... 1821
Chintae Choi, Hyunsik Ahn, Kwanhee Lee and Kiiae Shin

Dragline Swing Automation ................................................................. 1827
Graeme J. Winstanley, Peter I. Corke and Jonathan M. Roberts

Towards Automatic Container Handling Cranes ....................................... 1833
M.W.M.G. Dissanayake, D.C. Rye and H.F. Durrant-Whyte

UNDERWATER ROBOTICS I

Decreasing the Energy Costs of Swimming Robots Through Passive Elastic Elements .............................. 1839
Karen A. Harper, Mathew D. Berkemeier and Sheryl Grace

Comparison Study on Advanced Thruster Control of Underwater Robots .......... 1845
J. Yuh, C.L. Tsukamoto, W. Lee, S.K. Choi and J. Lorentz

Visual Servoing Techniques Applied to an Underwater Vehicle .................. 1851
Patrick Rives and Jean-Jaques Borrelly

Issues in AUV Design and Deployment for Oceanographic Research .............. 1857
Hanumant Singh, Dana Yoerger and Albert Bradley

SERVICE ROBOTICS

Office Waste Cleanup: An Application for Service Robots ......................... 1863
E. Prassler, E. Stroulia and M. Strobe1

A Rubbertuator-Based Structure-Climbing Inspection Robot ....................... 1869
Robert T. Pack, Joe L. Christopher Jr. and Kazuhiko Kawamura

Teachingless Spray-Painting of Sculptured Surface by an Industrial Robot .... 1875
Naoki Asakawa and Yoshimi Takeuchi

Autonomous Robot Navigation for Precision Horticulture .......................... 1880
T. Hague, J.A. Marchant and N.D. Tillett

TELEROBOTICS & TELEOPERATION III

Mobile Vehicle’s Egomotion Estimation from Time Varying Image Sequences .... 1886
A. Branca, G. Cicirelli, E. Stella and A. Distante

xxix
Frequency Domain Modeling of Aided GPS with Application to High-Speed Vehicle Navigation Systems  .  1892
  E.M. Nebot, H. Durrant-Whyte and S. Scheding

Experiments in Autonomous Underground Guidance ......................................................... 1898
  E.M. Nebot, H. Durrant-Whyte, S. Scheding, J. Roberts, P. Corke, J. Cunningham,
  B. Cook and M. Stevens

Slip Modelling and Aided Inertial Navigation of an LHD .................................................. 1904
  E. Nebot, H. Durrant-Whyte, S. Scheding and G. Dissanayake

CONTROLS - PARAMETER IDENTIFICATION

On Parameter Identification of Robot Manipulators ............................................................. 1910
  Fernando Reyes and Rafael Kelly

Adaptive Control of Mixed Rigid/Flexible Joint Robot Manipulators Based on Virtual Decomposition . 1916
  Wen-Hong Zhu and Joris De Schutter

Dynamic Identification of Robots with Power Model .......................................................... 1922
  Maxime Gautier

Parameter Identification for Dynamic Simulation .............................................................. 1928
  A. Joukhadar, Ch. Laugier and F. Garat

STEREO VISION

Real-Time Color Stereo Vision System for a Mobile Robot Based on Field Multiplexing ............ 1934
  Yoshio Matsumoto, Tomohiro Shibata, Katsuhiko Sakai, Masayuki Inaba and Hirochika Inoue

Vision Based Model Generation for Indoor Environments .................................................. 1940
  C. Eberst, D. Burschka and C. Robl

Optimal Stereo Mast Configuration for Mobile Robots ......................................................... 1946
  Wesley H. Huang and Eric P. Krotkov

Adaptive Variable Baseline Stereo for Vergence Control .................................................. 1952
  William Klarquist and Alan Bovik

MODELING & SIMULATION III

Modeling of Plain Knitted Fabrics for Their Deformation Control ......................................... 1960
  Takahiro Wada, Shinichi Hirai, Tatsuya Hirano and Sadao Kawamura

Simulation of FMS with Application of Reuse and Object-Oriented Technology .................... 1966
  George L. Kovács, Sándor Kopáčsi and Ildikó Kmecs

Dynamical Simulation of Assemblies of Planar, 1DOF Parts with Changing Contacts Using
  Configuration Spaces ....................................................................................................... 1972
  Elisha Sacks and Leo Joskowicz
Assembly Automation Using Vibratory End Effector: Modeling and Stability Analysis .......................... 1980
Sooyong Lee and Haruhiko Asada

**MOBILE ROBOTS PLANNING & CONTROL**

Characterization of Monoped Equilibrium Gaits .................................................. 1986
Daniel E. Koditschek and William J. Schwind

Vision Based Navigation System Considering Error Recovery for Autonomous Mobile Robot ........ 1993
Toshio Fukuda, Yasunori Abe, Fumihito Arai, Yasunari Yokoyama and Yoshio Tanaka

Temporally Coherent Stereo: Improving Performance Through Knowledge of Motion .............. 1999
Vladimir Tucakov and David G. Lowe

A Crash Avoidance System Based Upon the Cockroach Escape Response Circuit ................. 2007
Roger D. Quinn, Chun-Ta Chen and Roy E. Ritzmann

**INTELLIGENT CONTROL II**

Generating and Evaluating Regrasp Operations .................................................. 2013
F. Röhrdanz and F.M. Wahl

A Model-Based Online Control of Optimal Fixturing Process .................................. 2019
J.Y.H. Fuh, Y.F. Wang and Y.S. Wong

A Two-Level Search Algorithm for Motion Planning ........................................... 2025
Pekka Isto

A Quasi-Linear Method for Computing and Projecting onto C-Surfaces: Planar Case .......... 2032
George V. Paul and Katsushi Ikeuchi

**ROBOT CONTROL DESIGN**

Controller Design for Multiple Simultaneous Specifications with Application to Robotic Systems ........ 2038
Hugh T. Liu and James K. Mills

Minimum Effort Motions for Open Chain Manipulators with Task-Dependent End-Effector Constraints ................................................................. 2044
James E. Bobrow and Bryan J. Martin

Preliminary Studies of a Second Generation Brachiation Robot Controller ...................... 2050
Daniel E. Koditschek, Jun Nakanishi and Toshio Fukuda

