Mechanical Design In Organisms

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Materials Selection in Mechanical Design

Biology and Systematics of Colonial Organisms

Marine Technology Society Journal

Biology of Benthic Organisms

Mechanical Design of Hydroids

This book examines the evolution of self-organised multicellular structures, and the remarkable transition from unicellular to multicellular life. It shows the way forward in developing new robotic entities that are versatile, cooperative and self-configuring.

Solid Biomechanics

Why do you shift from walking to running at a particular speed? How can we predict transition speeds for animals of different sizes? Why must the flexible elastic of arterial walls behave differently than a rubber tube or balloon? How do leaves manage to expose a broad expanse of surface while suffering only a small fraction of the drag of flags in high winds? The field of biomechanics--how living things move and work--hasn't seen a new general textbook in more than two decades. Here a leading investigator and teacher lays out the key concepts of biomechanics using examples drawn from throughout the plant and animal kingdoms. Up-to-date and comprehensive, this is also the only book to give thorough coverage to both major subfields of biomechanics: fluid and solid mechanics. Steven Vogel explains how biomechanics makes use of models and methods drawn from physics and mechanical engineering to investigate a wide range of general questions--from how animals swim and fly and the modes of terrestrial locomotion to the way organisms respond to wind and water currents and the operation of circulatory and suspension-feeding systems. He looks also at the relationships between the properties of biological materials--spider silk, jellyfish jelly, muscle, and more--and their various structural and functional roles. While written primarily for biology majors and graduate students in biology, this text will be useful for physical scientists and engineers seeking a sense of the state of the art of biomechanics and a guide to its rather scattered literature. For a still wider audience, it establishes the basic biological context for such applied areas as ergonomics, orthopedics, mechanical prosthetics, kinesiology, sports medicine, and biomimetics.

Plant Biomechanics

Sets forth the techniques needed to create a vast array of useful biopolymer nanocomposites Interest in biopolymer nanocomposites is soaring. Not only are they green and sustainable materials, they can also be used to develop a broad range of useful products with special properties, from therapeutics to coatings to packaging materials. With contributions from an international team of leading nanoscientists and materials researchers, this book draws together and reviews the most recent developments and techniques in biopolymer nano-composites. It describes the preparation, processing, properties, and applications of bio- polymer nanocomposites developed from chitin, starch, and cellulose, three renewable resources. Biopolymer Nanocomposites features a logical organization and approach that make it easy for readers to take full advantage of the latest science and technology in designing these materials and developing new products and applications. It begins with a chapter reviewing our current understanding of bionanocomposites. Next, the book covers such topics as: Morphological and thermal investigations of chitin-based nanocomposites Applications of starch nanoparticle and starch-based bionanocomposites Spectroscopic characterization of renewable nanoparticles and their composites Nanocellulosic products and their applications Protein-based nanocomposites for food packaging Throughout the book, detailed case studies of industrial applications underscore the unique challenges and opportunities in developing and working with biopolymer nanocomposites. There are also plenty of figures to help readers fully grasp key concepts and techniques. Exploring the full range of applications, Biopolymer Nanocomposites is recommended for researchers in a broad range of industries and disciplines, including biomedical engineering, materials science, physical chemistry, chemical engineering, and polymer science. All readers will learn how to create green, sustainable products and applications using these tremendously versatile materials.

Life's Devices

This book was originally published in 2002. Elastic proteins occur in a wide range of biological systems where they have evolved to fulfil precise biological roles. The best known include proteins in vertebrate muscles and connective tissues, such as titin, elastin and fibrillin, and spider silks. However, other examples include byssus and abductin from bivalve molluscs, resilin from arthropods and gluten from wheat. Interest in elastomeric proteins has been high for several reasons. Firstly, their biological and medical significance, particularly in human disease. Secondly, the unusual properties of proteins such as spider silks provide opportunities to develop materials. Thirdly, the development of scanning probe microscopy makes it possible to study structures and biomechanical properties of these proteins at the single molecule level. This book will be of value to anyone with an interest in the various aspects of elastomeric proteins.

