

Robotic Systems

Advanced Techniques and Applications

edited by

SPYROS G. TZAFESTAS

*National Technical University of Athens,
Department of Electrical and Computer Engineering,
Athens, Greece*



KLUWER ACADEMIC PUBLISHERS

DORDRECHT / BOSTON / LONDON

CONTENTS

PREFACE	xi
PART 1	
ROBOT KINEMATIC AND DYNAMIC ANALYSIS	
Direct Kinematics of the 6–4 Fully Parallel Manipulator with Position and Orientation Uncoupled <i>C. Innocenti, V. Parenti-Castelli</i>	3
A General Method for a Closed-Form Solution to Robot Kinematics Problems <i>C. Galletti, P. Fanghella</i>	11
Fast Implementation of Robotic Manipulator Kinematics using Cordic and Systolic Processors <i>V.G. Mertzios, S.S. Scarlatos</i>	19
A Formal Framework for Specifying Robot Kinematics <i>V.S. Alagar, T.D. Bui, K. Periyasamy</i>	27
Non-Geometrical Parameters Identification for Robot Kinematic Calibration by Use of Neural Network Techniques <i>J.-M. Renders, J.R. Millan, M. Becquet</i>	37
The Use of Skew-Symmetric Cartesian Tensors in Describing Orientations and Invariants of Spatial Rotations <i>C.A. Balafoutis, R.V. Patel</i>	45
An Automatic Verification of Simplified Robot Models <i>K. Swider</i>	53
A Comparison Between Theoretically Derived and Experimentally Verified Dynamic Modelling of a SCARA Robot <i>T.A. Rieswijk, J. de Haas, G.Honderd, W. Jongkind</i>	61
Dynamics of Robots Having Supple Bodies <i>P. Andre, J.-P. Taillard, P. Mitrouchev, L. Losco</i>	71
A Finite Elements Model of Two-Joint Robots with Elastic Forearm <i>P. Muraca, M. La Cava, A. Ficola</i>	79

On the Modelling of the Contact Forces of Constrained Robots

K.A. Tahboub, P.C. Müller

87

PART 2

ROBOT CONTROL

Passivity and Learning Control for Robot Tasks under Geometric Constraints <i>S. Arimoto, T. Nariwa</i>	99
A Decentralized Adaptive Controller for Robot Manipulator Trajectory Control <i>P. Desai</i>	109
Robust Control of Robot Arms Using the Variable Structure Approach <i>A.J.L. Nievergeld, H.H. van de Ven</i>	117
A Comparison of Direct Adaptive Controllers Applied to a Class 1 Manipulator <i>D.P. Stoten, S.P. Hodgson</i>	125
An Algorithm for the Nonlinear Adaptive Robot Control Synthesis <i>B.M. Novaković</i>	135
Model Reference Adaptive Control of Robotic Manipulators Using a Modified Output Error Method <i>R.Y.J. Tam, S.C.A. Thomopoulos</i>	143
Application of Modified Generalized Predictive Controllers to Trajectory Control of a Robot Arm <i>S.S. Gençev, Y. Istefanopoulos, T. Ergün</i>	151
Design of Manipulator Trajectories with Minimum Motion Time and Specified Accuracy <i>Y. Song, R.M.C. De Keyser</i>	159
The Use of Simulation Systems to Control Manually Operated Remote Manipulators, with Long Pure Time Delays <i>M. Griffin, R. Mitchell</i>	167
Path Coordinated Control of Robotic Arms <i>S. Arnaltes, J. Pérez Oria</i>	175
Command Matching for a Constraint Robot System <i>P.N. Paraskevopoulos, F.N. Koumboulis, K.G. Tzierakis</i>	183
Control of a Flexible Arm for Prescribed Frequency Domain Tolerances: Modelling, Controller Design, Laboratory Experiments <i>M. Kelemen, J. Starrenburg, A. Bagchi</i>	193

PART 3**ROBOT PATH PLANNING AND TRACKING**

High-Speed Robot Path Planning in Time-Varying Environment Employing a Diffusion Equation Strategy <i>G. Schmidt, W. Neubauer</i>	207
Path Planning of Transfer Motions for Industrial Robots by Heuristically Controlled Decomposition of the Configuration Space <i>G. DueLEN, C. Willnow</i>	217
Planning and Optimization of Geometrical Trajectories Inside Collision-Free Subspaces with the Aid of High-Order Hermite Splines <i>T.A. Rieswijk, P. Schalkwijk, G. Honderd</i>	225
A Fast and Efficient Algorithm for the Computation of Path Constrained Time-Optimal Motions <i>T.A. Rieswijk, M. Sirks, G. Honderd, W. Jongkind</i>	235
Three-Dimension Abstraction of Convex Space Path Planning <i>P.K. Sinha, P.L. Ho</i>	245
An Approach to Real-Time Flexible Path Planning <i>A.C. Meng, S. Ntafos, M. Tsoukalas</i>	253
A Path Planning Method for Mobile Robots in a Structured Environment <i>F.V. Hatzivasilou, S.G. Tzafestas</i>	261
Minimum-Time Motion Planner for Mobile Robots on Uneven Terrains <i>A. Liegeois, C. Moignard</i>	271
Mobile Robot Trajectory Planning <i>P.K. Sinha, A. Benmounah</i>	279
Task Modeling for Planning an Autonomous Mobile Robot <i>V. Schaeffer, A. Mauboussin</i>	287
An Optimal Solution to the Robot Navigation Planning Problem Based on an Electromagnetic Analogue <i>V. Petridis, T.D. Tsiboukis</i>	297
Real-Time LQG Robotic Visual Tracking <i>N.P. Papanikolopoulos, P.K. Khosla</i>	305
Trajectory Tracking for Mobile Robot <i>S. Delaplace, P. Blazevic, J.G. Fontaine, N. Pons, J. Rabit</i>	313

