

Contents

Part I Reconfiguration Theory

1	Metamorphic Structure Representation: Designing and Evaluating Anatomies of Metamorphic Manipulators	3
	Charalampos Valsamos, Vassilis C. Moulianitis and Nikos Aspragathos	
2	A Method for Configuration Representation of Metamorphic Mechanisms with Information of Component Variation	13
	Wuxiang Zhang and Xilun Ding	
3	Enumeration Problems: A Bridge Between Planar Metamorphic Robots in Engineering and Polyforms in Mathematics	25
	Anelize Zomkowski Salvi, Roberto Simoni and Daniel Martins	
4	A Discontinuously Movable Constant Velocity Shaft Coupling of Koenigs Joint Type.	35
	Chung-Ching Lee and Jacques M. Hervé	
5	A Special Wohlhart’s Double-Goldberg 6R Linkage and its Multiple Operation Forms Among 4R and 6R Linkages.	45
	Chaoyang Song and Yan Chen	
6	The Equivalent Resistance Gradient Model of Metamorphic Mechanisms and the Design Approach	53
	Shujun Li and Jian S. Dai	
7	Biological Modeling Representations and Configuration Evolution Analysis of a Novel Metamorphic Loading Mechanism	63
	Ganwei Cai, Yuchen Pan, Hongzhou Wang and Jian S. Dai	

8	On the Matrix Representation Methods for Variable Topology Mechanisms	73
	Lung-Yu Chang and Chin-Hsing Kuo	
9	Geometric Constraints Resulting From Puzzles	83
	Liping Zhang and Jian S. Dai	
10	Reconfigurable Assembly Approach for Wind Turbines Using Multiple Intelligent Agents	95
	C. Deters, H. A. Wurdemann, Jian S. Dai, L. D. Seneviratne and K. Althoefer	
11	Development of a Reconfigurable Compliant Education Kit for Undergraduate Mechanical Engineering Education	105
	Shouzhong Li, Jingjun Yu, Yue Wu and Guanghua Zong	
 Part II Topology, Kinematics and Design of Reconfigurable Mechanisms		
12	Structural Synthesis of a Class of Metamorphic Parallel Mechanisms with Variable Mobility	119
	Wei Ye, Yuefa Fang and Sheng Guo	
13	Structural Representation of Reconfigurable Linkages	127
	Ketao Zhang, Yuefa Fang, Guowu Wei and Jian S. Dai	
14	Topological Analysis of Configuration Evolution of a Novel Type of Electric Loader with Metamorphic Functions	139
	Ganwei Cai, Yuchen Pan, Hongzhou Wang and Jian S. Dai	
15	Analysis of Freedom Degrees of Self-Help Chair for the Old Based on the Principle of Metamorphic Mechanism.	149
	Ju-Jiang Cao, Yu-Qi Wang and Ji-Wei Sun	
16	The Variable Graph of Metamorphic Mechanisms or Variable Topology Mechanisms	161
	Chuan-He Liu	
17	Type Synthesis of Planar Parallel Mechanism Incorporating Actuated Limb with Zero/One Constraint with Set Conception	177
	Gang Dong, Yimin Song and Tao Sun	

18 Dynamics Modeling and Analysis of Compaction Force of Crawler on Cone Lamp Pole. 189
 Nan-Jiang Gu and Zhong-Bin Liu

19 Deformation Discipline of the Flexspline in Harmonic Drives with Engagement Output 197
 Huimin Dong, Zhi Chen, Chunmao Zhang and Delun Wang

20 Development of a New Steering Mechanism for Automobiles 209
 R. Venkatachalam and A. Padma Rao

21 Constructing Rolling Mechanisms Based on Tetrahedron Units 221
 Yao-Bin Tian and Yan-An Yao

22 A Compliant 5-bar Tristable Mechanism Utilizing Metamorphic Transformation 233
 Guimin Chen, Yi Liu and Yanjie Gou

Part III Reconfigurable Parallel Mechanisms

23 Type Synthesis of Partially Decoupled 2-DOF Parallel Mechanisms with Two 1T1R Operational Modes. 245
 Xianwen Kong

24 Reconfiguration and Actuation Scheme of 3rTPS Metamorphic Parallel Mechanisms with Parallel Constraint Screws 259
 Dongming Gan, Jian S. Dai, Jorge Dias and Lakmal Seneviratne

25 Topological Structure Synthesis of 3-Translation Parallel Mechanisms. 269
 Huiping Shen, Tongzhu Yu, Jiaming Deng, Zheng Wang and Tingli Yang

26 Development of Reconfigurable Spherical Motion Generator 285
 Shiu Hang Ip, Chao Chen, Richard P. H. Chen and Denny Oetomo