Modular Organisms

In this first comprehensive treatment of plant biomechanics, Karl J. Niklas analyzes plant form and provides a far deeper understanding of how form is a response to basic physical laws. He examines the ways in which these laws constrain the organic expression of form, size, and growth in a variety of plant structures, and in plants as whole organisms, and he draws on the fossil record as well as on studies of extant species to present a genuinely evolutionary view of the response of plants to abiotic as well as biotic constraints. Well aware that some readers will need an introduction to basic biomechanics or to basic botany, Niklas provides both, as well as an extensive glossary, and he has included a number of original drawings and photographs to illustrate major structures and concepts. This volume emphasizes not only methods of biomechanical analysis but also the ways in which it allows one to ask, and answer, a host of interesting questions. As Niklas points out in the first chapter, "From the archaic algae to the most derived multicellular terrestrial plants, from the spectral properties of light-harvesting pigments in chloroplasts to the stacking of leaves in the canopies of trees, the behavior of plants is in large part responsive to and intimately connected with the physical environment. In addition, plants tend to be exquisitely preserved in the fossil record, thereby giving us access to the past." Its biomechanical analyses of various types of plant cells, organs, and whole organisms, and its use of the earliest fossil records of plant life as well as sophisticated current studies of extant species, make this volume a unique and highly integrative contribution to studies of plant form, evolution, ecology, and systematics.

Functional Chordate Anatomy

First published in 1985. Routledge is an imprint of Taylor & Francis, an informa company.

BIOL & MGMT CERVIDAE PB

Issues in the Ecological Study of Learning

This book deals with an interface between mechanical engineering and biology. Available for the first time in paperback, it reviews biological structural materials and systems and their mechanically important features and demonstrates that function at any particular level of biological integration is permitted and controlled by structure at lower levels of integration. Five chapters discuss the properties of materials in general and those of biomaterials in particular. The authors examine the design of skeletal elements and discuss animal and plant systems in terms of mechanical design. In a concluding chapter they investigate organisms in their environments and the insights gained from study of the mechanical aspects of their lives.

Marine Biology

Understanding materials, their properties and behavior is fundamental to engineering design, and a key application of materials science. Written for all students of engineering, materials science and design, this book describes the procedures for material selection in mechanical design in order to ensure that the most suitable materials for a given application are identified from the full range of materials and section shapes available. Extensively revised for this fourth edition, Materials Selection in Mechanical Design is recognized as one of the leading materials selection texts, and provides a unique and genuinely innovative resource. Features new to this edition * Material property charts now in full color throughout * Significant revisions of chapters on engineering materials, processes and process selection, and selection of material and shape while retaining the book's hallmark structure and subject content * Fully revised chapters on hybrid materials and materials and the environment * Appendix on data and information for engineering materials fully updated * Revised and expanded end-of-chapter exercises and additional worked examples Materials are introduced through their properties; materials selection charts (also available on line) capture the important features of all materials, allowing rapid retrieval of information and application of selection techniques. Merit indices, combined with charts, allow optimization of the materials selection process. Sources of material property data are reviewed and approaches to their use are given. Material processing and its influence on the design are discussed. New chapters on environmental issues, industrial engineering and materials design are included, as are new worked examples, exercise materials and a separate, online Instructor's Manual. New case studies have been developed to further illustrate procedures and to add to the practical implementation of the text. * The new edition of the leading materials selection text, now with full color material property charts * Includes significant revisions of chapters on engineering materials, processes and process selection, and selection of material and shape while retaining the book's hallmark structure and subject content * Fully revised chapters on hybrid materials and materials and the environment * Appendix on data and information for engineering materials fully updated * Revised and expanded end-of-chapter exercises and additional worked examples

The International Dental Journal

Structural Biomaterials

Written by one of the most highly respected researchers in marine biology, this text is the most current and accessible treatment of all aspects of this interdisciplinary field. Marine Biology aims to heighten students' inherent fascination with the ocean and marine life and describes in an easily understandable manner the biological principles which govern marine biological systems. It introduces the rich diversity of the marine environment by focusing on three major themes: 1) function, the way organisms solve problems and the chemical and physical factors affecting these solutions; 2) biodiversity, an overview of the various life forms in the ocean; and 3) ecology, the interaction of organisms with their environment. Designed for undergraduate courses at the sophomore to senior level, the book is designed to help students approach a great variety of material. Supplemented by suggestions for further reading, a glossary of important terms, text boxes highlighting significant equations and concepts, review questions at the end of each chapter, and an abundance of illustrative examples and visual material, this text is a fascinating introduction to marine biology which is both accessible to and captivating for students of marine biology, marine ecology, and marine science.

