Soft robots and smart dust

Description

?Yang, Y., & Jiao, P.. (2023). Nanomaterials and nanotechnology for biomedical soft robots. Materials Today Advances

? Digital Object Identifier: 10.1016/j.mtadv.2022.100338 • DOI URL • Download via Sci-Hub • Translation • Forward • Format • BibTeX • Citation Network Graph • Scite AI • OpenAlex API

□? Abstract

?“Soft robots have opened an emerging research direction in robotics due to their promising performance enabled by functional materials and fabrication technology. recent progress of functional materials has brought soft robots with advanced functionalities and greatly expanded their potential applications in various fields. biomedical applications have attracted significant research interests and become an emerging field. particular trends have been shifted to the submillimeter-scale biomedical soft robots and the integrated manipulatable devices with well controllability and compatibility. functionalities of these biomedical soft robots are dominated by nanomaterials and nanotechnology. however, lack of study has overviewed the promising development progress of functional nanomaterials and advanced nanotechnology in soft robots for biomedical applications. it is worthwhile to review such an important but not yet fully exposed research trend. to address such research gap, this review article focuses on the recent achievements, technological challenges and future trends of the nanomaterials and nanotechnology used in biomedical soft robots. we provide a state-of-the-art review on the current progress while mainly focusing on explaining the mechanism and functionality of the soft robots with respect to the nanomaterials and nanotechnology. in the end, we summarize the main challenges of biomedical soft robots and envision the future trends by outlooking the development of advanced nanomaterials and nanotechnology.”

?Liu, K., Chen, W., Yang, W., Jiao, Z., & Yu, Y.. (2023). Review of the Research Progress in Soft Robots. Applied Sciences (Switzerland)

? Digital Object Identifier: 10.3390/app13010120 • DOI URL • Download via Sci-Hub • Translation • Forward • Format • BibTeX • Citation Network Graph • Scite AI • OpenAlex API

□? Abstract

?“The soft robot is a new type of robot with strong adaptability, good pliability, and high flexibility. today, it is widely used in the fields of bioengineering, disaster rescue, industrial production, medical services, exploration, and surveying. in this paper, the typical driven methods, 3d printing technologies, applications, the existed problems, and the development prospects for soft robots are summarized comprehensively. firstly, the driven methods and materials of the soft robot are introduced, including fluid driven, smart materials driven, chemical reaction driven, a twisted and coiled polymer actuator,

and so on. secondly, the basic principles and characteristics of mainstream 3d printing technologies for soft materials are introduced, including fdm, diw, ip, sla, sls, and so on. then, current applications of soft robots, such as bionic structures, gripping operations, and medical rehabilitation are described. finally, the problems existing in the development of soft robots, such as the shortage of 3d printable soft materials, efficient and effective manufacturing of soft robots, shortage of smart soft materials, efficient use of energy, the realization of complex motion forms of soft robot, control action accuracy and actual kinematic modeling are summarized. based on the above, some suggestions are put forward pertinently, and the future development and applications of the soft robot are prospected."

?Armanini, C., Boyer, F., Mathew, A. T., Duriez, C., & Renda, F.. (2023). Soft Robots Modeling: A Structured Overview. IEEE Transactions on Robotics

? Digital Object Identifier: 10.1109/TRO.2022.3231360 • DOI URL • Download via Sci-Hub • Translation • Forward • Format • BibTeX • Citation Network Graph • Scite AI • OpenAlex API

□? Abstract

?"The robotics community has seen an exponential growth in the level of complexity of the theoretical tools presented for the modeling of soft robotics devices. different solutions have been presented to overcome the difficulties related to the modeling of soft robots, often leveraging on other scientific disciplines, such as continuum mechanics, computationalmechanics, and computer graphics. these theoretical and computational foundations are often taken for granted and this leads to an intricate literature that, consequently, has rarely been the subject of a complete review. for the first time, we present here a structured overview of all the approaches proposed so far to model soft robots. the chosen classification, which is based on their theoretical and numerical grounds, allows us to provide a critical analysis about their uses and applicability. this will enable robotics researchers to learn the basics of thesemodeling techniques and their associated numerical methods, but also to have a critical perspective on their uses."

