

PREFACE	ix
INTRODUCTION	1
C.T. Abdallah and F. L. Lewis	
PART 1 MOTION PLANNING	7
V. Lumelsky	
A New Algebraic Method for Robot Motion Planning and Real Geometry	9
J. Canny, <i>IEEE 28th Annual Symposium on Foundations of Computer Science Conference Record</i> (October 1987)	
Motion of Objects in Contact	19
J. Hopcroft and G. Wilfong, <i>The International Journal of Robotics Research</i> (Winter 1986)	
Effect of Kinematics on Motion Planning for Planar Robot Arms Moving Amidst Unknown Obstacles	34
V. J. Lumelsky, <i>IEEE Journal of Robotics and Automation</i> (June 1987)	
Robot Motion Planning: A Distributed Representation Approach	51
J. Barraquand and J. C. Latombe, <i>The International Journal of Robotics Research</i> (December 1991)	
PART 2 GEOMETRIC AND ASYMPTOTIC METHODS IN CONTROL	73
M. W. Spong	
On Manipulator Control by Exact Linearization	77
K. Kreutz, <i>IEEE Transactions on Automatic Control</i> (July 1989)	
Nonlinear Feedback in Robot Arm Control	82
T. J. Tarn, A. K. Bejczy, A. Isidori, and Y. Chen, <i>Proceedings of the IEEE Conference on Decision and Control</i> (December 1984)	
Dynamic Control of Robots with Joint Elasticity	98
A. De Luca, <i>Proceedings of the IEEE Conference on Robotics and Automation</i> (April 1988)	
Modeling and Control of Elastic Joint Robots	105
M. W. Spong, <i>ASME Journal of Dynamic Systems, Measurement, and Control</i> (December 1987)	
PART 3 ROBUST CONTROL	115
M. W. Spong	
Survey of Robust Control for Rigid Robots	117
C. Abdallah, D. Dawson, P. Dorato, and M. Jamshidi, <i>IEEE Control Systems Magazine</i> (February 1991)	
The Robust Control of Robot Manipulators	123
J.-J. E. Slotine, <i>The International Journal of Robotics Research</i> (Summer 1985)	
On L_2- and L_∞-Stability Approaches for the Robust Control of Robot Manipulators	139
N. Becker and W. M. Grimm, <i>IEEE Transactions on Automatic Control</i> (January 1988)	
Adaptive Model Following Control of Nonlinear Robotic Systems	143
S. N. Singh, <i>IEEE Transactions on Automatic Control</i> (November 1985)	
PART 4 ADAPTIVE CONTROL OF ROBOT MANIPULATORS	145
J.-J. E. Slotine	

On the Adaptive Control of Robot Manipulators	147
J.-J. E. Slotine and W. Li, <i>The International Journal of Robotics Research</i> (Fall 1987)	
Adaptive Computed Torque Control for Rigid Link Manipulations	158
R. H. Middleton and G. C. Goodwin, <i>Systems and Control Letters</i> (1988)	
Stability Analysis of an Adaptive Controller for Robotic Manipulators	165
N. Sadegh and R. Horowitz, <i>Proceedings of the IEEE Conference on Robotics and Automation</i> (1987)	
Adaptive Control of Mechanical Manipulators	172
J. J. Craig, P. Hsu, and S. S. Sastry, <i>The International Journal of Robotics Research</i> (Summer 1987)	
PART 5 LEARNING CONTROL	185
S. Arimoto	
Bettering Operation of Robots by Learning	189
S. Arimoto, S. Kawamura, and F. Miyazaki, <i>Journal of Robotic Systems</i> (1984)	
Adaptive Control of Manipulators Through Repeated Trials	206
J. J. Craig, <i>Proceedings of the American Control Conference</i> (June 1984)	
Robot Trajectory Learning Through Practice	214
C. G. Atkeson and J. McIntyre, <i>Proceedings of the IEEE Conference on Robotics and Automation</i> (1986)	
On the Iterative Learning Control Theory for Robotic Manipulators	220
P. Bondi, G. Casalino, and L. Gambardella, <i>IEEE Journal of Robotics and Automation</i> (February 1988)	
PART 6 TIME-OPTIMAL CONTROL	229
K. G. Shin	
Minimum-Time Control of Robotic Manipulators with Geometric Path Constraints	233
K. G. Shin and N. D. McKay, <i>IEEE Transactions on Automatic Control</i> (June 1985)	
Time-Optimal Control of Robotic Manipulators Along Specified Paths	244
J. E. Bobrow, S. Dubowsky, and J. S. Gibson, <i>The International Journal of Robotics Research</i> (Fall 1985)	
Improving the Efficiency of Time-Optimal Path-Following Algorithms	259
J.-J. E. Slotine and H. S. Yang, <i>IEEE Transactions on Robotics and Automation</i> (February 1989)	
Time-Optimal Control of Manipulators	266
E. D. Sontag and H. J. Sussmann, <i>Proceedings of the IEEE International Conference on Robotics and Automation</i> (April 1986)	
PART 7 FORCE AND IMPEDANCE CONTROL	273
N. H. McClamroch	
A Unified Approach for Motion and Force Control of Robot Manipulators: The Operational Space Formulation	277
O. Khatib, <i>IEEE Journal of Robotics and Automation</i> (February 1987)	
Hybrid Impedance Control of Robotic Manipulators	288
R. J. Anderson and M. W. Spong, <i>IEEE Journal of Robotics and Automation</i> (October 1988)	
Feedback Stabilization and Tracking of Constrained Robots	296
N. H. McClamroch and D. Wang, <i>IEEE Transactions on Automatic Control</i> (May 1988)	
Force and Position Control of Manipulators During Constrained Motion Tasks	304
J. K. Mills and A. A. Goldenberg, <i>IEEE Transactions on Robotics and Automation</i> (February 1989)	