Structures

Design in Nature

A conference held at the Conservation and Research Center, National Zoological Park, Smithsonian Institution, Front Royal, Virginia, August 1-5, 1982

Journal of Experimental Biology

Chemical reactions and interactions between molecules are commonly considered the basis of life, and thus the biochemical nature of cells and organisms is relatively well recognized. Research conducted in recent years, however, increasingly indicates that physical forces profoundly affect the functioning of life at all levels of its organization. To detect and to respond to such forces, plant cells and plants need to be structured mechanically. This volume focuses on mechanical aspects of plant life. It starts with a consideration of the mechanical integration of supracellular structures and mechanical properties of cellular building blocks to show how the structural integrity of plant cells is achieved and maintained during growth and development. The following chapters reveal how the functioning of integrated plant cells contributes to the mechanical integration of plants, and how the latter are able to detect physical stimuli and to reorganize their own cells in response to them. The mechanical aspects of plant responses to stresses are also presented. Finally, all these aspects are placed in an evolutionary context.

Mechanical Design in Organisms

The first comprehensive synthesis on development and evolution: it applies to all aspects of development, at all levels of organization and in all organisms, taking advantage of modern findings on behavior, genetics, endocrinology, molecular biology, evolutionary theory and phylogenetics to show the connections between developmental mechanisms and evolutionary change. This book solves key problems that have impeded a definitive synthesis in the past. It uses new concepts and specific examples to show how to relate environmentally sensitive development to the genetic theory of adaptive evolution and to explain major patterns of change. In this book development includes not only embryology and the ontogeny of morphology, sometimes portrayed inadequately as governed by "regulatory genes," but also behavioral development and physiological adaptation, where plasticity is mediated by genetically complex mechanisms like hormones and learning. The book shows how the universal qualities of phenotypes--modular organization and plasticity--facilitate both integration and change. Here you will learn why it is wrong to describe organisms as genetically programmed; why environmental induction is likely to be more important in evolution than random mutation; and why it is crucial to consider both selection and developmental mechanism in explanations of adaptive evolution. This book satisfies the need for a truly general book on development, plasticity and evolution that applies to living organisms in all of their life stages and environments. Using an immense compendium of examples on many kinds of organisms, from viruses and bacteria to higher plants and animals, it shows how the phenotype is reorganized during evolution to produce novelties, and how alternative phenotypes occupy a pivotal role as a phase of evolution that fosters diversification and speeds change. The arguments of this book call for a new view of the major themes of evolutionary biology, as shown in chapters on gradualism, homology, environmental induction, speciation, radiation, macroevolution, punctuation, and the maintenance of sex. No other treatment of development and evolution since Darwin's offers such a comprehensive and critical discussion of the relevant issues. Developmental Plasticity and Evolution is designed for biologists interested in the development and evolution of behavior, life-history patterns, ecology, physiology, morphology and speciation. It will also appeal to evolutionary paleontologists, anthropologists, psychologists, and teachers of general biology.

Comparative Biomechanics

Skeletal Growth of Aquatic Organisms

For anyone who has ever wondered why suspension bridges don't collapse under eight lanes of traffic, how dams hold back-or give way under-thousands of gallons of water, or what principles guide the design of a skyscraper or a kangaroo, this book will ease your anxiety and answer your questions. J. E. Gordon strips engineering of its confusing technical terms, communicating its founding principles in accessible, witty prose.

Bones

Elastomeric Proteins

Mechanical Design of Structural Materials in Animals explores the principles underlying how molecules interact to produce the functional attributes of biological materials: their strength and stiffness, ability to absorb and store energy, and ability to resist the fatigue that accrues through a lifetime of physical insults. These attributes play a central role in determining the size and shape of animals, the ways in which they can move, and how they interact with their environment. By showing how structural materials have been designed by evolution, John Gosline sheds important light on how animals work. Gosline elucidates the pertinent theories for how molecules are arranged into macromolecular structures and how those structures are then built up into whole organisms. In particular, Gosline develops the theory of discontinuous, fiber-reinforced composites, which he employs in a grand synthesis to explain the properties of everything from the body wall of sea anemones to spiders' silks and insect cuticles, tendons, ligaments, and bones. Although the theories are examined in depth, Gosline's elegant discussion makes them accessible to anyone with an interest in the mechanics of life. Focusing on the materials from which animals are constructed, this book answers fundamental questions about mechanical properties in nature.