?Qu, J., Xu, Y., Li, Z., Yu, Z., Mao, B., Wang, Y., … Li, T.. (2024). Recent Advances on Underwater Soft Robots. Advanced Intelligent Systems

? Digital Object Identifier: 10.1002/aisy.202300299 • DOI URL • Download via Sci-Hub • Translation • Forward • Format • BibTeX • Citation Network Graph • Scite AI • OpenAlex API

□? Abstract

?"The ocean environment has enormous uncertainty due to the influence of complex waves and undercurrents. the human beings are limited in their abilities to detect and utilize marine resources without powerful tools. soft robots employ soft materials to simplify the complex mechanical structures in rigid robots and adapt their morphology to the environment, making them suitable for performing some challenging tasks in place of manual labor. due to superior flexible and deformable bodies, underwater soft robots have played significant roles in numerous applications in recent decades. meanwhile, various technical challenges still need to be tackled to ensure the reliability and practical performance of underwater soft robots in complicated ocean environment. nowadays, some researchers have developed underwater soft robotic systems based on biomimetics and other disciplines, aiming at comprehensive exploration of ocean and appropriate utilization of unexploited

resources. this review presents the recent advances of underwater soft robots in the aspects of intelligent soft materials, fabrication, actuation, locomotion patterns, power storage, sensing, control, and modeling; additionally, the existing challenges and perspectives are analyzed as well."

?Jiang, J., Xu, S., Ma, H., Li, C., & Huang, Z.. (2023). Photoresponsive hydrogel-based soft robot: A review. Materials Today Bio

? Digital Object Identifier: 10.1016/j.mtbio.2023.100657 • DOI URL • Download via Sci-Hub • Translation • Forward • Format • BibTeX • Citation Network Graph • Scite AI • OpenAlex API

□? Abstract

?"Soft robots have received a lot of attention because of their great human-robot interaction and environmental adaptability. most soft robots are currently limited in their applications due to wired drives. photoresponsive soft robotics is one of the most effective ways to promote wireless soft drives. among the many soft robotics materials, photoresponsive hydrogels have received a lot of attention due to their good biocompatibility, ductility, and excellent photoresponse properties. this paper visualizes and analyzes the research hotspots in the field of hydrogels using the literature analysis tool citespace, demonstrating that photoresponsive hydrogel technology is currently a key research direction. therefore, this paper summarizes the current state of research on photoresponsive hydrogels in terms of photochemical and photothermal response mechanisms. the progress of the application of photoresponsive hydrogels in soft robots is highlighted based on bilayer, gradient, orientation, and patterned structures. finally, the main factors influencing its application at this stage are discussed, including the development directions and insights. advancement in photoresponsive hydrogel technology is crucial for its application in the field of soft robotics. the advantages and disadvantages of different preparation methods and structures should be considered in different application scenarios to select the best design scheme."

?Lee, Y., Koehler, F., Dillon, T., Loke, G., Kim, Y., Marion, J., … Anikeeva, P.. (2023). Magnetically Actuated Fiber-Based Soft Robots. Advanced Materials

? Digital Object Identifier: 10.1002/adma.202301916 • DOI URL • Download via Sci-Hub • Translation • Forward • Format • BibTeX • Citation Network Graph • Scite AI • OpenAlex API

□? Abstract

?"Broad adoption of magnetic soft robotics is hampered by the sophisticated field paradigms for their manipulation and the complexities in controlling multiple devices. furthermore, high-throughput fabrication of such devices across spatial scales remains challenging. here, advances in fiber-based actuators and magnetic elastomer composites are leveraged to create 3d magnetic soft robots controlled by unidirectional fields. thermally drawn elastomeric fibers are instrumented with a magnetic composite synthesized to withstand strains exceeding 600%. a combination of strain and magnetization engineering in these fibers enables programming of 3d robots capable of crawling or walking in magnetic fields orthogonal to the plane of motion. magnetic robots act as cargo carriers, and multiple robots can be controlled simultaneously and in opposing directions using a single stationary electromagnet. the scalable approach to fabrication and control of magnetic soft robots invites their

future applications in constrained environments where complex fields cannot be readily deployed."

?Stella, F., & Hughes, J.. (2023). The science of soft robot design: A review of motivations, methods and enabling technologies. Frontiers in Robotics and AI

? Digital Object Identifier: 10.3389/frobt.2022.1059026 • DOI URL • Download via Sci-Hub • Translation • Forward • Format • BibTeX • Citation Network Graph • Scite AI • OpenAlex API

□? Abstract

?"Novel technologies, fabrication methods, controllers and computational methods are rapidly advancing the capabilities of soft robotics. this is creating the need for design techniques and methodologies that are suited for the multi-disciplinary nature of soft robotics. these are needed to provide a formalized and scientific approach to design. in this paper, we formalize the scientific questions driving soft robotic design; what motivates the design of soft robots, and what are the fundamental challenges when designing soft robots? we review current methods and approaches to soft robot design including bio-inspired design, computational design and human-driven design, and highlight the implications that each design methods has on the resulting soft robotic systems. to conclude, we provide an analysis of emerging methods which could assist robot design, and we present a review some of the necessary technologies that may enable these approaches."