On Robust Impedance Force Control of Robot Manipulators .................................... 2057
Seul Jung, T.C. Hsia and R.G Bonitz
SENSOR FUSION

Target Identification with Multiple Logical Sonars Using Evidential Reasoning and Simple Majority Voting .................................................. 2063
Billur Barshan, Birsel Ayrulu and Simukai W. Utete

Nadaraya-Watson Estimator for Sensor Fusion Problems ................................................. 2069
Nageswara S. V. Rao

Uncertainty Self-Management with Perception Net Based Geometric Data Fusion .......... 2075
Sukhan Lee and Sookwang Ro

Cooperative Multi-Robot Observation of Multiple Moving Targets ............................. 2082
Lynne E. Parker and Brad A. Emmons

ISSUES IN MULTIPLE MANIPULATION

Evolutionary Action Maps for Navigating a Robot in an Unknown, Multidimensional, Stationary Environment, Part II: Implementation and Results ................. 2090
Ahmad A. Masoud and Samer A. Masoud

Two Mobile Robots Sharing Topographical Knowledge Generated by the Region-Feature Neural Network ........................................ 2097

Time-Suboptimal Inspection Task Sequence Planning for Two Cooperative Robot Arms Using Mixed Optimization Algorithms .................................. 2103
Bailin Cao, Gordon I. Dodds and George W. Irwin

Multi-Arm/Finger Grasping: One View to the Stability Problem .................................. 2109
M. M. Svinin, M. Kaneko and T. Tsuji

Design of Cooperating Spherical RPR Robots ......................................................... 2115
Pierre M. Larochelle

DISCRETE EVENTS MANUFACTURING SYSTEMS

Supervisory Control of a Discrete Event System to Get a Desired Internal Behavior .......... 2121
Hong-ju Moon and Wook Hyun Kwon

Feedback Control of Manufacturing Systems Using Controlled Marked Graphs with Time Constraints .................................................. 2127
Wook Hyun Kwon, Hyeok Gi Park and Hong-ju Moon

Control of Discrete Event Systems Modelled by Continuous Petri Nets - Case of Opened Manufacturing Lines ............................................ 2133
A. Amrah, N. Zerhouni and A. El Moudni

Automatic Control-Code Generation from Simulation for Flexible Material Handling Systems .......................... 2139
Wyatt S. Newman, Chrysanthie D. Chamis and Scott A. Ameduri

xxxii
UNDERWATER ROBOTICS II

AMADEUS: Advanced MANupulation for DEep Underwater Sampling .......................................................... 2145
D.M. Lane, J.B.C. Davies, G. Robinson, D.J. O'Brien, M. Pickett, D. Jones, E. Scott, Y. Wang,
G. Casalino, G. Bartolini, G. Cannata, A. Ferrara, D. Angelleti, M. Coccoli, G. Veruggio,
R. Bono, P. Virgili, G. Bruzzone, M. Canals, R. Pallas, E. Gracia and C. Smith

Biomimetic Robotic Propulsion Using Polymeric Artificial Muscles .......................................................... 2152
Mehran Mojarrad and Mohsen Shahinpoor

Design of Control Procedures for a Free-Floating Underwater Manipulation System .......................... 2158
D. Simon, K. Kapellos and B. Espiau

Modeling and Control for Underwater Robotic Manipulators - An Example ........................................ 2166
T.J. Tarn and S.P. Yang

ROBOT DESIGN

Design of Cuspidal and Non-Cuspidal Robot Manipulators ................................................................. 2172
P. Wenger

Designing Robots for Optimal Performance During Repetitive Motion ................................................ 2178
Sunil K. Agrawal and Tawiwat Veeraklaew

Experimental Analysis of the Disturbances Affecting Contact Force in Industrial Robots .............. 2184
Gianantonio Magnani, Gianni Ferretti and Paolo Rocco

Structural Design Optimization and Comparative Analysis of a New High-Performance Robot Arm via Finite Element Analysis .......................................................... 2190
Louis L. Whitcomb and Jaydeep Roy

TELEROBOTICS & TELEOPERATION IV

Diagonalization of Telerobotic Hand Controller Impedance for Accurate Force and Velocity Transmission . 2198
R.V. Dubey, S.E. Everett and T.F. Chan

A Model-Based Concept for Telerobotic Control of Decontamination and Dismantlement Tasks .......... 2204
W.R. Hamel, S.K. Marland and T.C. Widner

Designing Force Reflecting Teleoperators with Large Time Delays to Appear as Virtual Tools ........ 2212
Günter Niemeyer and Jean-Jacques E. Slotine

Bilateral Feedback Control of Telemanipulator via Computer Network in Discrete Time Domain .......... 2219
Kazuhiro Kosuge and Hideyuki Murayama

ROBOT SYSTEMS CONTROL

Energy Shaping Based Controllers for Rigid and Elastic Joint Robots: Analysis via Passivity Theorems .... 2225
Victor Santibañez and Rafael Kelly
Proposal of the Law-of-Inertia (Friction/Gravity-Free) Robots ................................................. 2232
S. Arimoto, H. Koga and T. Naniwa

Experimental Verification of Control Algorithms for a One Link Geared Robot ........................................ 2240
Krzysztof Kozlowski

Planning Controlled Slips In Dexterous Manipulation ................................................................. 2246
Shahram Payandeh

VISION APPLICATIONS

Estimation of Position and Orientation from Image Sequence of a Circle ............................................. 2252
Machiko Sato and J.K. Aggarwal

Gaze Control Using Human Eye Movements .................................................................................... 2258
François Chaumette and Fabien Spindler

Depth Estimation from a Sequence of Images Using Spherical Projection ........................................... 2264
M. Hanmandlu, V. Shantaram and K. Sudheer

Camera Settings for Dimensional Inspection Using Displacement and Quantization Errors .................. 2270
Michael M. Marefat, Kevin L. Crosby, Frank W. Ciarallo and Christopher C. Yang

MODELING & SIMULATION IV

Dynamic Multi-Rigid-Body Systems with Concurrent Distributed Contacts ........................................ 2276
Jeffrey C. Trinkle and Jong-Shi Pang

A Coordinate-Free Description of Robot Dynamics ............................................................................ 2282
F.C. Park