A Robust Tracking System for Mobile Robot Guidance <i>J. Frau, A. Larré, E. Montseny, G. Oliver</i>	321
A Real-Time Multiple Lane Tracker for an Autonomous Road Vehicle <i>K.P. Wershofen, V. Graefe</i>	333
PART 4	
MOBILE ROBOTS: ARCHITECTURES, PERCEPTION, NAVIGATION AND CONTROL	
An Architecture for Intelligent Mobile Robots <i>J. Sequeira, J. Sentieiro</i>	343
Software Architecture for an Autonomous Manipulator <i>J.B. Thevenon, E.J. Gaussens, P. LePage, F. Arlabosse</i>	351
Automatic Control of Mobility: The VAHM Project <i>K. Moumen, A. Pruski</i>	359
A Modular Approach to Mobile Robot Design <i>G. Barrall, K. Warwick</i>	367
Environment Representation by a Mobile Robot Using Quadtree Encoding of Range Data <i>L. Piotrowski</i>	375
Perception Planning in PANORAMA <i>A.M. de Campos, M.M. Matos, P. Fogaça</i>	383
Navigation and Perception Approach of PANORAMA Project <i>G. Frappier, P. Lemarquand, T. Van den Bogaert</i>	391
Trajectory Generation for Mobile Robots with Clothoids <i>G.M. van der Molen</i>	399
Digital Models for Autonomous Vehicle Terrain-Following <i>N. Christou, K. Parthenis, B. Dimitriadis, N. Gouvinanakis</i>	407
Navigation of a Mobile Robot <i>P. van Turennout, G. Honderd</i>	415
Robot Navigation and Exploration in an Unknown Environment <i>R. Malik, S. Prasad</i>	423
The Optimal Next Exploration: Uncertainty Minimization in Mobile Robot Self-Location <i>V. Caglioti</i>	431

A Parallel Blackboard Model for Mobile Robotics Control <i>M. Occello, C. Chaouiya, M.-C. Thomas</i>	439
PART 5	
ROBOT PROGRAMMING AND SENSORY DATA PROCESSING	
Graphical Robot Programming: Requirements and Existing Systems <i>G. Nikoleris</i>	451
Practical Error Compensation for Use in Off-Line Programming of Robots <i>S. Albright, K. Schröer</i>	459
Intelligent Programming of Force-Constrained Cooperating Robots <i>G. DueLEN, H. Münch, Y. Zhang</i>	469
Sensing Strategies Generation for Monitoring Robot Assembly Programs <i>V. Caglioti, M. Danieli, D. Sorrenti</i>	479
Integration of a Constraint Scheme in a Programming Language for Multi-Robots <i>D. Duhaut, E. Monacelli</i>	487
Software Architecture and Simulation Tools for Autonomous Mobile Robots <i>G.D. van Albada, J.M. Lagerberg, B.J.A. Kröse</i>	495
A Logical Framework of Sensor/Data Fusion <i>M.M. Kokar, K.P. Zavoleas</i>	505
Maintaining World Model Consistency by Matching Parametrized Object Models to 3d Measurements <i>M. Järviduoma, S. Pieskä, T. Heikkilä</i>	515
PART 6	
SOPHISTICATED ROBOTIC SYSTEMS AND APPLICATIONS	
A Model of Manned Robotic Systems <i>P.H. Wewerinke</i>	525
Design, Construction and Performance of an Anthropomorphic Robot Head <i>P. Mowforth, D. Wilson</i>	535
Multi-fingered Robot Hands <i>E.A. Al-Gallaf, A.J. Allen, K. Warwick</i>	543
Multidirectional Pneumatic Force Sensor for Grippers <i>R. Caen, S. Colin</i>	551

Grasping in an Unstructured Environment Using a Coordinated Hand Arm Control <i>S. Agrawal, R. Bajcsy</i>	559
Effective Integration of Sensors and Industrial Robots by Means of a Versatile Sensor Control Unit <i>J. Wahrburg</i>	569
Identification and Evaluation of Hydraulic Actuator Models for a Two-Link Robot Manipulator <i>J.-J. Zhou, F. Conrad</i>	577
A Modular Architecture for Controlling Autonomous Agents <i>L. Petropoulakis</i>	585
Development of Intelligent Control for Robot Cells Using Knowledge Based Simulation <i>Z. Doulgeri, G. D'Alessandro</i>	595
Recent Advances in Robot Grinding <i>A. Ikonomopoulos, L. Dritsas</i>	603
A Low Cost Robot Based Integrated Manufacturing System for the Garment Industry <i>I. Gibson, P. Bowden, P.M. Taylor, A.J. Wilkinson</i>	611
Vision for Robot Guidance in Automated Butchery <i>G. Purnell, K. Khodabandehloo</i>	619
Use of Robots in Surgical Procedures <i>P.N. Brett, K. Khodabandehloo</i>	627
AUTHOR INDEX	637