?Ng, C. S. X., Tan, M. W. M., Xu, C., Yang, Z., Lee, P. S., & Lum, G. Z.. (2021). Locomotion of Miniature Soft Robots. Advanced Materials

? Digital Object Identifier: 10.1002/adma.202003558 • DOI URL • Download via Sci-Hub • Translation • Forward • Format • BibTeX • Citation Network Graph • Scite AI • OpenAlex API

□? Abstract

?"Miniature soft robots are mobile devices, which are made of smart materials that can be actuated by external stimuli to realize their desired functionalities. here, the key advancements and challenges of the locomotion producible by miniature soft robots in micro- to centimeter length scales are highlighted. it is highly desirable to endow these small machines with dexterous locomotive gaits as it enables them to easily access highly confined and enclosed spaces via a noninvasive manner. if miniature soft robots are able to capitalize this unique ability, they will have the potential to transform a vast range of applications, including but not limited to, minimally invasive medical treatments, lab-on-chip applications, and search-and-rescue missions. the gaits of miniature soft robots are categorized into terrestrial, aquatic, and aerial locomotion. except for the centimeter-scale robots that can perform aerial locomotion, the discussions in this report are centered around soft robots that are in the micro- to millimeter length scales. under each category of locomotion, prospective methods and strategies that can improve their gait performances are also discussed. this report provides critical analyses and discussions that can inspire future strategies to make miniature soft robots significantly more agile."

?Kim, J. G., Park, J. E., Won, S., Jeon, J., & Wie, J. J.. (2019). Contactless manipulation of soft robots . Materials

? Digital Object Identifier: 10.3390/ma12193065 • DOI URL • Download via Sci-Hub • Translation • Forward • Format • BibTeX • Citation Network Graph • Scite AI • OpenAlex API

□? Abstract

?"In recent years, jointless soft robots have demonstrated various curvilinear motions unlike conventional robotic systems requiring complex mechanical joints and electrical design principles. the materials employed to construct soft robots are mainly programmable anisotropic polymeric materials to achieve contactless manipulation of miniaturized and lightweight soft robots through their anisotropic strain responsivity to external stimuli. although reviews on soft actuators are extensive, those on untethered soft robots are scant. in this study, we focus on the recent progress in the manipulation of untethered soft robots upon receiving external stimuli such as magnetic fields, light, humidity, and organic solvents. for each external stimulus, we provide an overview of the working principles along with the characteristics of programmable anisotropic materials and polymeric composites used in soft robotic systems. in addition, potential applications for untethered soft robots are discussed based on the physicochemical properties of programmable anisotropic materials for the given external stimuli."

?Wang, S., & Sun, Z.. (2023). Hydrogel and Machine Learning for Soft Robots' Sensing and Signal Processing: A Review. Journal of Bionic Engineering

? Digital Object Identifier: 10.1007/s42235-022-00320-y • DOI URL • Download via Sci-Hub • Translation • Forward • Format • BibTeX • Citation Network Graph • Scite AI • OpenAlex API

□? Abstract

?"The soft robotics field is on the rise. the highly adaptive robots provide the opportunity to bridge the gap between machines and people. however, their elastomeric nature poses significant challenges to the perception, control, and signal processing. hydrogels and machine learning provide promising solutions to the problems above. this review aims to summarize this recent trend by first assessing the current hydrogel-based sensing and actuation methods applied to soft robots. we outlined the mechanisms of perception in response to various external stimuli. next, recent achievements of machine learning for soft robots' sensing data processing and optimization are evaluated. here we list the strategies for implementing machine learning models from the perspective of applications. last, we discuss the challenges and future opportunities in perception data processing and soft robots' high level tasks."