Automatic Generation of Dynamics for Modular Robots with Hybrid Geometry .................................... 2288
I-Ming Chen and Guilin Yang

Drum Roll: Increasing Bandwidth Through Passive Impedance Modulation ..................................... 2294
Robert D. Howe, Aram Z. Hajian and Daniel S. Sanchez

MULTIPLE MOBILE ROBOTS

Adaptive Formation Control for Distributed Autonomous Mobile Robot Groups .............................. 2300
Hiroaki Yamaguchi

Dynamic Robot Planning: Cooperation Through Competition ......................................................... 2306
Edward W. Large, Henrik I. Christensen and Ruzena Bajcsy

Operating a Large Fleet of Mobile Robots Using the Plan-Merging Paradigm .................................... 2312
R. Alami, S. Fleury, M. Herrb, F. Ingrand and S. Qutub
Constrain and Move: A New Concept to Develop Distributed Object Transferring Protocols ............... 2318
Majid Nili Ahmadabadi and Nakano Eiji

DESIGN & ANALYSIS ISSUES

Arm-Manipulator Coordination for Load Sharing Using Reflexive Motion Control ......................... 2326
Yuan F. Zheng and Omar M. Al-Jarrah

A 3-D Modular Gripper Design Tool ................................................................. 2332
Russell G. Brown and Randy C. Brost

Fuzzy Routing of Queueing Systems with Heterogeneous Servers ........................................ 2340
Yannis A. Phillis and Runtong Zhang

A General Method for Accessibility Analysis ........................................................................ 2346
Hoda A. ElMaraghy and Anis Limaiem

ROBUST CONTROL

Nonlinear Optimization of Robust H∞ Controllers for Industrial Robot Manipulators ................. 2352
Michel F. de Mathelin, Hansjörg G. Sage, Gabriel Abba, Jacques A. Gangloff and Eric Ostertag

Robust Control of Manipulators Using Hamiltonian Optimization ............................................ 2358
W.K. Chung, Youngjin Choi and Y. Youm

Robustness and Performance Tradeoffs in Torque Control of Robots with Harmonic Drive Transmission ................................................................. 2365
Majid M. Moghaddam and Andrew A. Goldenberg

A New Type of Robust Tracking Control of Robot Manipulators Based on Generalized SP-D Control Scheme ................................................................. 2371
Masayuki Fujita and Natsuo Tanaka

FLEXTURE CONTROL / CAD-DIRECTED MANIPULATION

A Comparison of Real and Simulated Designs for Vibratory Parts Feeding .................................... 2377
Dina R. Berkowitz and John Canny

Sensorless Parts Orienting with a One-Joint Manipulator ............................................................ 2383
Matthew T. Mason, Srinivas Akella, Wesley H. Huang and Kevin M. Lynch

Mechanics for Vibratory Manipulation ....................................................................................... 2391
Wesley H. Huang and Matthew T. Mason

Study of Deformation and Insertion Tasks of a Flexible Wire .................................................... 2397
Hirofumi Nakagaki, Kosei Kitagaki, Tsukasa Ogawara and Hideo Tsukune
REDUNDANT MANIPULATOR III

Stabilization Constraint Method for Torque Optimization of a Redundant Manipulator .................................... 2403
Yong-San Yoon and Ick-Chan Shim

The Improved Parallel Scheme for Multiple-Goal Priority Considerations of Redundant Manipulators ...... 2409
Fan-Tien Cheng, Ming-Shan Shih, Fan-Chu Kung and York-Yin Sun

Trajectory Planning of Redundant Manipulators for Minimum Energy Consumption without Matrix Inversion ....................................................................................................... 2415
Andre R. Hirakawa and Atsuo Kawamura

Joint Configuration Conservation and Joint Limit Avoidance of Redundant Manipulators ......................... 2421
Charles C. Nguyen and Zhen-Lei Zhou

PART FEEDING & MANIPULATION

Avoiding Deadlocks in Automated Manufacturing Systems with Shared Material Handling System ...... 2427
Naiqi Wu

Nonprehensile Manipulation for Orienting Parts in the Plane ................................................................. 2433
Nina B. Zumel and Michael A. Erdmann

Tuning Robotic Part Feeder Parameters to Maximize Throughput .......................................................... 2440
Ken Goldberg and Dadi Gudmundsson

Part Orientation with Programmable Vector Fields: Two Stable Equilibria for Most Parts ...................... 2446
Lydia E. Kavraki

HABITAT ROVERS

Automatic Mountain Detection and Pose Estimation for Teleoperation of Lunar Rovers ......................... 2452
Fabio Cozman and Eric Krotkov

The Rocky 7 Rover: A Mars Sciencecraft Prototype .................................................................................... 2458

Mars Surveyor '98 Lander MVACS Robotic Arm Control System Design Concepts ................................. 2465
Robert G. Bonitz

Automation of Bioregenerative Habitats for Space Environments ........................................................... 2471
Kristin M. Lai-Fook and Robert O. Ambrose

EXPLORATION WITH TOUCH

Pulling Motion Based Tactile Sensing for Concave Surface ....................................................................... 2477
Makoto Kaneko, Mitsuru Higashimori and Toshio Tsuji

xxxvi
Haptic Exploration of Objects with Rolling and Sliding ........................................ 2485
A.M. Okamura, M.L. Turner and M.R. Cutkosky

Mechano Thermo and Proprioceptor Feedback for Integrated Haptic Feedback .......... 2491
Darwin G. Caldwell, N. Tsagarakis and A. Wardle

A Remote-Brained Full-Body Humanoid with Multisensor Imaging System of Binocular Viewer, Ears, Wrist Force and Tactile Sensor Suit ........................................ 2497
Masayuki Inaba, Tetsuo Ninomiya, Yukiko Hoshino, Kenichiro Nagasaka, Satoshi Kagami and Hirochika Inoue

CAD MODELS: DEVELOPMENT & USE

Simplifying Complex CAD Geometry with Conservative Bounding Contours ............... 2503
Yan Zhuang, Ken Goldberg and Mary Pickett

A Robotic System for 3-D Model Acquisition from Multiple Range Images .................. 2509
Peter K. Allen and Michael K. Reed