27 Reconfiguration Analysis of a Fully Reconfigurable Parallel Robot 295
 Allan Daniel Finistauri and Fengfeng Xi

28	Type-Changeable Kinematic Pair Evolved Reconfigurable Parallel Mechanisms	309
	Ketao Zhang, Evangelos Emmanouil, Yuefa Fang and Jian S. Dai	
29	Developing a New Concept of Self Reconfigurable Intelligent Swarm Fixtures	321
	Luis de Leonardo, Matteo Zoppi, Li Xiong, Serena Gagliardi and Rezia Molfino	
30	Configuration Change and Mobility Analysis of a New Metamorphic Parallel Mechanism Used for Bionic Joint	333
	Guoguang Jin and Boyan Chang	
31	Optimal Design of a New Parallel Kinematic Machine for Large Volume Machining	343
	Yan Jin, Zhuming Bi, Colm Higgins, Mark Price, Weihai Chen and Tian Huang	
32	A Study of the Instantaneous Kinematics of the 5-RSP Parallel Mechanism Using Screw Theory	355
	Ernesto Rodriguez-Leal, Jian S. Dai and Gordon R. Pennock	
33	Experimental Modal Analysis for a 3-DOF PKM Module	371
	Jun Zhang, Hai-wei Luo and Tian Huang	
34	Analysis on Motion Characters for A 3-PRS Parallel Mechanism	379
	Zheng Gao, Rui Su, Jianting Zhao and Hongrui Wang	
35	Effect of Different Terrain Parameters on Walking	389
	Shahram Mohseni-Vahed and Yun Qin	
 Part IV Bio-Reconfiguration Techniques and Biomedical Devices		
36	Bi-Behavioral Prosthetic Knee Enabled by a Metamorphic Compliant Mechanism	401
	Shannon Zirbel, Shane Curtis, Rachel Bradshaw, Luke Duffield, Greg Teichert, Nicholas Williams, Ron Rorrer, Spencer Magleby and Larry Howell	

37 A Novel Actuator with Reconfigurable Stiffness for a Knee Exoskeleton: Design and Modeling 411
 Nikos C. Karavas, Nikos G. Tsagarakis, Jody Saglia and Darwin G. Galdwell

38 Bio-Inspired Dynamic Model for a Reconfigurable Multiple Continuum Arm Robot. 423
 Rongjie Kang, David T. Branson, Emanuele Guglielmino and Darwin G. Caldwell

39 A Novel Reconfigurable Unit for High Dexterous Surgical Instrument 433
 Linan Zhang, Shuxin Wang, Jianmin Li, Xiaofei Wang, Chao He and Jinxing Qu

40 Design and Kinematics Analysis of a Novel MR-Compatible Robot for Needle Insertion 443
 Chaochao Cheng, Shan Jiang, Jun Liu and Jinlong Lou

41 A Flexible-Waist Quadruped Robot Imitating Infant Crawl. 455
 Cheng Liu, Xiuli Zhang, Dongdong Li and Kunling Zhou

42 Design and Analysis of a Portable Reconfigurable Minimally Invasive Surgical Robot 465
 Chao He, Shuxin Wang, Xiaofei Wang, Anlin Zhang and Dongchun Liu

43 A Passive Robotic Platform for Three-Dimensional Scanning of Ex Vivo Soft Tissue 477
 Jichun Li, Jelizaveta Zirjakova, Wei Yao, Kaspar Althoefer, Prokar Dasgupta and Lakmal D Seneviratne

44 Design and Fabrication of DNA Origami Mechanisms and Machines. 487
 Hai-Jun Su, Carlos Ernesto Castro, Alexander Edison Marras and Michael Hudoba

45 Multibody Modelling Applied to Origami Carton Folding 501
 Ferdinando Cannella, Jian S. Dai and Daniele Clari

Part V Analysis and Design of Reconfigurable Robots

46	Hardware Design and Testing of ModRED: A Modular Self-Reconfigurable Robot System	515
	S. G. M. Hossain, Carl A. Nelson and Prithviraj Dasgupta	
47	Structures and Characteristics in Reconfigurable Modular Robots	525
	B. Madhevan and M. Sreekumar	
48	Typical 3 + 3 Gait Motion Analysis of a Radial Symmetrical Six-Legged Robot Based on Metamorphic Theory	535
	Xilun Ding and Xu Kun	
49	An Automatic Dynamics Generation Method for Reconfigurable Modular Robot	551
	Wenbin Gao and Hongguang Wang	
50	A Kind of Architecture and Key Technologies for Developing Modular Robot	561
	Hongxing Wei, Jingtao Lei and Tianmiao Wang	
51	Metamorphic Mechanism Analysis of a Chinese Massage Robot End-Effector	569
	Lv-Zhong Ma, Peng Fei, Jun Zhang and Guanghong Zhao	
52	Roller Skating Analysis of a Novel Quadruped Robot with Extendable Body	577
	Xilun Ding and Hao Chen	
53	Performance Analysis of a Quadruped/Biped Reconfigurable Walking Robot with Parallel Leg Mechanism	587
	Hongbo Wang, Xing Hu, Lingfeng Sang, Zhen Xu and Jianjun Wang	
54	Intelligent Fingertip Sensing for Contact Information Identification	599
	Hongbin Liu, Xiaojing Song, Joao Bimbo, Kaspar Althoefer and Lakmal Senerivatne	
55	Conceptual Design and Kinematic Analysis of a Five-Fingered Anthropomorphic Robotic Hand	609
	Pramod Kumar Parida, B. B. Biswal and Rabindra Narayan Mahapatra	