Mechanical Design of Structural Materials in Animals

This volume contains the Proceedings of the AMS Special Session on Biological Fluid Dynamics: Modeling, Computation, and Applications, held on October 13, 2012, at Tulane University, New Orleans, Louisiana. In recent years, there has been increasing interest in the development and application of advanced computational techniques for simulating fluid motion driven by immersed flexible structures. That interest is motivated, in large part, by the multitude of applications in physiology and biology. In some biological systems, fluid motion is driven by active biological tissues, which are typically constructed of fibers that are surrounded by fluid. Not only do the fibers hold the tissues together, they also transmit forces that ultimately result in fluid motion. In other examples, the fluid may flow through conduits such as blood vessels or airways that are flexible or active. That is, those conduits may react to and affect the fluid dynamics. This volume responds to the widespread interest among mathematicians, biologists, and engineers in fluid-structure interactions problems. Included are expository and review articles in biological fluid dynamics. Applications that are considered include ciliary motion, upside-down jellyfish, biological feedback in the kidney, peristalsis and dynamic suction pumping, and platelet cohesion and adhesion.

Mechanical Properties of Bone

Biopolymer Nanocomposites

Magnetite Biomineralization and Magnetoreception in Organisms

Looks at how the structure of plants and animals help them cope with their surroundings and discusses materials, shapes, movements, and energy

South African Journal of Science

Solid Biomechanics is the first book to comprehensively review the mechanical design of organisms. With a physical approach and a minimum of mathematics, the textbook introduces readers to the world of structural mechanics and sheds light on the dazzling array of mechanical adaptations that link creatures as dissimilar as bacteria, plants, and animals. Exploring a wide range of subjects in depth, from spider silks and sharkskin to climbing plants and human food processing, this immensely accessible text demonstrates that the bodies of animals and plants are masterpieces of engineering, enabling them to survive in a hostile world. The textbook describes how organisms construct materials from limited components, arrange materials into efficient structures that withstand different types of stresses, and interact mechanically with their environment. Looking at practical and historical aspects of the subject, the book delves into how the mechanics of organisms might be applied to other engineering scenarios and considers the ways structural biomechanics could and should develop in the future if more is to be learned about the form and function of organisms. Solid Biomechanics will be useful to all those interested in how organisms work, from biologists and engineers to physicists and students of biomechanics, bionics, and materials science. The first comprehensive review of the structural mechanics of organisms Introduces the subject using a physical approach involving minimal mathematics Three complementary sections: materials, structures, and mechanical interactions of organisms Links the dazzling array of mechanical adaptations seen in widely differing organisms Practical and historical approach shows how mechanical adaptations have been discovered and how readers can perform their own investigations

Biomimetics

The mystery of how migrating animals find their way over unfamiliar terrain has intrigued people for centuries, and has been the focus of productive research in the biological sci ences for several decades. Whether or not the earth's magnetic field had anything to do with their navigational abilities has sufaced and been dismissed several times, beginning at least in the mid to late 1800s. This topic generally remained out of the mainstream of scientific research for two reasons: (1) The apparent irreproducibility of many of the be havioral experiments which were supposed to demonstrate the existence of the magnetic sense; and (2) Perceived theoretical difficulties which were encountered when biophysi cists tried to understand how such a sensory system might operate. However, during the mid to late 1960s as the science of ethology (animal behavior) grew, it became clear from studies on bees and birds that the geomagnetic field is used under a variety of conditions. As more and more organisms were found to have similar abilities, the problem shifted back to the question as to the basis of this perception. Of the various schemes for trans ducing the geomagnetic field to the nervous system which have been proposed, the hy pothesis of magnetite-based magnetoreception discussed at length in this volume has per haps the best potential for explaining a wide range of these effects, even though this link is as yet clear only in the case of magnetotactic bacteria.

Comparative Biomechanics

The classic textbook on comparative biomechanics—revised and expanded Why do you switch from walking to running at a specific speed? Why do tall trees rarely blow over in high winds? And why does a spore ejected into air at seventy miles per hour travel only a fraction of an inch? Comparative Biomechanics is the first and only textbook that takes a comprehensive look at the mechanical aspects of life—covering animals and plants, structure and movement, and solids and fluids. An ideal entry point into the ways living creatures interact with their immediate physical world, this revised and updated edition examines how the forms and activities of animals and plants reflect the materials available to nature, considers rules for fluid flow and structural design, and explores how organisms contend with environmental forces. Drawing on physics and mechanical engineering, Steven Vogel looks at how animals swim and fly, modes of terrestrial locomotion, organism responses to winds and water currents, circulatory and suspension-feeding systems, and the relationship between size and mechanical design. He also investigates links between the properties of biological materials—such as spider silk, jellyfish jelly, and muscle—and their structural and functional roles. Early chapters and appendices introduce relevant physical variables for quantification, and problem sets are provided at the end of each chapter. Comparative Biomechanics is useful for physical scientists and engineers seeking a guide to state-of-the-art biomechanics. For a wider audience, the textbook establishes the basic biological context for applied areas—including ergonomics, orthopedics, mechanical prosthetics, kinesiology, sports medicine, and biomimetics—and provides materials for exhibit designers at science museums. Problem sets at the ends of chapters Appendices cover basic background information Updated and expanded documentation and materials Revised figures and text Increased coverage of friction, viscoelastic materials, surface tension, diverse modes of locomotion, and biomimetics