A Model and Inferencing Mechanism for Spatial Reasoning with Manufactured Components .......... 2515
Michael M. Marefat and Erik J. Johnson

Tolerance Analysis and Synthesis by Interval Constraint Networks ......................... 2522
Michael M. Marefat, Christopher C. Yang and Frank W. Ciarallo

FLEXTURE CONTROL

Experiments on Reaction Null-Space Based Decoupled Control of a Flexible Structure Mounted Manipulator System ................................................................. 2528
D.N. Nenchev, K. Yoshida, P. Vichitkulsawat, A. Konno and M. Uchiyama

Significance of Spline Curve in Path Planning of Flexible Manipulator .................... 2535
Akira Mohri, Pritam Kumar Sarkar and Motoji Yamamoto

On the Improvement of Tracking Performance of Flexible Robot Arm Using FFT Method ................................................................. 2541
Lilong Cai and Xiaoqi Tang

Observer Design for Flexible Joint Manipulators with Parameter Uncertainties ............. 2547
Pierre Sicard and Nicolas Léchevin

VISION-BASED SYSTEMS

Obstacle Location Estimation Using Planar Projection Stereopsis Method .................... 2553
Kazunori Onoguchi, Nobuyuki Takeda and Mutsumi Watanabe

An Interactive System for Creating Object Models from Range Data Based on Simulated Annealing ................. 2559
William A. Hoff, Frederick W. Hood and Robert H. King

xxxvii
Color-Feature-Based Finger Tracking for Breast Palpation Quantification ........................................ 2565
  Jianchao Zeng, Yue Wang, Matthew Freedman and Seong K. Mun

Non-Contact Impedance Control for Redundant Manipulators Using Visual Information ....................... 2571
  Toshio Tsuji, Hiromasa Akamatsu and Makoto Kaneko

FAULT TOLERANCE I

Providing Fault Tolerance for Active Vision Systems in Real-Time ..................................................... 2577
  Jeffrey A. Fayman, Ehud Rivlin and Daniel Mossé

An Analysis of the Post-Fault Behavior of Robotic Manipulators ......................................................... 2583
  A.A. Maciejewski, M. Goel and V. Balakrishnan

Grid Based Fault Detection and Calibration of Sensors on Mobile Robots .............................................. 2589
  Martin Soika

Real-Time Failure-Tolerant Control of Kinematically Redundant Manipulators .................................... 2595
  A.A. Maciejewski, K.N. Groom and V. Balakrishnan

NONHOLONOMIC MOBILE ROBOTS I

Wheel Rolling Constraints and Slip in Mobile Robots ............................................................................. 2601
  Shashank Shekhar

Minimum Time Motion of a Mobile Robot with Two Independent, Acceleration-Driven Wheels ................ 2608
  Jean-Yves Fourquet and Marc Renaud

A Hybrid Feedback Control System for a Nonholonomic Car-Like Vehicle ........................................ 2614
  F. Lobo Pereira, J. Almeida and J. Borges Sousa

Introducing the “Sphericle”: An Experimental Testbed for Research and Teaching in Nonholonomy ........ 2620
  Antonio Bicchi, Andrea Balluchi, Domenico Prattichizzo and Andrea Gorelli

NEURAL NETWORKS & ROBOT CONTROL I

A Hybrid Learning Architecture Based on Neural Networks for Adaptive Control of a Walking Machine ... 2626
  Winfried Ilg, Thomas Mühlriedel and Karsten Berns

Robot Compliance Control Algorithm Based on Neural Network Classification and Learning of Robot-
Environment Dynamic Models ................................................................................................................. 2632
  Miomir Vukobratović and Duško Katić

Cerebellar Learning for Control of a Two-Link Arm in Muscle Space .................................................. 2638
  Andrew H. Fagg, Nathan Sitko, Andrew G. Barto and James C. Houk

A Neural Network Robust Controller for a Class of Nonlinear MIMO Systems .................................... 2645
  D.Y. Meddah, A Benallegue and A.R. Cherif
PARALLEL MANIPULATORS I

Operational Quality Analysis of Parallel Manipulators with Actuation Redundancy
Sungbok Kim .................................................. 2651

The 321-HEXA: A Fully-Parallel Manipulator with Closed-Form Position and Velocity Kinematics
Herman Bruyninckx ........................................... 2657

Analysis for a Planar 3 Degree-of-Freedom Parallel Mechanism with Actively Adjustable Stiffness Characteristics
Whee-Kuk Kim, Byung Ju Yi and Jun-Yong Lee .................................................. 2663

A Singularity-Consistent Parameterization Based Direct Kinematics Algorithm for a Class of Parallel Manipulators
S. Bhattacharya, D. N. Nenchev and M. Uchiyama ........................................... 2671

KINEMATICS I

Experimental Identification of Kinematic Constraints
Pierre E. Dupont, Timothy M. Schulteis and Robert D. Howe .................................................. 2677

Natural Motion Analysis Based on the Singularity-Consistent Parameterization
D.N. Nenchev and M. Uchiyama .................................................. 2683

Trajectory Generation for Kinematic Legged Robots
Bill Goodwine and Joel Burdick .................................................. 2689

Qualitative Transitions in Object Reorienting Behaviour -- Part 1: The Effects of Varying Friction
Graham E. Deacon, Mark Wright and Chris Malcolm .................................................. 2697

PATH PLANNING

A Practical Motion Planning Strategy Based on a Plane-Sweep Approach
Enrico Pagello and Claudio Mirolo .................................................. 2705

Demonstrated Trajectory Selection by Hidden Markov Model
S.K. Tso and K.P. Liu .................................................. 2713

Path Planning in Expansive Configuration Spaces
David Hsu, Jean-Claude Latombe and Rajeev Motwani .................................................. 2719

Optimal Route Re-Planning for Mobile Robots: A Massively Parallel Incremental A* Algorithm
Nicholas Flann, Ma Tao, Amr Elssamadisy and Ben Abbott .................................................. 2727
Volume 4 (pages 2735-3620)

PROCESS PLANNING & CONTROL

Scheduling Method with the Consideration of Machine Setup in Flexible Manufacturing Systems .............................................. 2735
Doo Yong Lee and Seong Jin Yim

