

Robotic Surgery

Smart Materials, Robotic Structures,
and Artificial Muscles

Mohsen Shahinpoor
Siavash Ghesemi



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Robotic Surgery Smart Materials Robotic Structures And Artificial Muscles

**Kenneth K. W. Kwan, Alfonso H. W.
Ngan**



Robotic Surgery Smart Materials Robotic Structures And Artificial Muscles:

Robotic Surgery Mohsen Shahinpoor, Siavash Gheshmi, 2014-11-18 Robotic surgery has already created a paradigm shift in medical surgical procedures and will continue to expand to all surgical and microsurgical interventions. There is no doubt that in doing so robotic surgical systems such as the da Vinci surgical system will become smarter and more sophisticated with the integration, implementation, and synergy.

Ionic Polymer Metal Composites (IPMCs) Mohsen Shahinpoor, 2016 A comprehensive resource on ionic polymer metal composites IPMCs edited by the leading authority on the subject.

Fundamentals of Smart Materials Mohsen Shahinpoor, 2020-04-22 This textbook covers the fundamentals of different functional material systems aimed at advanced undergraduate and postgraduate students. Each chapter includes an introduction to the material, its applications and uses, with example problems, fabrication and manufacturing techniques, conclusions, homework problems, and a bibliography. Edited by a leading researcher in smart materials, topics include piezoelectric materials, magnetostrictive materials, shape memory alloys, mechanochromic materials, chemomechanical polymers, and self-healing materials.

Soft Robotics Fouad Sabry, 2025-03-23 Soft robotics introduces the fundamental concepts of soft robotics, highlighting its potential to revolutionize various industries by mimicking biological systems.

Actuator Explores the role of actuators in soft robotics, essential components that enable robots to move and interact with their environments.

Electroactive polymer Examines electroactive polymers, materials that change shape when stimulated by electricity, a key innovation for soft robotics.

Liquidcrystal polymer Focuses on liquidcrystal polymers, offering a deep dive into their unique properties and applications in creating flexible, responsive robotic systems.

Dielectric elastomers Investigates dielectric elastomers, which provide the necessary flexibility and responsiveness for creating soft, adaptable robots.

Adaptable robotics Discusses the importance of adaptable robots that can change their form and function in response to external conditions, enhancing versatility.

Stretchable electronics Covers stretchable electronics, a breakthrough in integrating electronics into soft robots, enabling them to remain functional despite deformation.

Haptic perception Explores how haptic perception is integrated into soft robots, allowing them to sense and respond to physical touch in ways that enhance interaction.

Robotics Provides a broader look at robotics, connecting soft robotics with traditional robotic systems and showcasing their combined potential.

Ferroelectric polymer Highlights the role of ferroelectric polymers in soft robotics, particularly in applications requiring precise, responsive movements.

Tactile sensor Details the development of tactile sensors that enhance the sensory capabilities of soft robots, crucial for delicate tasks.

Robotic sensing Explores robotic sensing technologies that enable soft robots to perceive and react to their environment, mimicking humanlike sensory perception.

Artificial muscle Focuses on artificial muscles that mimic the function of biological muscles, allowing robots to perform complex movements with ease.

Electronic skin Investigates the development of electronic skin, a material that gives robots the ability to sense touch, pressure, and temperature.

Projection microstereolithography Discusses projection

microstereolithography a 3D printing technology that plays a critical role in fabricating soft robotic components Liquid crystalline elastomer Provides insight into liquid crystalline elastomers materials with unique properties that are key to creating responsive soft robots St phanie P Lacour A chapter dedicated to St phanie P Lacour a leading researcher whose work in soft robotics has paved the way for many innovations in the field Continuum robot Explores the design and function of continuum robots which offer flexibility and adaptability by using soft continuous structures Mohsen Shahinpoor Focuses on Mohsen Shahinpoor a pioneer in the field of soft robotics whose research has greatly influenced the development of artificial muscles and actuators Peristaltic robot Delves into peristaltic robots inspired by biological systems that utilize fluid-driven motion for tasks requiring precision and flexibility Soft exoskeleton Concludes with an examination of soft exoskeletons wearable robotic systems that enhance human strength and mobility showing the human-robot collaboration potential

Soft and Stiffness-controllable Robotics Solutions for Minimally Invasive Surgery Jelizaveta Konstantinova, Helge Wurdemann, Ali Shafti, 2022-09-01 Soft and Stiffness controllable Robotics Solutions for Minimally Invasive Surgery presents the results of a research project funded by European Commission STIFF FLOP STIFFness controllable Flexible and Learn able manipulator for surgical Operations In Minimally Invasive Surgery MIS tools go through narrow openings and manipulate soft organs that can move deform or change stiffness There are limitations on modern laparoscopic and robot assisted surgical systems due to restricted access through Trocar ports lack of haptic feedback and difficulties with rigid robot tools operating inside a confined space filled with organs Also many control algorithms suffer from stability problems in the presence of unexpected conditions Yet biological manipulators like the octopus arm can manipulate objects while controlling the stiffness of selected body parts and being inherently compliant when interacting with objects STIFF FLOP robot is an innovative soft robotic arm that can squeeze through a standard MIS reconfigure itself and stiffen by hydrostatic actuation to perform compliant force control tasks while facing unexpected situations Technical topics discussed in the book include Soft actuators Continuum soft manipulators Control kinematics and navigation of continuum manipulators Optical sensors for force torque and curvature Haptic feedback and human interface for surgical systems Validation of soft stiffness controllable robots