?Wang, Y., Ma, X., Jiang, Y., Zang, W., Cao, P., Tian, M., … Zhang, L.. (2022). Dielectric elastomer actuators for artificial muscles: A comprehensive review of soft robot explorations. Resources Chemicals and Materials

? Digital Object Identifier: 10.1016/j.recm.2022.09.001 • DOI URL • Download via Sci-Hub • Translation • Forward • Format • BibTeX • Citation Network Graph • Scite AI • OpenAlex API

□? Abstract

?"Dielectric elastomer actuators (deas) artificial muscle is a typical interdisciplinary research category,

which has developed by leaps and bounds in the past 20 years, showing great application prospects in various fields. upon external electrical stimulation, dielectric elastomers (des) display large deformation, high energy density and fast response, affording a promising material candidate for soft robotics. herein, the working mechanisms, commonly used materials as well as the concepts for improving the performance of dea materials are introduced. various dea driven soft robots, including soft grippers, bioinspired artificial arms, crawling/walking/underwater/flying/jumping soft robots and tunable lenses, are then described in detail. finally, the main challenges of dea driven soft robots are summarized, and some perspectives for promoting the practical application of deas are also proposed."

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?Edwards, C.. (2012). Smart dust. Engineering and Technology

? Digital Object Identifier: 10.1049/et.2012.0612 • DOI URL • Download via Sci-Hub • Translation • Forward • Format • BibTeX • Citation Network Graph • Scite AI • OpenAlex API

□? Abstract

?"The paper gives an overview of the 'smart dust' – small, unobtrusive electronic sensors spread across the landscape. the sensors use the zigbee low-power wireless standard to send a message to relays mounted on street lamps, which then pass the data to a central computer. this surface-to-surface sensors can link up for the ultimate surveillance and control network of a smart city."

?Warneke, B., Last, M., Liebowitz, B., & Pister, K. S. J.. (2001). Smart dust: communicating with a cubic-millimeter computer. Computer

? Digital Object Identifier: 10.1109/2.895117 • DOI URL • Download via Sci-Hub • Translation • Forward • Format • BibTeX • Citation Network Graph • Scite AI • OpenAlex API

□? Abstract

?"The smart dust project is exploring whether an autonomous sensing, computing, and communication system can be packed into a cubic-millimeter mote to form the basis of integrated, massively distributed sensor networks. this project will facilitate innovative methods of interacting with the environment, providing more information from more places less intrusively."

?O'Brien, D. C., Liu, J. J., Faulkner, G. E., Sivathasan, S., Yuan, W. W., Member, S. C., & Elston, S. J. . (2009). Design and implementation of optical wireless communications with optically powered smart dust motes. IEEE Journal on Selected Areas in Communications

? Digital Object Identifier: 10.1109/JSAC.2009.091214 • DOI URL • Download via Sci-Hub • Translation • Forward • Format • BibTeX • Citation Network Graph • Scite AI • OpenAlex API

□? Abstract

?"Complete electronic and micro-mechanical systems can now be fabricated on the scale of hundreds

of microns. implementing radio frequency wireless communications with such ‘smart dust’ is challenging, due to the power required and the small size of any antennas that can be implemented. optical wireless communications, using a modulated retro-reflector at the smart dust has the advantages of low-power consumption and highly directive channels that allow long communications ranges. in this paper we report the design and implementation of a communications system that uses a base station to communicate with, and power, smart dust motes, over ranges of 10s of metres. a base station that uses holographic beamsteering is described, and dust motes that use silicon ics to provide communications, power and modulation control. results indicate the dust mote will operate at a range of over 30m from the base station. © 2009 ieee.”

?Rajesh, D., & Kiruba, D. G.. (2021). A probability based energy competent cluster based secured ch selection routing EC2SR protocol for smart dust. Peer-to-Peer Networking and Applications

? Digital Object Identifier: 10.1007/s12083-021-01144-z • DOI URL • Download via Sci-Hub • Translation • Forward • Format • BibTeX • Citation Network Graph • Scite AI • OpenAlex API

□? Abstract

?“Smart dust consists of several wireless mobile smart dust nodes which animatedly broadcast information amongst themselves without dependence of basestation. smart dust is more susceptible to diverse types of attacks and protect network because of its uniqueness of mobility in air and energetic in the environment. interruption means any irregular action that challenge to compromise reliability, privacy and accessibility of resources. a novel, dynamic energy efficient cluster based secure routing identifies these challenges while discovering exact routing and identifying malicious in smart dust node. design is structured as a dynamic hierarchy in which information is broadcasted among source to destination without any loss. to increase communication, more effectively dynamic hierarchy is reconfigured by inclusion of clustering techniques. cluster heads are selected based on residual energy and change in topology. proposed protocol is used for securing data and routing tactic will broadcasting. simulation of energy efficient cluster based secured routing protocol is carried out by ns2. this routing protocol provides enhanced energy efficiency, secured clustering, enlarges the lifetime of network, enhances deliverance ratio, delay and diminishes packet loss.”

Category

1. General

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