Colored Timed Petri Net Based Statistical Process Control and Fault Diagnosis to Flexible Manufacturing Systems .............................................. 2741
Han-Pang Huang and Chung-Hseng Kuo

Feature-Less Approach to Process Planning .................................................. 2747
Amitabha Mukerjee and Neelesh Kumar Jain

A Systems Engineering Approach to the Design of an Integrated Decision Support System for a Textile Company .............................................. 2753
G. Gonçalves, J. Borges Sousa and F. Lobo Pereira

SPACE ROBOT CONTROL

Control of Residual Vibrations in the Space Shuttle Remote Manipulator System .............................................. 2759
R.V. Patel, S. Kalaycioglu and H.P. Xie

Dynamically Equivalent Manipulator for Space Manipulator System: Part 1 .............................................. 2765
Yangsheng Xu, Bin Liang and Marcel Bergerman

Stability Aspects of Vision-Based Control for Space Robots .............................................. 2771
Michael E. Stieber, George Vukovich and Emil Petriu

A Study on an Adaptive Gait for a Quadruped Walking Robot under External Forces .............................................. 2777
Dong-Oh Kang, Yun-Jung Lee, Yeh Sun Hong, Zeungnam Bien and Seung-Ha Lee

ESTIMATION USING SENSORY INFORMATION

Accurate Odometry and Error Modelling for a Mobile Robot .............................................. 2783
Lindsay Kleeman and Kok Seng Chong

Active Self-Calibration of Hand-Mounted Laser Range Finders .............................................. 2789
Guo-Qing Wei and G. Hirzinger

Collaborative Calibration: Extending Shape from Motion Calibration .............................................. 2795
Richard M. Voyles and Pradeep K. Khosla

An Auto-Focusing Measurement System with the Piezoelectric Translator .............................................. 2801
Lilong Cai and Ji-Hua Zhang
GEOMETRIC REASONING IN WORLD MODELING

Rapid World Modeling: Fitting Range Data to Geometric Primitives ............................................... 2807
John T. Feddema and Charles Q. Little

Fast Generation of Adaptive Quadrilateral Meshes from Range Images ........................................ 2813
Miguel Angel García, Angel Domingo Sappa and Luis Bisañez

Shape Description of General, Curved Surfaces Using Tactile Sensing and Surface Normal Information ... 2819
S. Payandeh, M. Charlebois and K. Gupta

Embeding Rotations in Translational Configuration Space .............................................................. 2825
Jan Rosell, Luis Bisañez and Raúl Suárez

FLEXTURE CONTROL II

Vibration Suppression Control of Constrained Spatial Flexible Manipulators ...................................... 2831
Jin-Soo Kim, Kuniaki Suzuki, Mitsuhiro Yamano and Masaru Uchiyama

An Experimental Study of Contact Transition Control of a Single Flexible Link using Positive Acceleration Feedback ................................................................. 2838
Stewart J. Moorehead and David Wang

Nonlinear Adaptive Control of a Flexible Manipulator for Automated Deburring .................................. 2844
Li-Chen Fu and Ling-Hui Chang

Contact Control of Flexible Micro/Macro-Manipulators ....................................................................... 2850
Jae Y. Lew

VISUAL SERVOING

On Optimising Tracking Performance for Visual Servoing ................................................................. 2856
Markus Vincze and Carl F.R. Weiman

Vision-Guided Robot Manipulator Control as Learning and Recall Using SHOSLIF ............................. 2862
Wey-Shiuan Hwang and John (Juyang) Weng

Real-Time Visual Tracking of 3-D Objects with Dynamic Handling of Occlusion ................................ 2868
P. Wunsch and G. Hirzinger

Experimental Evaluation of Uncalibrated Visual Servoing for Precision Manipulation ....................... 2874
Martin Jägersand, Olac Fuentes and Randal Nelson

FAULT TOLERANCE II

Observer-Based Fault Detection for Robot Manipulators ....................................................................... 2881
Fabrizio Caccavale and Ian D. Walker
Calibration of a Hand/Eye Matrix and a Connection Matrix Using Relative Pose Measurements .......................... 2888
Hanqi Zhuang and Andreas Melchinger

Euclidean-Space Measures of Robotic Joint Failures ................................................................. 2894
James D. English and Anthony A. Maciejewski

Effect of Kinematic Structure and Dual Actuation on Fault Tolerance of Robot Manipulators ............... 2902
Vittorio Monteverde and Sabri Tosunoglu

NONHOLONOMIC MOBILE ROBOTS II

A New Line Tracking Method for Nonholonomic Vehicles ....................................................... 2908
Yutaka J. Kanayama and Fariba Fahroo

Including a Non-Holonomic Constraint in the FSP (Full Space Parameterization) Method for Mobile Manipulators’ Motion Planning ....................................................... 2914
François G. Pin, Charles J. Hacker, Kathryn B. Gower and Kristi A. Morgansen

Dynamic Path Modification for Car-Like Nonholonomic Mobile Robots ........................................ 2920
R. Chatila, M. Khatib, H. Jaouni and J.P. Laumond

Ease of Dynamic Modelling of Wheeled Mobile Robots (WMRs) Using Kane’s Approach ............... 2926
R. Rajagopalan and K. Thanjavur

NEURAL NETWORKS & ROBOT CONTROL II

Neural Network Adaptive Sliding Mode Control and its Application to SCARA Type Robot Manipulator ... 2932
Okyay Kaynak and Melikşah Ertuğrul

Performance Improvement of Flexible Material Handling Robot by Error Detection and Replanning .... 2938
Fumihito Arai, Hidekazu Niu and Toshio Fukuda

Acquisition of Visually Guided Swing Motion Based on Genetic Algorithms and Neural Networks in Two-Armed Bipedal Robot ................................................................. 2944
Ken’ichiro Nagasaka, Masayuki Inaba, Hirochika Inoue and Atsushi Konno

Rapid Unsupervised Connectionist Learning for Backing a Robot with Two Trailers ...................... 2950
Maria Gini, Dean F. Hougen and James Slagle

PARALLEL MANIPULATORS II

The Analytical Forward Displacement Kinematics of the “31-12” Parallel Manipulator ...................... 2956
Herman Bruyninckx

The Analytical Jacobian and its Derivative for a Parallel Manipulator ............................................. 2961
Stefan Dutrê, Herman Bruyninckx and Joris De Schutter