Advances in Automation, Signal Processing, Instrumentation, and Control Venkata Lakshmi Narayana Komanapalli, N. Sivakumaran, Santoshkumar Hampannavar, 2021-03-04 This book presents the select proceedings of the International Conference on Automation Signal Processing Instrumentation and Control i CASIC 2020 The book mainly focuses on emerging technologies in electrical systems IoT based instrumentation advanced industrial automation and advanced image and signal processing It also includes studies on the analysis design and implementation of instrumentation systems and high accuracy and energy efficient controllers The contents of this book will be useful for beginners researchers as well as professionals interested in instrumentation and control and other allied fields

Smart Structures Theory Inderjit Chopra, Jayant Sirohi, 2014 This book focuses on smart materials and structures

which are also referred to as intelligent adaptive active sensory and metamorphic. The ultimate goal is to develop biologically inspired multifunctional materials with the capability to adapt their structural characteristics, monitor their health condition, perform self diagnosis and self repair, morph their shape and undergo significant controlled motion.

Advanced Piezoelectric Materials Kenji Uchino, 2017-06-20. Advanced Piezoelectric Materials Science and Technology Second Edition provides revised, expanded and updated content suitable for those researching piezoelectric materials or using them to develop new devices in areas such as microelectronics, optical, sound, structural and biomedical engineering. Three new chapters cover multilayer technologies with base metal internal electrodes, templated grain growth preparation techniques for manufacturing piezoelectric single crystals and piezoelectric MEMS technologies. Chapters from the first edition have been revised in order to provide up to date comprehensive coverage of developments in the field. Part One covers the structure and properties of a range of piezoelectric materials. Part Two details advanced manufacturing processes for particular materials and device types including three new chapters. Finally Part Three covers materials development for three key applications of piezoelectric materials. Dr Kenji Uchino is a pioneer in piezoelectric actuators. Professor of Electrical Engineering at Penn State University and Director of the International Center for Actuators and Transducers. He has authored 550 papers, 54 books and 26 patents in the ceramic actuator area. Features an overview of manufacturing methods for a wide range of piezoelectric materials. Provides revised, expanded and updated coverage compared to the first edition including three new chapters. Suitable for those researching piezoelectric materials or using them to develop new devices in areas such as microelectronics, optical, sound, structural and biomedical engineering.

Artificial Muscles Mohsen Shahinpoor, Kwang J. Kim, Mehran Mojarad, 2007-02-21. Smart materials are the way of the future in a variety of fields from biomedical engineering and chemistry to nanoscience, nanotechnology and robotics. Featuring an interdisciplinary approach to smart materials and structures. *Artificial Muscles: Applications of Advanced Polymeric Nanocomposites* thoroughly reviews the existing knowledge of

Human-Robot Interaction Dan Zhang, Bin Wei, 2020-08-19. This book introduces state of the art technologies in the field of human robot interactions. It details advances made in this field in recent decades including dynamics, controls, design, analysis, uncertainties and modelling. The text will appeal to graduate students, practitioners and researchers in the fields of robotics, computer and cognitive science and mechanical engineering.

Ionic Polymer Metal Composites for Sensors and Actuators Inamuddin, Abdullah M. Asiri, 2019-03-16. This book discusses the fundamentals of bending actuation with a focus on ionic metal composites. It describes the applications of ionic polymer metal composite (IPMC) actuators from conventional robotic systems to compliant micro robotic systems used to handle the miniature and fragile components during robotic micro assembly. It also presents mathematical modelings of actuators for engineering, biomedical, medical and environmental systems. The fundamental relation of IPMC actuators to the biomimetic systems are also included.

Dielectric Elastomers as Electromechanical Transducers Federico Carpi, Danilo De Rossi, Roy

Kornbluh, Ronald Edward Pelrine, Peter Sommer-Larsen, 2011-09-06 Dielectric Elastomers as Electromechanical Transducers provides a comprehensive and updated insight into dielectric elastomers one of the most promising classes of polymer based smart materials and technologies This technology can be used in a very broad range of applications from robotics and automation to the biomedical field The need for improved transducer performance has resulted in considerable efforts towards the development of devices relying on materials with intrinsic transduction properties These materials often termed as smart or intelligent include improved piezoelectrics and magnetostrictive or shape memory materials Emerging electromechanical transduction technologies based on so called ElectroActive Polymers EAP have gained considerable attention EAP offer the potential for performance exceeding other smart materials while retaining the cost and versatility inherent to polymer materials Within the EAP family dielectric elastomers are of particular interest as they show good overall performance simplicity of structure and robustness Dielectric elastomer transducers are rapidly emerging as high performance pseudo muscular actuators useful for different kinds of tasks Further in addition to actuation dielectric elastomers have also been shown to offer unique possibilities for improved generator and sensing devices Dielectric elastomer transduction is enabling an enormous range of new applications that were precluded to any other EAP or smart material technology until recently This book provides a comprehensive and updated insight into dielectric elastomer transduction covering all its fundamental aspects The book deals with transduction principles basic materials properties design of efficient device architectures material and device modelling along with applications Concise and comprehensive treatment for practitioners and academics Guides the reader through the latest developments in electroactive polymer based technology Designed for ease of use with sections on fundamentals materials devices models and applications **Advanced**