PART 8 FLEXIBILITY EFFECTS ON PERFORMANCE AND CONTROL 321

S. Turkovich

Initial Experiments on the End-Point Control of a Flexible One-Link Robot	325
R. H. Cannon, Jr. and E. Schmitz, <i>The International Journal of Robotics Research</i> (Fall 1984)	
Recursive Lagrangian Dynamics of Flexible Manipulator Arms	339
W. J. Book, <i>The International Journal of Robotics Research</i> (Fall 1984)	
Experiments in Identification and Control of Flexible-Link Manipulators	355
S. Turkovich and A. P. Tzes, <i>IEEE Control Systems Magazine</i> (February 1990)	

PART 9 DEXTEROUS END-EFFECTORS AND GRASPING 361

S. S. Sastry and P. Hsu

The Kinematics of Contact and Grasp	367
D. J. Montana, <i>The International Journal of Robotics Research</i> (June 1988)	
Computing and Controlling the Compliance of a Robotic Hand	383
M. R. Cutkosky and I. Kao, <i>IEEE Transactions on Robotics and Automation</i> (April 1989)	
Dynamics and Stability in Coordination of Multiple Robotic Mechanisms	398
Y. Nakamura, K. Nagai, and T. Yoshikawa, <i>The International Journal of Robotics Research</i> (April 1989)	
Grasping and Coordinated Manipulation by a Multifingered Robot Hand	416
Z. Li, P. Hsu, and S. Sastry, <i>The International Journal of Robotics Research</i> (August 1989)	

PART 10 REDUNDANT ROBOTS 435

A. DeLuca

Review of Pseudoinverse Control for Use with Kinematically Redundant Manipulators	441
C. A. Klein and C.-H. Huang, <i>IEEE Transactions on Systems, Man, and Cybernetics</i> (March/April 1983)	
Task-Priority Based Redundancy Control of Robot Manipulators	447
Y. Nakamura, H. Hanafusa, and T. Yoshikawa, <i>The International Journal of Robotics Research</i> (Summer 1987)	
Redundancy Resolution of Manipulators Through Torque Optimization	460
J. M. Hollerbach and K. C. Suh, <i>IEEE Journal of Robotics and Automation</i> (August 1987)	
On the Inverse Kinematics of Redundant Manipulators	468
D. R. Baker and C. W. Wampler II, <i>The International Journal of Robotics Research</i> (March/April 1988)	

PART 11 DYNAMICALLY DEXTEROUS ROBOTS 487

D. E. Koditschek

Dynamic Stability and Resonance in a One Legged Hopping Machine	491
M. H. Raibert, <i>Proceedings of the 4th Symposium on the Theory and Practice of Robots and Manipulators</i> , A. Morecki, G. Bianchi, and K. Kedzior, Eds. Warsaw: Polish Scientific Publishers	
Understanding and Applying a Robot Ping-Pong Player's Expert Controller	498
R. L. Andersson, <i>Proceedings of the IEEE International Conference on Robotics and Automation</i> (1989)	
Passive Dynamic Walking	504
T. McGeer, <i>The International Journal of Robotics Research</i> (April 1990)	
From Stable to Chaotic Juggling: Theory, Simulation, and Experiments	525
M. Bühl and D. E. Koditschek, <i>Proceedings of the IEEE Conference on Robotics and Automation</i> (May 1990)	

AUTHOR INDEX	531
SUBJECT INDEX	533
EDITORS' BIOGRAPHIES	539