Kinematic Design of a Six Degree-of-Freedom In-Parallel Manipulator for Probing Task .................. 2967
A Methodology for Geometric Design of Closed Kinematic Chain Mechanisms ........................................ 2974
  C.C. Nguyen, M.D. Bryfogle, Z-L. Zhou and S.S. Antrazi

KINEMATICS II

Singularity-Consistent Inverse Kinematics of a 6 D.O.F. Manipulator with a Non-Spherical Wrist .............. 2980
  Y. Tsumaki, S. Kotera, D.N. Nenchev and M. Uchiyama

Geometrical Approach for the Workspace of a 6-DOF Parallel Manipulators .................................... 2986
  W.K. Chung, D.I. Kim and Y. Youm

Manipulation of Polyhedral Parts by Rolling .............................................................. 2992
  Antonio Bicchi, Alessia Marigo and Yacine Chitour

Control of Manipulators with Free-Joints via the Averaging Method ........................................ 2998
  Takahiro Suzuki and Yoshihiko Nakamura

KINESTHETIC VR

A Whole Body Kinesthetic Display Device for Virtual Reality Applications ................................ 3006
  Gerald P. Roston and Thomas Peurach

A Five-Bar-Linkage Force Reflecting Interface for a Virtual Reality System ................................ 3012
  Mennas Ching and David W. L. Wang

A Touch and Force Display System for Haptic Interface ......................................................... 3018
  Tsuneo Yoshikawa and Akihiro Nagura

Realization of a Virtual Sports Training System with Parallel Wire Mechanism ................................ 3025
  Tetsuya Morizono, Kazuhiro Kurahashi and Sadao Kawamura

SOFTWARE FOR MANUFACTURING

Graphical User Interface to Manipulate Objects in the Micro World with a High Precision Robot ............ 3031
  Miguel Rodriguez and Alain Codourey

Symbols Facilitate Programming of Industrial Robots ............................................................... 3037
  Detlef Zühike, Frank Möbius and Christoph Schröder

A Flexible Software Architecture for Agile Manufacturing ......................................................... 3043
  Yoohwan Kim, Ju-Yeon Jo, Virgilio B. Velasco Jr., Nicholas A. Barendt, Andy Podgurski,
  Gültekin Ozsoyoglu and Frank L. Merat

A Database Server Architecture for Agile Manufacturing ............................................................. 3048
  Gültekin Özsoyoglu, SungKil Lee, Huang-Cheng Kuo and N. Hürtan Balkir

xliv
**SPACE ROBOTS**

System Engineering Approach in Designing the Teleoperation System of the ETS-VII Robot Experiment Satellite ............................................................ 3054
*Mitsushige Oda*

Path Planning for a Tethered Space Robot ........................................... 3062
*M. Nohmi, D.N. Nenchev and M. Uchiyama*

Robotic Systems for the International Space Station ................................ 3068
*M.E. Stieber, C.P. Trudel and D.G. Hunter*

Autonomous Retrieval of Tumbling Satellite Based on Predictive Trajectory ........................................... 3074
*Takashi Kubota, Hiroyuki Nagamatsu and Ichiro Nakatani*

**TACTILE SENSING**

A Tactile Sensor System for a Three-Fingered Robot Manipulator .............. 3080
*Ján Jockusch, Jörg Walter and Helge Ritter*

Acoustic Resonant Tensor Cell for Tactile Sensing ................................ 3087
*Hiroyuki Shinoda, Kenichi Matsumoto and Shigeru Ando*

Some Basic Issues in Teletaction .......................................................... 3093
*R.S. Fearing, G. Moy and E. Tan*

An Approach to Integrated Tactile Perception ........................................ 3100
*P. Dario, D. Takkeucci, C. Laschi, R. Lazzarini, R. Magni and A. Starita*

**GEOMETRY BASED MOTION PLANNING/CONTROL**

A Model-Free Decentralized Control for Robot Manipulators ................... 3106
*Lilong Cai and Xiaoqi Tang*

Enhancing GJK: Computing Minimum and Penetration Distances Between Convex Polyhedra ....................... 3112
*Stephen Cameron*

On Smooth and Safe Trajectory Planning in 2D Environments .................... 3118
*A. Elnagar and A.M. Hussein*

Nonholonomic Path Planning for Pushing a Disk Among Obstacles ............ 3124
*Pankaj K. Agarwal, Jean-Claude Latombe, Rajeev Motwani and Prabhakar Raghavan*