Mobile Robotics DaeEun Kim, 2020-03-06 Mobile robotics is a challenging field with great potential It covers disciplines including electrical engineering mechanical engineering computer science cognitive science and social science It is essential to the design of automated robots in combination with artificial intelligence vision and sensor technologies Mobile robots are widely used for surveillance guidance transportation and entertainment tasks as well as medical applications This Special Issue intends to concentrate on recent developments concerning mobile robots and the research surrounding them to enhance studies on the fundamental problems observed in the robots Various multidisciplinary approaches and integrative contributions including navigation learning and adaptation networked system biologically inspired robots and cognitive methods are welcome contributions to this Special Issue both from a research and an application perspective

Proceedings of the ASME Conference on Smart Materials, Adaptive Structures and Intelligent Systems--2009, 2009 A collection of 81 full length peer reviewed technical papers that covers such topics as Bio inspired Smart Materials and Structures Enabling Technologies and Integrated System Design Multifunctional Materials and Structural Health Monitoring NDE **Handbook of Research on Advancements in Robotics and Mechatronics** Habib, Maki

K.,2014-12-31 The field of mechatronics integrates modern engineering science and technologies with new ways of thinking enhancing the design of products and manufacturing processes This synergy enables the creation and evolution of new intelligent human oriented machines The Handbook of Research on Advancements in Robotics and Mechatronics presents new findings practices technological innovations and theoretical perspectives on the the latest advancements in the field of mechanical engineering This book is of great use to engineers and scientists students researchers and practitioners looking to develop autonomous and smart products and systems for meeting today s challenges

Stimuli-responsive Actuating Materials for Micro-robotics Kenneth K. W. Kwan,Alfonso H. W. Ngan,2024-02-29 Stimuli responsive Actuating Materials for Micro Robotics examines the latest stimuli responsive actuating materials with high potential for applications in micro robotics The material science functionalities and performance and synthesis of these materials are reviewed Then the common enabling technologies for material and signal integration such as 3 4D printing and interface engineering chemo mechanics modelling of the materials are discussed Finally there is a chapter that looks at the prospects of materials for micro robotics including case studies for specific applications such as self folding origami robots and robots for micro surgery Stimuli Responsive Actuating Materials for Micro Robotics is suitable for researchers and practitioners working in the subject areas of materials science and engineering Examines high performance stimuli responsive actuating materials for micro robotics applications Discusses common enabling technologies and micro robotics device construction with a focus on integration of materials Reviews the application prospects of material driven micro robots in micro surgery and compact engineering

Biomimetics Yoseph Bar-Cohen,2016-04-19 A review of the current state of the art of biomimetics this book documents key biological solutions that provide a model for innovations in engineering and science Leading experts explore a wide range of topics including artificial senses and organs mimicry at the cell materials interface modeling of plant cell wall architecture biomimetic composites artificial muscles biomimetic optics and the mimicking of birds insects and marine biology The book also discusses applications of biomimetics in manufacturing products medicine and robotics biologically inspired design as a tool for interdisciplinary education and the biomimetic process in artistic creation

Biomimetic and Biohybrid Systems Fabian Meder,Alexander Hunt,Laura Margheri,Anna Mura,Barbara Mazzolai,2023-07-31 This book constitutes the proceedings of the 12th International Conference on Biomimetic and Biohybrid Systems Living Machines 2022 in Genoa Italy held in July 19 22 2022 The 44 full papers and 14 short papers presented were carefully reviewed and selected from 67 submissions They deal with research on novel life like technologies inspired by the scientific investigation of biological systems biomimetics and research that seeks to interface biological and artificial systems to create biohybrid systems The conference aims to highlight the most exciting research in both fields united by the theme of Living Machines br ppChapters 3 9 11 12 and 15 are available open access under a Creative Commons Attribution 4 0 International License via link [springer.com](https://www.springer.com)

Smart Structures and Materials ,2005

Handbook of Research on Biomimetics and Biomedical

Robotics Habib, Maki, 2017-12-15 Biomimetic research is an emerging field that aims to draw inspiration and substances from natural sources and create biological systems in structure mechanism and function through robotics The products have a wide array of application including surgical robots prosthetics neurosurgery and biomedical image analysis The Handbook of Research on Biomimetics and Biomedical Robotics provides emerging research on robotics mechatronics and the application of biomimetic design While highlighting mechatronical challenges in today s society readers will find new opportunities and innovations in design capabilities in intelligent robotics and interdisciplinary biomedical products This publication is a vital resource for senior and graduate students researchers and scientists in engineering seeking current research on best ways to globally expand online higher education

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