56 Dynamic Analysis of Cable-Driven Humanoid Arm Based on Lagrange’s Equation 619
 Jianhua Wang, Xiang Cui, Weihai Chen and Yan Jin

57 Reconfiguration of System for Waste Collection with Robotics Methodologies. 629
 Alberto Rovetta

Part VI Control of Reconfigurable Robots

58 Study on Decentralized Control of Reconfigurable Manipulator Based on Third-Order ESO 647
 Yanli Du, Yanfeng Qiao, Zhiqian Wang, Mujun Xie and Yuanchun Li

59 A Combined Backstepping Terminal Sliding Mode Algorithm Based Decentralized Control Scheme for Reconfigurable Manipulators. 657
 Bo Zhao, Zhiqian Wang, Yanfeng Qiao, Keping Liu and Yuanchun Li

60 Underactuated Gripper That Is Able to Convert from Precision to Power Grasp by a Variable Transmission Ratio 669
 Stefan A. J. Spanjer, Ravi Balasubramanian, Aaron M. Dollar and Just L. Herder

61 Transparency Analysis of a Force Sensorless Master-Slave Control by Force Feedback Based Virtual Impedance Controller with Time Delay 681
 Ryosuke Horie, Kiyotoshi Komuta and Toshiyuki Murakami

62 Friction Compensation and Control Strategy for the Dexterous Robotic Hands 697
 Vahid Aminzadeh, Rich Walker, Ugo Cupcic, Hugo Elias and Jian S. Dai

63 On the Task Specific Evaluation and Optimisation of Cable-Driven Manipulators. 707
 Darwin Lau, Kishor Bhalerao, Denny Oetomo and Saman K. Halgamuge

64 Motion Coordination Strategy of Quadruped Robot Inspired by the Locomotion of Animal 717
 Hongkai Li and Zhendong Dai

65	Robotics Studies in Europe	727
	Valentina Resaz, Fabrice Meriaudeau, David Fofi and Matteo Zoppi	
Part VII Deployable Mechanisms and Applications of Reconfigurable Mechanisms		
66	Deployable Masts Based on the Bennett Linkage	739
	Hongwei Guo and Zhong You	
67	Structural Synthesis of Ancient Chinese Chu State Repeating Crossbow	749
	Kuo-Hung Hsiao and Hong-Sen Yan	
68	Duality of the Platonic Polyhedrons and Isomorphism of the Regular Deployable Polyhedral Mechanisms (DPMs)	759
	Guowu Wei and Jian S. Dai	
69	A Brief Survey on Inflatable Deployment Space Structures’ Research and Development	773
	Jinguo Liu and Shufeng Sun	
70	A Novel Surface Deployable Antenna Structure Based on Special Form of Bricard Linkages	783
	Ji Cui, Hailin Huang, Bing Li and Zongquan Deng	
71	Geometric and Combined Analysis of the Color-Flipping Ball . . .	793
	Duanling Li, Guochao Bai, Qizheng Liao and Zhanjiang Du	
72	Forward Displacement Analysis of two Foldable 3US Parallel Mechanisms	805
	Yun Qin and Jian S. Dai	
73	A Reconfigurable Linkage and Its Applications in Lift Mechanism	815
	Jing-Shan Zhao, Zheng-Fang Yan and Fu-Lei Chu	
74	Dynamic Analysis on Crank-Connecting Rod Mechanism of Reciprocating Pumps with Crankshaft–Bushing Clearance	831
	Lixin Xu, Yuhu Yang, Yonggang Li and Chongning Li	
75	Design and Analysis of a Biphasic Variable Impedance Actuator	841
	Bo Han, Matteo Zoppi and Rezia Molfino	

76 H-Beam Cutting System Based on Pro/E Model-Driven Technology 851
Wenbin Duan, Juliang Xiao and Gang Wang

77 The Typical Box-Taking Mechanism and Its Development Trend of Automatic Cartonng Machine 861
Jujiang Cao, Lei Zhang and Long Li

78 A ‘Multilink Spatial Hyper Redundant’ Manipulator. 869
Praveen Jagadeesan, Sabarish Sivaprakasham,
Dinesh Kumar and M. Madhu

Author Index 877