**FLEXURE CONTROL III**

Nonlinear Modeling and Robust $H\infty$-Based Control of Flexible Joint Robots with Harmonic Drives ........ 3130
*Majid M. Moghadam and Andrew A. Goldenberg*
<table>
<thead>
<tr>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental Study on Robust Force Control of a Flexible Arm with a Symmetric Rigid Tip Body</td>
<td>3136</td>
</tr>
<tr>
<td>Fumitoshi Matsuno, Satoshi Umeyama and Shozaburo Kasai</td>
<td></td>
</tr>
<tr>
<td>Experimental Results for Nonlinear Decoupling Control of Flexible Multi-Link Manipulators</td>
<td>3142</td>
</tr>
<tr>
<td>R.V. Patel, M. Moallem and K. Khorasani</td>
<td></td>
</tr>
<tr>
<td>Control of Robot Arms Using Joint Torque Sensors</td>
<td>3148</td>
</tr>
<tr>
<td>Guoguang Zhang and Junji Furusho</td>
<td></td>
</tr>
<tr>
<td>VISUAL SERVOING APPLICATIONS</td>
<td></td>
</tr>
<tr>
<td>Vision-Based Servoing Control for Legged Robots</td>
<td>3154</td>
</tr>
<tr>
<td>Koh Hosoda, Mitsuhiko Kamado and Minoru Asada</td>
<td></td>
</tr>
<tr>
<td>Real-Time Vehicle Following Through a Novel Symmetry-Based Approach</td>
<td>3160</td>
</tr>
<tr>
<td>Nikolaos P. Papanikolopoulos and Yue Du</td>
<td></td>
</tr>
<tr>
<td>Towards Visually Servoed Manipulation of Car Engine Parts</td>
<td>3166</td>
</tr>
<tr>
<td>Visually Guided Microassembly Using Optical Microscopes and Active Vision Techniques</td>
<td>3172</td>
</tr>
<tr>
<td>Bradley J. Nelson and Barmeshwar Vikramaditya</td>
<td></td>
</tr>
<tr>
<td>CALIBRATION OF MANIPULATORS</td>
<td></td>
</tr>
<tr>
<td>Kinematic Calibration of a Re-Configurable Robot (RoboTwin)</td>
<td>3178</td>
</tr>
<tr>
<td>Nitin Juneja and A. A. Goldenberg</td>
<td></td>
</tr>
<tr>
<td>A Method for Industrial Robot Calibration</td>
<td>3184</td>
</tr>
<tr>
<td>Juha Röning and Alexander Korzun</td>
<td></td>
</tr>
<tr>
<td>Kinematic Calibration Using a Plane Constraint</td>
<td>3191</td>
</tr>
<tr>
<td>John M. Hollerbach and Milan Ikits</td>
<td></td>
</tr>
<tr>
<td>A Novel Kinematic Calibration Algorithm for Reconfigurable Robotic Systems</td>
<td>3197</td>
</tr>
<tr>
<td>I-Ming Chen and Guilin Yang</td>
<td></td>
</tr>
<tr>
<td>MODELING &amp; SIMULATION V</td>
<td></td>
</tr>
<tr>
<td>Using IDEF0 for Dynamic Process Analysis</td>
<td>3203</td>
</tr>
<tr>
<td>Lawrence Peters and John Peters</td>
<td></td>
</tr>
<tr>
<td>Using Simulation for Plant Monitoring in Real Time</td>
<td>3209</td>
</tr>
<tr>
<td>H.R. Nicholls, J.J. Rowland and M.G. Taylor</td>
<td></td>
</tr>
<tr>
<td>Simulation-Based Robot Cell Design in AdeptRapid</td>
<td>3214</td>
</tr>
<tr>
<td>John J. Craig</td>
<td></td>
</tr>
</tbody>
</table>
An Approach to Minimize Robotics System Development and Integration Time .................. 3220
R. Lumia, G. Starr, J. Wood, B. Jones, I.M. Shohet and E. Ledman

NEURAL NETWORK VISION & SENSING

High Speed Edge Detection by Sampling a Time Series with an Orthogonal Neural Network ................. 3226
M.E. Ulug

Real-Time Pose Estimation of 3-D Objects from Camera Images Using Neural Networks .................. 3232
P. Wunsch, S. Winkler and G. Hirzinger

Modular Neural-Visual Servoing Using a Neural-Fuzzy Decision Network .................. 3238
Q.M. Jonathan Wu and Kevin Stanley

Recognition of Plants with CTFM Ultrasonic Range Data Using a Neural Network .................. 3244
Neil L. Harper and Phillip J. McKerrow

PARALLEL MANIPULATORS III

Optimization of a Three DOF Translational Platform for Well-Conditioned Workspace .................. 3250
Richard E. Stamper, Lung-Wen Tsai and Gregory C. Walsh

A Coordinate Measuring Machine with Parallel Mechanisms ............................................. 3256
Hanqi Zhuang and Yingli Wang

Articular Velocities of Parallel Manipulators, Part II: Finding all the Robots with Fixed Extremal Articular Velocity for Performing a Fixed Cartesian Velocity Over a Whole Workspace .......... 3262
Jean-Pierre Merlet

Maximum Velocity Analysis of Parallel Manipulators ............................................. 3268
Patrick Huynh and Tatsuo Arai

UNDER-ACTUATED SYSTEM

Stabilization of Underactuated Robots: Theory and Experiments for a Planar 2R Manipulator .................. 3274
Giuseppe Oriolo, Alessandro De Luca and Raffaella Mattone

Minimum-Time Control of the Acrobot ............................................. 3281
Gary Boone

Nonlinear Regulation of an Underactuated System ............................................. 3288
B. Castillo-Toledo, L.E. Ramos and J. Alvarez

Dynamic Control of Underactuated Manipulators with Free-Swinging Passive Joints in Cartesian Space .... 3294
Ju-Jang Lee and Jin-Ho Shin
ROBOT FLEXIBILITY & MOBILITY

Experimental Evaluation of Neural Network Based Controllers for Tracking the Tip Position of a Flexible-Link Manipulator ................................................................. 3300
K. Khorasani, H.A. Talebi and R.V. Patel

Motion Planning and Control for Hilare Pulling a Trailer: Experimental Issues ................................................................. 3306
J.P. Laumond, S. Sekhavat, F. Lamiraux, G. Bauzil and A. Ferrand

A Simple Rest-to-Rest Control Command for a Flexible Link Robot ................................................................. 3312
M.H. Ang, Jr., H. Yang and H. Krishnan

Analysis of Requirements for High Speed Rough Terrain Autonomous Mobility ................................................................. 3318
Alonzo Kelly and Anthony Stentz

TASK ANALYSIS & SCHEDULING

Design and Analysis of a Dynamic Scheduler for a Flexible Assembly System ................................................................. 3334
Li-Chen Fu, Tz-Shian Huang and Yung-Yu Chen

A Hierarchical Architecture for Resource Allocation, Plan Execution, and Revision for Operation of a Network of Communications Antennas ................................................................. 3340
S.A. Chien, R.W. Hill Jr., A. Govindjee, X. Wang, T. Estlin, M.A. Griesel, R. Lam and K.V. Fayyad

Experimental Task Analysis ................................................................. 3348
Jane Mulligan and Alan K. Mackworth

Manipulation Task Primitives for Composing Robot Skills ................................................................. 3354
J. Daniel Morrow and Pradeep K. Khosla

MODELING, SIMULATION & CONTROL

Modeling, Simulation, and Control of a Hydraulic Stewart Platform ................................................................. 3360
D. Li and S.E. Salcudean

An Event-Driven Architecture for Controlling Behaviors of the Office Conversant Mobile Robot, Jijo-2 ................................................................. 3367
Toshihiro Matsui, Hideki Asoh, Isao Hara and Nobuyuki Otsu

Load Sharing of Decentralized-Controlled Multiple Mobile Robots Handling a Single Object ................................................................. 3373
Kazuhiro Kosuge, Tomohiro Oosumi and Kunihiko Chiba

