

Preface

The demands on today's products have become increasingly complex as customers expect enhanced performance across a variety of diverse and changing system operating conditions. This needs quick changeover and reconfiguration for machines and production lines. The changing climates along with the hazardous environments and space exploration also need devices and robots with variable capacity and changeable structures with certain versatility and flexibility.

As a backbone of machines and robots, mechanisms need to have additional abilities to vary mobility and/or topology to meet multiple functional requirements or to adapt to changing operating conditions. These types of mechanisms with variable mobility which emerged in the 1990s raised much interest in the past two decades in their topology, kinematics, dynamics, and stiffness and evolve into reconfigurable robots in many fields and applications.

To meet the above trend, two international conferences have been successfully held, including the First ASME/IEEE International Conference on Reconfigurable Mechanisms and Robots (ReMAR 2009) and the Second ASME/IFTToMM International Conference on Reconfigurable Mechanisms and Robots (ReMAR 2012). Excellent papers on seven topic areas in reconfigurable mechanisms and robots from these two conferences can be found in *Reconfigurable Mechanisms and Robots* (eds. J.S. Dai, M. Zoppi and X. Kong, KC Edizioni, IEEE Catalog No. CFP0943G-PRT, 2009) and in *Advances in Reconfigurable Mechanisms and Robots I* (eds. J.S. Dai, M. Zoppi and X. Kong, Springer, ISBN 978-1-4471-4140-2, 2012), respectively.

Following the success of ReMAR 2009 and ReMAR 2012, we are holding the Third IEEE/IFTToMM International Conference on Reconfigurable Mechanisms and Robots (ReMAR 2015) to provide an international forum for presenting recent advances in reconfigurable mechanisms and robots and for discussing of their applications in domestic, hazardous, outer-space, and manufacturing environments. With 116 submissions, the rigorous review process was held with detailed and in-depth comments on each paper. This resulted in the acceptance of 93 papers

with an additional period for authors to revise their papers according to the reviewers' comments.

This book is the result of the successful international conference with 93 papers by authors from 21 countries that are compiled into seven parts as reconfiguration theory; topology, kinematics, and design of reconfigurable mechanisms; reconfigurable parallel mechanisms; bio-reconfiguration techniques and biomedical devices; analysis and design of reconfigurable robots; control of reconfigurable robots; and deployable mechanisms and applications of reconfigurable mechanisms.

The book starts from the reconfiguration theory part that focuses on metamorphic mechanisms with multifurcation, reconfigurable overconstrained mechanisms, and mechanisms with multiple operation modes. Compliant reconfigurable mechanisms are also investigated.

Part II of the book is dedicated to the topology, kinematics, and design of reconfigurable mechanisms. The foldability characteristic of origami carton and a kind of loading mechanism with metamorphic characteristics are analyzed, and the inverse kinematics and kineto-statics of metamorphic palm of the KCL/TJU metamorphic hand are presented. The topological configurations of a kind of reconfigurable cube mechanism are enumerated to show its reconfigurability. This part also covers the design of constant-force mechanisms and workspace analysis of reconfigurable mechanisms.

The study on reconfigurable parallel mechanisms, which have the characteristics of both conventional parallel mechanisms and reconfigurable mechanisms, has attracted increasing attention in recent years. Part III presents several types of novel parallel mechanisms, such as 3rRPS metamorphic parallel mechanism with 3R and 1T2R motion, parallel mechanism with multiple operation modes, Exechon-inspired parallel kinematic machine, a new reconfigurable parallel manipulator with 5-axis capability, a novel parallel manipulator with an articulated gripping platform, and a two-axis swaying platform. These reconfigurable parallel manipulators are presented as well as the analysis on their topology, mobility variations, type synthesis, reconfiguration analysis and force balancing. In addition, mechanism analysis of parallel lifting mechanism for Schnabel car is investigated. A prestressed fault-tolerant six-axis force sensor is also presented.

Part IV is about the bio-inspired mechanisms and robots as well as biomedical devices. This part firstly presents the work on applying the metamorphic mechanism to the lower rehabilitation robots and bi-behavioral ankle joint in artificial leg. The bio-inspired reconfigurable robots, such as snake-like robot, flexible neck mechanism of a turtle robot and bionic foot, are further developed for revealing the advantage of reconfigurability.

Part V focuses on the analysis and design of reconfigurable robots, including a robot capable of autonomous robotic team repair, high-speed parallel robots, a spraying robot for airfoil, and structures and characteristics exploration on self-reconfigurable robots. In this part, novel manipulators, such as M^2 gripper, industrial robot manipulator, clip-type manipulator, inspection robot, underactuated cable-driven parallel robot and continuum robot, are developed and have been

successfully used. Intelligent service reconfiguration for home robots and surgery robots is also investigated.

Part VI continues on the topics of the reconfigurable robots and focuses on emotional control, bio-control, self-assembly planning, and efficient motion simulation and collision detection algorithm. In addition, predictable precision manipulation of unknown objects with underactuated fingers and task-based control strategies and the implementation for a six-legged multitask robot and a walking chair robot are analyzed to promote the development of the research on control strategy of reconfigurable robots.

The final part of the book contributes to deployable mechanisms and applications of reconfigurable mechanisms. The section starts from the research on a lock/release mechanism based on shape memory alloy for SAR antenna. Then, a six-wheeled planetary surface locomotion system with single motor driving folded-deployed suspension is presented. A reconfigurable deployable mechanism is revealed, and an approach to the mobility analysis of deployable mechanism is proposed. A modular deployable antenna is presented. The reconfigurability of a variable compression ratio engine and a robotic fixture for automotive assembly welding are investigated as well as some interesting application on linear telescopic mechanism and deployable mechanism for grasping sacked non-rigid materials.

This book presents the most recent research results and new discoveries in the area of reconfigurable mechanisms and robots across the disciplines for advancing the knowledge in the field of mechanisms and robotics and for economic development.

We thank all the authors for their contributions and meticulous manner in preparing their manuscripts and thank all the reviewers for their rigorous review and detailed comments to help authors to improve their papers. Further, we are also indebted to Qun Zhang and Mariyam Sattar for their dedication and persistence in checking every manuscript and contacting the authors for their revision of the manuscripts and for finalizing this book and to the staff of Springer for putting the whole book together.

We have received immense support from the National Natural Science Foundation of China (NSFC), the Ministry of Education of China, Beihang University, the Automation and Robotics Society of IEEE, and the International Federation for the Promotion of Mechanism and Machine Science (IFTToMM). We acknowledge the financial support from NSFC (Grant Numbers 51125020, 51275015, and 51105013) and K.C. Wong Education Foundation.

We are grateful to members of the scientific committee, the program committee, and the track chairs/co-chairs for the rigorous peer review of papers. We thank the organizing teams in Beihang University who worked so hard to put together exciting sessions and presentations. We particularly thank Wuxiang Zhang and Qun Zhang for conference preparation and website editing, Shengnan Lv for paper handling and author contacting, and Shaodan Zhang for financial arrangement.

Advances in Reconfigurable Mechanisms and Robots II

Ding, X.; Kong, X.; Dai, J.S. (Eds.)

2016, XVIII, 1117 p., Hardcover

ISBN: 978-3-319-23326-0