Biomechanics, structures and systems

Bringing Fossils to Life

This is a comprehensive and accessible overview of what is known about the structure and mechanics of bone, bones, and teeth. In it, John Currey incorporates critical new concepts and findings from the two decades of research since the publication of his highly regarded The Mechanical Adaptations of Bones. Crucially, Currey shows how bone structure and bone's mechanical properties are intimately bound up with each other and how the mechanical properties of the material interact with the structure of whole bones to produce an adapted structure. For bone tissue, the book discusses stiffness, strength, viscoelasticity, fatigue, and fracture mechanics properties. For whole bones, subjects dealt with include buckling, the optimum hollowness of long bones, impact fracture, and properties of cancellous bone. The effects of mineralization on stiffness and toughness and the role of microcracking in the fracture process receive particular attention. As a zoologist, Currey views bone and bones as solutions to the design problems that vertebrates have faced during their evolution and throughout the book considers what bones have been adapted to do. He covers the full range of bones and bony tissues, as well as dentin and enamel, and uses both human and non-human examples. Copiously illustrated, engagingly written, and assuming little in the way of prior knowledge or mathematical background, Bones is both an ideal introduction to the field and also a reference sure to be frequently consulted by practicing researchers.

Symbiotic Multi-Robot Organisms

Mechanical Integration of Plant Cells and Plants

"This book should go a long way towards filling the communication gap between biology and physics in [the area of biomaterials]. It begins with the basic theory of elasticity and viscoelasticity, describing concepts like stress, strain, compliance, and plasticity in simple mathematical terms. . . . For the non-biologist, these chapters provide a clear account of macromolecular structure and conformation. . . . [Vincent's work] is a delight to read, full of interesting anecdotes and examples from unexpected sources. . . . I can strongly recommend this book, as it shows how biologists could use mechanical properties as well as conventional methods to deduce molecular structure."--Anna Furth, The Times Higher Education Supplement In what is now recognized as a standard introduction to biomaterials, Julian Vincent presents a biologist's analysis of the structural materials of organisms, using molecular biology as a starting point. He explores the chemical structure of both proteins and polysaccharides, illustrating how their composition and bonding determine the mechanical properties of the materials in which they occurincluding pliant composites such as skin, artery, and plant tissue; stiff composites such as insect cuticle and wood; and biological ceramics such as teeth, bone, and eggshell. Here Vincent discusses the possibilities of taking ideas from nature with biomimicry and "intelligent" (or self-designing and sensitive) materials.

Biological Fluid Dynamics: Modeling, Computations, and Applications

Order in Living Organisms

One of the leading textbooks in its field, Bringing Fossils to Life applies paleobiological principles to the fossil record while detailing the evolutionary history of major plant and animal phyla. It incorporates current research from biology, ecology, and population genetics, bridging the gap between purely theoretical paleobiological textbooks and those that describe only invertebrate paleobiology and that emphasize cataloguing live organisms instead of dead objects. For this third edition Donald R. Prothero has revised the art and research throughout, expanding the coverage of invertebrates and adding a discussion of new methodologies and a chapter on the origin and early evolution of life.

Advances in Mechanical Design

Developmental Plasticity and Evolution

Composite Materials

Reveals how recurring patterns in nature are accounted for by a single governing principle of physics, explaining how all designs in the world from biological life to inanimate systems evolve in a sequence of ever-improving designs that facilitate flow.

Design Homology

This book describes the latest advances in, and applications of, dynamic mechanical analysis, optimization and control, mechanical transmission theory and applications, mechanical reliability theory and engineering, theory and application of friction and wear, vibration, noise analysis and control, mechanical dynamics and its applications, heat and heat engineering, etc. It provides a comprehensive survey of the latest advance, and also constitutes a valuable reference source for researchers in this field. Volume is indexed by Thomson Reuters CPCI-S (WoS).