Indoor Navigation with Uncertainty Using Sensor-Based Motions ................................................................. 3379
T. Siméon, M. Khatib, B. Bouilly and R. Chatila
VISION & LEARNING

Development of an Eye Movement Tracking Type Head Mounted Display: Capturing and Displaying Real Environment Images with High Reality .................................................. 3385
Kazuyo Iwamoto and Kazuo Tanie

Real-Time Visual Behaviors with a Binocular Active Vision System ........................................ 3391
Jorge Batista, Paula Peixoto and Helder Araújo

Pose-Independent Recognition of Convex Objects from Sparse Tactile Data ................................ 3397
Stefano Caselli, Giuseppe Beccari and Francesco Zanichelli

Robot Impedance Generation from Logic Task Description Through Progressive Learning .......... 3403
Boo-Ho Yang and Haruhiko H. Asada

MOTION PLANNING II

Nonholonomic Motion Planning for Multiple Mobile Manipulators ........................................... 3409
Jaydev P. Desai and Vijay Kumar

Snake Robot Free Climbing ........................................................................................................ 3415
Martin Nilsson

Self-Organizing Geometric Certainty Maps: A Compact and Multifunctional Approach to Map Building, Place Recognition and Motion Planning .................................................. 3421
J.A. Janät, M.W. White, J.C. Sutton III, W.E. Snyder, S.M. Scoggins and E. Grant

Sensor Based Planning for a Planar Rod Robot: Incremental Construction of the Planar Rod-HGVG ...... 3427
Howie Choset, Brian Mirtich and Joel Burdick

FLEXURE CONTROL IV

Control of Flexible Joint Robot System by Backstepping Design Approach .............................. 3435
Jin S. Lee and Jong H. Oh

Vibration Suppression Control of Robot Arms Using a Homogeneous-Type Electrorheological Fluid .... 3441
Junji Furusho, Guouang Zhang and Masamichi Sakaguchi

A Hybrid Numerical Method for Solving the Inverse Kinematics of a Class of Spatial Flexible Manipulators ........................................................................................................ 3449
Y.Q. Dai, A.A. Loukianov and M. Uchiyama

Time-Optimal Transportation of Flexible Payloads ..................................................................... 3455
M.D. Majors and R.J. Richards

AGENT-BASED APPROACHES

Flexible Agent-Based Robotic Assembly Cell .............................................................................. 3461
Jagdeep S. Basran, Emil M. Petriu and Dorina C. Petriu
An Approach for Monitoring and Control of Agent-Based Systems ................................................. 3467
S. Ramaswamy, A. Suraj and K.S. Barber

Agent-Based Design of Fault Tolerant Manipulators for Satellite Docking ........................................... 3473
Christiaan J.J. Paredis and Pradeep K. Khosla

Tropism-Based Cognition for the Interpretation of Context-Dependent Gestures ..................................... 3481
Richard M. Voyles, Arvin Agah, Pradeep K. Khosla and George A. Bekey

ISSUES IN ROBOTICS & AUTOMATION

Achieving Impedance Objectives in Robot Teleoperation ................................................................. 3487
Craig R. Carignan and David L. Akin

Design and Forward Kinematic Analysis of a Robotic Snake ............................................................. 3493
G. Migadis and K.J. Kyriakopoulos

Modeling of Sawyer Planar Sensor and Motor Dependence on Planar Yaw Angle Rotation .................. 3499
Jehuda Ish-Shalom

The OmniMate Mobile Robot-Design, Implementation and Experimental Results ................................. 3505
Johann Borenstein and John Evans

SORMA:: Interoperating Distributed Robotics Hardware ........................................................................ 3511
Jörg A. Walter

MOBILE ROBOTS - PATH PLANNING

When to Explicitly Replan Paths for Mobile Robots ............................................................................ 3519
Robin R. Murphy, Alisa Marzilli and Ken Hughes

Conflict-Free Motion of Multiple Mobile Robots Based on Decentralized Motion Planning and Negotiation ................................................................. 3526
Günther Schmidt and Kianoush Azarm

Heat Trails as Short-Lived Navigational Markers for Mobile Robots .................................................... 3534
R. Andrew Russell

Sensor-Based Planning with the Freespace Assumption ........................................................................ 3540
Sven Koenig and Yury Smirnov

NEURAL NETWORKS IN ROBOTICS

Augmenting the Human-Machine Interface: Improving Manual Accuracy ............................................ 3546
Cameron N. Riviere and Pradeep K. Khosla

Control of the Distributed Autonomous Robotic System Based on the Biologically Inspired Immunological Architecture ............................................................................. 3551
Naoki Mitsumoto, Toshio Fukuda, Fumihito Arai and Hidenori Ishihara
A Comparison of Direct and Model-Based Reinforcement Learning
Christopher G. Atkeson and Juan Carlos Santamaria

Collision-Free Path Planning with Neural Networks
Sukhan Lee and George Kardaras

ROBOT CONTROL ARCHITECTURES

Cobot Control
J. Edward Colgate, R. Brent Gillespie, Witaya Wannasuphoprasit and Michael A. Peshkin

Experimental Comparison of Hybrid and External Control Structures for a Mobile Manipulator
Clotilde Perrier, Lise Cellier and Pierre Dauchez

A Reusable Software Architecture for Manual Controller Integration
Mitch Pryor, Chetan Kapoor, Rich Hooper and Delbert Tesar

A Decentralized Object Impedance Controller for Object/Robot-Team Systems:
Theory and Experiments
William C. Dickson, Robert H. Cannon Jr. and Stephen M. Rock

INVERSE KINEMATICS

Lowest-Order Rate Control of Mechanisms Near Singularities
Kevin A. O'Neil, Y.C. Chen and J. Seng

A Predictive Algorithm for Rate Control of Mechanisms Near Singularities
Y.C. Chen, J. Seng and Kevin A. O'Neil

A Motion Planning Based Approach for Inverse Kinematics of Redundant Robots:
The Kinematic Roadmap
Kamal Gupta and Juan Manuel Ahuactzin

Towards an Efficient Interval Method for Solving Inverse Kinematic Problems
Albert Castellet and Federico Thomas